SFIM-AEC-IR-CR-95002

Fort Devens Sudbury Training Annex
Middlesex County, Massachusetts

Final Addendum Report
Site/Remedial Investigation

September 1995

Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland 21010-5401

Prepared by:

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

"In accordance with 40 CFR 1500, this document is intended to comply with NEPA of 1969."

AEC Form 45, 1 Feb 93 replaces THAMA Form 45 which is obsolete.

INSTRUCTIONS FOR UPDATING THE ADDENDUM REPORT

The text and tables distributed to you are to be placed in your Draft Final SI/RI Report binder as replacements for existing text and tables. You should have received:

- A 2-part color cover consisting of a front-piece and side-piece;
- New document control page, title page, and table of contents with lists of figures, tables, and acronyms;
- REPORT TEXT - new Section 1, Section 2, Section 3, Section 4, Section 5, and Section 6;
- TABLES - new Tables 1-3 and 1-4;
- APPENDIX C - new text sections for the Human Health and Ecological Risk Assessments, and one page with Table 5-6 and 5-7 for the Human Health Risk Assessment;
- Appendix D - Table D-50.

Each of these report sections are separated by a colored sheet.

1. Retain all tab dividers for text Sections, Tables, Figures, and Appendices. Retain all cover pages for each section of the report.
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5. Remove text for the Human Health Risk Assessment in Appendix C and replace with new text.
6. Remove page with Tables 5-6 and 5-7 in the Tables section following the Human Health Risk Assessment and replace with new page.
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8. Insert Table D-50 at end of Appendix D.
9. Replace black-and-white report cover with color cover.

Your report should now be a complete. If it is not, please contact Steve McGinn at 508-435-9561.

OHM Remediation
Services Corp.
A Subsidiary of OHM Corporation

September 22, 1995

Commander
U.S. Army Environmental Center (USAEC)
Aberdeen Proving Ground, MD 21010-5401

ATTN: SFIM-AEC-IRB (Mr. Ted Ruff)

RE: LETTER OF TRANSMITTAL
FINAL SI/RI ADDENDUM REPORT
SITE/REMEDIAL INVESTIGATION
FORT DEVENS SUDBURY TRAINING ANNEX
CONTRACT NO. DAAA15-90-D-0019; TASK ORDER 0001
OHM PROJECT NO. 14316

Dear Sir:

OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, is pleased to submit 12 copies of the Final SI/RI Addendum Report. Additional copies have been submitted to Fort Devens, USEPA, MADEP, and other TRC members as indicated on Attachment I.

If you have any questions or comments, please contact me at 508/435-9561.

Sincerely,

Stephen R. McGinn
Project Manager

SRM:pjc
Attachment/Enclosures

cc: J. Colella
S. McGinn
D. Pringle
Project File

ATTACHMENT I
FINAL SI/RI ADDENDUM REPORT
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OHM Remediation
Services Corp.
A Subsidiary of OHM Corporation

ADDENDUM TO THE SITE/REMEDIAL INVESTIGATION REPORT FORT DEVENS SUDBURY TRAINING ANNEX MIDDLESEX COUNTY, MASSACHUSETTS

Prepared for:

United States Army Environmental Center
Aberdeen Proving Ground, Maryland
Contract No. DAAA15-90-D-0019
Task Order No. 0001

Prepared by:

OHM Remediation Services Corp.
Pittsburgh, Pennsylvania
A Subsidiary of OHM Corporation

September 22, 1995
OHM Project No. 14316

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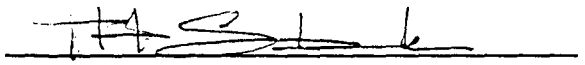
Sud Sep 97
Devens

Concur and recommend for immediate implementation:

U.S. DEPARTMENT OF THE ARMY



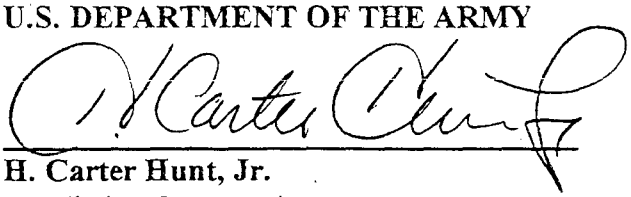
26 Sept. 1997

Thomas Strunk Date
U.S. Army Sudbury Annex, BRAC Environmental Coordinator
Devens Reserve Forces Training Area
Devens, Massachusetts

The foregoing represents the decision for No Action Under CERCLA by the U.S. Department of the Army and the U. S. Environmental Protection Agency, with the concurrence of the Commonwealth of Massachusetts Department of Environmental Protection.

Concur and recommend for immediate implementation:

U.S. DEPARTMENT OF THE ARMY



26 Sep 97

H. Carter Hunt, Jr. — Date
Installation Commander,
Devens Reserve Forces Training Area
Devens, Massachusetts

The foregoing represents the decision for No Action Under CERCLA by the U.S. Department of the Army and the U. S. Environmental Protection Agency, with the concurrence of the Commonwealth of Massachusetts Department of Environmental Protection.

Concur and recommend for immediate implementation:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

9-30-97

Harley F. Laing
Director,
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Region I

Date

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LIST OF ACRONYMS

AEHA	- U.S. Army Environmental Hygiene Agency
Annex	- Ft. Devens Sudbury Training Annex
AOC	- Area of Contamination
ARARs	- Applicable or Relevant and Appropriate Requirements
AST	- Aboveground Storage Tank
ATEC	- ATEC Associates, Inc.
AWQC	- Ambient Water Quality Criteria
BGS	- Below Ground Surface
Bionetics	- Bionetics Corporation
BNAs	- Base/neutral/acid extractables
BRA	- Baseline Risk Assessment
BTEX	- Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	- Comprehensive Environmental Response, Compensation, and Liability Act
COC	- Chemical of Concern
CX	- Categorical Exclusion
°C	- Degrees Centigrade
ppDDD	- 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane
ppDDE	- 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene
ppDDT	- 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DEET	- N,N-diethyl-3-methyl-benzamide
DEHP	- bis(2-Ethylhexyl)phthalate
1,1-DCE	- 1,1-Dichloroethene

EMO	-	Environmental Management Office
Enpro	-	Enpro Services, Inc.
EPIC	-	Environmental Photographic Interpretation Center
FPDWS	-	Federal Priority Drinking Water Standards
FS	-	Feasibility Study
GEM	-	Gem Systems, Inc.
HA	-	Hand Auger
HI	-	Hazard Index
HMX	-	High-melting Explosive
HQ	-	Hazard Quotient
i	-	Gradient
IAG	-	Interagency Agreement
IRDMIS	-	Installation Restoration Data Management Information System
IRP	-	Installation Restoration Program
K	-	Hydraulic Conductivity
K_d	-	Adsorption Coefficient
K_{oc}	-	Organic Carbon Partition Coefficient
K_{ow}	-	Octanol-Water Partition Coefficient
MADEP	-	Massachusetts Department of Environmental Protection
MADEQE	-	Massachusetts Department of Environmental Quality and Engineering (now MADEP)
MCC	-	Maximum Contaminant Concentrations
MCLs	-	Maximum Contaminant Levels
MCP	-	Massachusetts Contingency Plan
MFFA	-	Massachusetts Fire Fighting Academy
mg/kg	-	Milligrams per kilogram (ppm)

MOTS	- Maynard Ordnance Test Station
MSL	- Mean Sea Level
NEPA	- Department of the Army National Environmental Policy Act of 1969
NPL	- National Priorities List
n_e	- Effective Porosity
OHM	- OHM Remediation Services Corp., a Wholly-Owned Subsidiary of OHM Corporation
OP Pest	- Organophosphorus Pesticides
PAH	- Polynuclear Aromatic Hydrocarbons
PAL	- Public Archaeological Laboratory, Inc.
PCA	- 1,1,2,2-Tetrachloroethane
PCB	- Polychlorinated Biphenyl
PCB/Pest	- Polychlorinated Biphenyls/Pesticides
PCE	- Perchloroethylene or Tetrachloroethylene
PCOC	- Potential Chemical of Concern
PHC	- Petroleum Hydrocarbon
PID	- Photoionization Detector
POLs	- Petroleum, Oil, or Lubricants
PPA	- Potentially Productive Aquifer
ppm	- Parts per million
PVC	- Polyvinyl Chloride
QA	- Quality Assurance
QC	- Quality Control
RDX	- Royal Demolition Explosive
RfD	- Reference Dose

RI	-	Remedial Investigation
SA	-	Study Area
SARA	-	Superfund Amendments and Reauthorization Act
SCH-40	-	Schedule 40 (pipe thickness)
SMCLs	-	Secondary Maximum Contaminant Levels
SI	-	Site Investigation
SI/RI	-	Site Investigation/Remedial Investigation
SSI	-	Screening Site Inspection
T	-	Transmissivity
TAL	-	Target Analyte List
TBC	-	To Be Considered
TCE	-	Trichloroethylene
TCL	-	Target Compound List
TCLP	-	Toxicity Characteristic Leaching Procedure
TEPS	-	Total Environmental Program Support
TMI	-	Technology Management, Inc.
TOC	-	Total Organic Carbon
TPH	-	Total Petroleum Hydrocarbons
TRC	-	Technical Review Committee
1,1,1-TCA	-	1,1,1-Trichloroethane
UBK	-	Uptake/Biokinetic
UCL	-	Upper Confidence Limit
U. S.	-	United States
USACE	-	U.S. Army Corps of Engineers
USAEC	-	U.S. Army Environmental Center

USAF	-	U.S. Air Force
USATHAMA	-	U.S. Army Toxic and Hazardous Materials Agency
USCS	-	Unified Soil Classification System
USEPA	-	U.S. Environmental Protection Agency
USGS	-	U.S. Geological Survey
UST	-	Underground Storage Tank
V	-	Velocity
VOC	-	Volatile Organic Compound
Zecco	-	Zecco, Inc.
μg/g	-	Micrograms per gram (ppm)
μg/l	-	Micrograms per liter (ppb)
μg/dl	-	Micrograms per deciliter

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13. ABSTRACT *(Maximum 200 words)*

This document presents complete Remedial Investigation (RI) results for Areas of Contamination (AOCs) A4, A7, and A9, and complete Site Investigation (SI) results for Study Areas (SAs) A3/P5, P4, P7, P17, P19, P20, P25, P35, P49, P51, P59, and P60 at the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts. Based on the RI results, actual or threatened releases of hazardous substances from AOCs A7 and A9, if not addressed by implementing a source control remedy, may present an imminent and substantial endangerment to public health, welfare, or the environment. AOC A4 may require solid waste closure under Massachusetts state regulations due to the presence of solid debris. Based on the SI results, supplemental site investigations are recommended for SAs P17, P20, P59, and P60, limited removal actions are recommended for A3/P5, P4, and P35, and no further action is recommended for P7, P19, P25, P49, and P51.

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1.0 INTRODUCTION

This report is submitted as the Addendum to the Final Site/Remedial Investigation Report for the Fort Devens Sudbury Training Annex (Annex) located in Middlesex County, Massachusetts (OHM, 1994), to the U.S Army Environmental Center (USAEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen Proving Ground, Maryland. The Site/Remedial Investigation will be referred to as the Site Investigation/Remedial Investigation (SI/RI). This report documents the results of the Phase II SI/RI and combines the data with the results of the Phase I SI/RI. The work was performed under Total Environmental Program Support (TEPS) Contract No. DAAA15-90-D-0019, Delivery Order No. DA06. This document has been prepared as Contract Data Requirement ELIN A009A.

This addendum is not a stand-alone document and is not meant to serve as a comprehensive source of information for installation history, study area (SA) characteristics, or project procedures. Detailed information regarding these topics can be found in the Final Master Environmental Plan (OHM, 1992A), the Final Addendum to the Final Technical Plans (OHM, 1992B), the Final Site/Remedial Investigation Report (OHM, 1994), and the Final Addendum to the Final Technical Plans for the Phase II Feasibility Study (OHM, 1993). Field work and data evaluation were performed in accordance with the Final Health and Safety Plan (OHM, 1992C), the Final Work Plan (OHM, 1992D), the Final Field Sampling Plan (OHM, 1992E), the Final Quality Assurance Project Plan (OHM, 1992F), and the Community Relations Plan (Dames & Moore, 1991).

These documents were developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), USAEC Geotechnical Requirements (USATHAMA, 1987), USAEC Quality Assurance Program (USATHAMA, 1990), and the U.S. Environmental Protection Agency (USEPA) Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988).

The activities involved in the investigation qualify for a categorical exclusion (CX) in accordance with Department of the Army National Environmental Policy Act of 1969 (NEPA) Regulations CS A18, Army Regulation 200-2, Appendix A, and did not require prior preparation of an environmental assessment under NEPA since no extraordinary circumstances existed. The work was conducted under the purview of USAEC, the U.S. Army, USEPA Region I, the Massachusetts Department of Environmental Protection (MADEP), and the U.S. Fish and Wildlife Service, as well as local officials and interest groups.

1.1 PURPOSE OF REPORT

This addendum presents the results of the detailed contamination assessment in terms of the potential on-site source, nature and extent of contamination, transport pathways, and the potential effects on human health and the environment. It is intended to provide site-specific background information and chemical data to be used to support the decision making process regarding the selection and evaluation of remedial measures. To that end, information from previous investigations has been combined with data obtained by OHM during the Phase I and Phase II SI/RIs.

1.2 SITE BACKGROUND INFORMATION

The Annex, acquired by the federal government in the early 1940s, is located approximately 2 miles north of the town of Sudbury, Massachusetts. It has historically served as a munitions holding ground, an ordnance test station, a research and development facility, and as a troop training ground. In early 1990,

the Annex was placed on the National Priorities List (NPL) with a hazard ranking of 35.57. Currently, the facility contains family housing for U.S. military services personnel, a geophysical radar station, and guest houses. Figure 1-1 is a map of the installation displaying all SAs investigated or sampled during the Phase II SI/RI. A detailed description of the site, including site history, physical setting, and descriptions of each area of contamination (AOC) and SA, is included in Section 2.0 of the Final SI/RI Report (OHM, 1994).

Figures 1-2 through 1-6 show all sampling locations for the Phase I and Phase II SI/RI. Figure 1-2 shows the location of all surface soil, sediment, surface water, and drum/tank samples collected for analysis. Figure 1-3 shows all test pit and hand auger sampling locations. All soil boring locations are presented on Figure 1-4, while the locations of monitoring wells, staff gages, and water supply wells are shown on Figure 1-5. The rapid bioassessment sampling locations are presented on Figure 1-6. An explanation of the map symbols used on the SA site maps is presented on Figure 1-7.

1.3 SCOPE OF THE PHASE II SI/RI

The field work for the Phase II SI/RI was conducted between October 1993 and January 1994. It was intended to provide additional data regarding site soil, sediment, ground water, and surface water quality to support the remedy selection process and no further action decisions. Phase II SI/RIs were conducted at 16 SAs. Table 1-1 presents the investigative activities conducted in each area, along with the number and type of samples collected, while Appendix A contains the complete sample collection record. The primary objectives of the investigation were to:

- Conduct field investigations, sampling, and analyses to support the remedy selection processes at AOCs A4, A7, and A9

- Provide additional information on chemical concentrations in soil, sediment, ground water, and surface water at the remaining SAs listed in Table 1-1 to allow the U.S. Army to make appropriate decisions regarding further action at these sites.

1.4 SCREENING CRITERIA

Based on meetings, discussions, and guidance provided by the USAEC, USEPA Region I, MADEP, and the Technical Review Committee (TRC), the following matrix-specific screening criteria were used:

1.4.1 Surface Soil

Analytical results for surface soils were initially screened using the 95% upper confidence level (UCL) and maximum background surface soil values. These values were derived using both OHM and Ecology & Environment, Inc. (E&E) background surface soil data. All background surface soil values are presented in Table 1-2. A second table presenting all background surface soil values is presented as Table 2-1 in the Draft Final Addendum to the Human Health Risk Assessment in Appendix C.

All surface soil results were also screened using Massachusetts Contingency Plan (MCP) S-1/GW-1 soil values presented in 30 CMR 40.0975(6)(a) (MADEP, 1993). The MCP S-1/GW-1 soil screening criteria are presented in Table 1-2. Ecological screening criteria were provided by USEPA Region I. These values were compiled by the Region I Environmental Services Assistance Teams (ESAT) and are

presented in a letter report dated June 10, 1993, to the USEPA Region I Environmental Services Division (ESAT, 1993). Ecological screening criteria are presented in Table 1-3.

1.4.1.1 Risk Based Soil Cleanup Level for Thallium

A risk-based cleanup level for thallium of 20 μg/g has been provided by the USEPA. This cleanup level results in a Hazard Index of One and is documented in a letter dated May 19, 1995 from Bob Lim of USEPA Region I, to Ronald Ostrowski, Installation Environmental Officer, Fort Devens, Massachusetts (USEPA, 1995). For screening purposes, the MCP S-1/GW-1 standard of 8 μg/g was used.

1.4.1.2 The MCP Beryllium Standard

It should be noted that during the writing and revision of this and other related reports, a revised version of the MCP was issued and became effective on February 1, 1995. In the revised MCP the S-1/GW-1 soil value for beryllium was revised from 0.4 micrograms per gram (μg/g) to 0.7 μg/g (310 CMR 40.0975(6)(a)). The change in this screening value eliminates all but 3 of the 50 previous exceedances noted for this metal at the Annex. The 3 remaining exceedances are samples P50CD1A (1.02 μg/g), P22SO2A (0.85 μg/g), and P51SO4B (0.73 μg/g). Even though this change has occurred, the original discussions regarding exceedances of the 0.4 μg/g MCP S-1/GW-1 standard have been retained in order to maintain consistency between the various OHM reports submitted for this site. In addition, since beryllium in the range of 0.4-0.7 μg/g was considered background for the site, the MCP change does not affect recommended actions at the Annex.

1.4.1.3 ESAT Ecological Screening Criteria

Two of the ecological screening criteria for surface soil presented in the ESAT (1993) document have been amended by OHM. The screening value for beryllium presented in the original ESAT document is 55 μg/g. The source for this value is cited as the geometric mean value for beryllium in soils of the Eastern United States (east of 96th meridian) in Shacklette and Boerngnen (1984; see Table 2, page 6). However, the value actually presented in this publication is 0.55 μg/g. This lower value has been used to screen all surface soil results and is presented in Table 1-3.

The ESAT screening value for the PAH fluoranthene has also been amended. The screening criteria of 0.10 μg/g for this compound was obtained from Beyer (1990), Table 1, column A. All other soil criteria from Beyer (1990) for PAHs and other organic compounds were from column B of the Beyer (1990) table. Column B refers "..to moderate soil contamination that requires additional study..", while column A refers "..to background concentrations in soil or detection limits..". To be consistent with other organic compounds, the column B value of 10 μg/g for fluoranthene has been used to screen all surface soil results. This amended value is presented in Table 1-3.

1.4.2 Subsurface Soil

Analytical results for subsurface soils were screened using background surface soil values and MCP S-1/GW-1 values (Table 1-2).

1.4.3 Ground Water

The primary ground water screening criteria were the Federal Primary Drinking Water Standards - USEPA Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) (USEPA, 1994). In addition, detected compounds not included in the USEPA MCL or SMCL lists were compared with the MCP GW-1 standards presented in 310 CMR 40.0974(2) (MADEP, 1993). Ground water criteria are presented in Table 1-4.

1.4.4 Surface Water

Surface water analytical results were initially screened using background surface water values presented by E&E in their Draft Phase II Site Investigations Report (E&E, 1994, Section 6.2.2, Table 6-2). All positive detections were also evaluated using ecological screening criteria provided by USEPA Region I (ESAT, 1993), and the Ambient Water Quality Criteria (AWQC) freshwater continuous concentration and human health for consumption of organisms only criterion as presented in 40 CFR 131.36(b)(1). The ecological criteria are presented in Table 1-3.

1.4.5 Sediment

Analytical results for sediment samples have been evaluated using background sediment values (Table 1-2) presented by E&E in their Draft Phase II Site Investigations Report (E&E, 1994, Section 6.2.2, Table 6-2). All positive detections were also evaluated using ecological values provided by USEPA Region I (ESAT, 1993) (Table 1-3).

1.4.6 Toxicity Characteristic Leaching Procedure Results

All Toxicity Characteristic Leaching Procedure (TCLP) data were compared to the Resource Conservation and Recovery Act (RCRA) Maximum Contaminant Concentrations (MCC) for Toxicity Characteristic Wastes (40 CFR 261.24).

1.5 REPORT ORGANIZATION

This report is divided into the following sections:

- Section 1.0 - Describes the purpose and organization of this report
- Section 2.0 - Describes the remedial investigation (RI) results for AOC A4
- Section 3.0 - Describes the RI results for AOC A7
- Section 4.0 - Describes the RI results for AOC A9
- Section 5.0 - Describes the site investigation (SI) results for each SA
- Section 6.0 - Contains a list of the references cited in this report

- Appendices contain the sample collection record, field forms, boring logs, well construction diagrams, analytical data, quality assurance/quality control (QA/QC) evaluation, supplemental human health and ecological risk assessments (ERAs), and data disks.

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2.0 REMEDIAL INVESTIGATION OF AOC A4

AOC A4, Waste Dump, is located in the eastern Annex adjacent to the East Gate as shown on Figure 1-1. This area was reportedly used for 3 to 4 years during the late 1960s and early 1970s for the burial of unidentified chemical wastes and drums.

Figure 2-1 is a map of AOC A4 showing the locations for all investigative work performed and samples collected. Table 2-1 lists all samples collected in AOC A4 during the Phase II SI/RI, the sample media, and analytical parameters requested.

2.1 AREA CHARACTERISTICS AND HISTORY

AOC A4 is approximately 1,000 feet long by 200 feet wide and contains a surface dump in a depression at the southwest end, in addition to an old building foundation and stone well at the northeast end. The building foundation has been identified as the site of the Rice Tavern or Vose Farm by the Public Archaeology Laboratory, Inc. (PAL) and is of potential historic significance (PAL, 1985). The stone well is collapsed approximately 3 feet below ground surface (BGS) and could not be sampled. A few drums were located northwest of the surface dump and small piles of rubbish and construction debris were found northeast of the dump. Small amounts of construction debris, including old roadway pavement, have reportedly been dumped at this location since 1986.

As shown on Figure 2-1, the majority of AOC A4 consists of a clearing which parallels the north side of Old Marlborough Road and slopes gently to the southwest. The clearing is bordered by woods and a narrow drainage ditch that flows along the northwestern side of the area and drains into a wetland adjacent to AOC A4 on the northwest.

2.1.1 Area-Specific Background Information

The area-specific background information is organized into several sections. These include past site usage, previous environmental investigations and physical results, the nature and extent of contamination as determined from prior work, and prior remedial actions. Information regarding past land usage, environmental investigations, remedial actions, and physical and chemical results have been obtained from aerial photographs, maps, reports, correspondence, memorandums, records reviews, and interviews. Each section is arranged in chronological order.

2.1.1.1 Historical Aerial Photographs and Site Maps

Six sets of aerial photographs taken between 1943 and 1992 (Table 2-2) and one set of low oblique, color infrared photographs, taken in 1981 (USEPA, 1982) have been examined. These photographs were used in conjunction with three maps prepared by OHM (1992A: Figures 3-2, 3-3, and 3-4) that summarize Ft. Devens site maps for the period 1942 to 1979. This was done in order to assess past site usage, physical changes, and developments that have occurred in and around AOC A4. The following discussion presents the results of this preliminary examination

1943

At this time, AOC A4 was primarily cleared fallow fields with a few scattered trees (Figure 2-2). One large building and several smaller ones were present near the intersection of Old Marlborough (now Craven

Road) and Old Lancaster (Puffer) Road (now Patrol Road). The site was bordered on the north by a narrow drainage ditch in the northeast and center areas, and a wooded lowland in the northwest. A mature, well developed orchard is located north of the drainage ditch. It extends from Old Lancaster Road on the northeast, to a wooded lowland on the southwest.

1952

The site underwent few changes between 1943 and 1952 (Figure 2-3). Although still consisting primarily of cleared, fallow fields, some revegetation had occurred in the southwest and northeast. All buildings evident in 1943 were still present, and no additional buildings were evident.

1963

Substantial changes occurred in and around AOC A4 between 1952 and 1963 (Figure 2-4). In the northeast part of the area, all buildings had been razed, while the center and southwest portions of the area appear to be devoid of vegetation due to frequent traffic. Although heavily wooded in 1952, the lowland bordering AOC A4 on the northwest appears to be largely devoid of trees.

A low earthen dam is visible at the southwestern end of the lowland across a stream that flowed into Puffer Pond from the southeast. The dam was constructed at a narrow opening between the southwestern end of SA A3 and the northern tip of the higher ground bordering the southern shore of Puffer Pond. Rising water behind this dam may be the cause of the vegetation changes in the formerly wooded lowland.

1978

There are few changes evident in the 1978 aerial photo of AOC A4 (Figure 2-5). The central and southwestern portions of the area appear to be devoid of all vegetation due to continuing traffic and use. The northeastern end, and the unused portions of the central and southwestern areas, have been partially revegetated. Parts of the lowland to the northwest may also be revegetated.

1981

AOC A4 was not included in the photographic coverage of the Annex presented in the USEPA's 1981 report.

1986

Few changes are evident between 1978 and 1986. The central and southern portions of the area still appear to be heavily traveled and are devoid of vegetation in large areas. Debris, and possibly drums, were visible in the southwestern area. The northeastern area continues to revegetate and appears to be little used relative to the rest of AOC A4. Many downed tree trunks were visible in the lowland to the northwest, and it appeared that this area was developing, or had developed, into a wetland along with the lowland areas west of Old Marlborough Road. The dam at the southwest end of the lowland appears to have been breached near its southern end, and a narrow stream appears to be flowing southwestward into Puffer Pond.

1992

The sixth set of aerial photographs was taken in March 1992, by the Bionetics Corporation of Warrenton, Virginia (Bionetics) under contract to the USEPA's Environmental Photographic Interpretation Center (EPIC) group. These photographs, along with numerous ground control targets and control points used to establish horizontal and vertical control, and supplemental higher-altitude aerial photographs, were used to produce an updated topographic site map of the Annex.

AOC A4 was more heavily overgrown (Figure 2-6). Revegetation of the sandy central and southwestern portions of the site had begun and there were no signs of heavy traffic or frequent use. The lowland to the northwest appeared to be an open wetland. The areas bordering AOC A4 in the north central and northeast were completely overgrown.

2.1.1.2 Previous Investigations and Results

1958 - USACE

In September 1958, the United States Army Corps of Engineers (USACE) inspected this site and evaluated its suitability as a location for the Capehart Housing units (USACE, 1958). The location was designated Possible Site C - the East Gate Area. It was south of the intersection of Old Lancaster (Puffer) Road and Old Marlborough Road, and included land both north and south of Old Marlborough Road. This includes the northeast portions of AOC A4 and SA P14.

The site was described as generally fallow with a few trees and an abandoned orchard located in the western portion of the site (between AOC A4 and SA A3). A large three-story poultry barn and smaller buildings were also present.

1980 - USATHAMA

Environmental investigations were initiated at the Annex in 1980 under the Installation Restoration Program (IRP) in order to address possible environmental impacts from past land usage. USATHAMA conducted a preliminary site assessment consisting of a detailed records search (USATHAMA, 1980).

USATHAMA identified 22 known or suspected locations of waste material in their preliminary site assessment, one of which was designated Location 15, Old Gravel Pit/Chemical Burial/Dump Fill Area. The usage period identified was from 1940 to the present (1980, the reporting date). AOC A4 (Location 15) was identified due primarily to its reported use as a chemical waste burial area over a 3- to 4-year period from the late 1960s until about 1970. No information was discovered concerning the nature or volume of the chemicals buried.

1983 - U.S. Army Environmental Hygiene Agency

The U.S. Army Environmental Hygiene Agency (AEHA) conducted a Hydrogeological and Subsurface Investigation (AEHA, 1983) for 11 AOCs identified by USATHAMA (1980). The purpose of this investigation included evaluating the hydrogeologic setting and ground water quality. Monitoring well EHA7 was installed in the eastern end of AOC A4 as an upgradient well for the entire Annex (Figure 2-1).

Monitoring well EHA7 is located hydraulically upgradient from the portion of AOC A4 where waste disposal was reported. The soil was described in the well construction diagram for EHA7 as sand with traces of silt and cobbles. Refusal at EHA7 occurred at a depth of 15 feet BGS. Refusal was most likely caused by bedrock, as several outcrops are present near the well location.

1984 - Dames & Moore, Inc.

Dames & Moore, Inc. (Dames & Moore) installed two monitoring wells, DM4 and DM5, in AOC A4 (Figure 2-1). In addition, three sets of surface water/sediment samples (SW2/SD2, SW5/SD5, SW11/SD11) were collected in the general vicinity (Dames & Moore, 1986).

Monitoring wells DM4 and DM5 were installed to monitor ground water quality downgradient of reported dumping and burial areas. Boring logs for these wells describe the soil as sand with gravel and traces of silt and cobbles. Both of these borings were advanced to a depth of 20 feet BGS. It was reported by Dames & Moore (1986) that unusual conditions were noted during the boring of well DM5. A dark gray sand layer with a distinct cesspool odor was encountered from 5.5 to 10 feet BGS. It was assumed that the boring penetrated an old latrine pit constructed when AOC A4 was used as a bivouac area during training exercises. Other possible sources considered were the Rice Tavern or a barn. These structures were identified during Dames & Moore's aerial photointerpretation.

Ground water was measured at elevations of 186.28 mean sea level (MSL) and 186.17 MSL at DM4 and at elevations of 192.81 MSL and 192.23 MSL in DM5 during August 1984. At EHA7, ground water elevations were recorded at 194.56 MSL and 194.06 MSL during the same time period. Local ground water flow was assumed to be towards the stream on the northwestern edge of the area.

Surface water/sediment sample SW/SED 15 was collected from the stream flowing into Puffer Pond on the southeast (Figures 2-2 through 2-6). Analysis of this surface water sample, along with other surface water samples collected from Puffer Pond and associated streams, indicated that there was no significant contamination of surface water in this area (Dames & Moore, 1986).

1985 - Public Archaeological Laboratory, Inc.

The Public Archaeological Laboratory, Inc. (PAL) conducted an archaeological survey of the Annex (PAL, 1985). The cellar hole and abandoned well located in the northeast end of AOC A4 by the intersection of Old Marlborough Road and Old Lancaster (Puffer) Road was designated Historic Site No. 12. The integrity of the cellar hole and associated cultural deposits was reported as relatively good. The primary disturbance was considered to be the demolition of the structure and the removal of much of the resulting debris.

Cultural material recovered consisted primarily of structural debris, window glass, nails, brick, wood, and ceramics. It was noted that little material pre-dating the nineteenth century was recovered.

The site was identified as the Rice Tavern or Vose Farm and was reported to have been in use prior to 1685 when the Rice family acquired it. The tavern was used as a stopping place for stagecoaches on the Boston-Lancaster Route until 1815. After 1815 the tavern was occupied as a farmhouse by the Vose family who were listed as owners as late as 1898. By 1942, the property was owned by E.N. Buckingham. This site was reported to be one of the most significant historical and archeological resources within the Annex

due to its early date of occupancy, the variety of activities occurring on the site, the location at the intersection of two important transportation corridors, and its state of preservation.

2.1.1.3 Nature and Extent of Contamination Determined from Previous Investigations

1983 - AEHA

Monitoring well EHA7 was sampled by AEHA in 1983 for drinking water parameters (metals, pesticides, and fluoride). The only positive detections were NO_2+NO_3 as N, reported at a concentration of 0.34 µg/L (AEHA, 1983).

1984 - Dames & Moore

Monitoring wells EHA7, DM4, and DM5 were sampled by Dames & Moore in 1984. Both iron and manganese were found at concentrations up to 3,000 µg/L, which were interpreted by Dames & Moore to be consistent with naturally occurring levels in the region. Copper was found at a maximum concentration of 50 µg/L and selenium was present in DM5 at 3 µg/L. Hexavalent chromium was found only in EHA7 at 30 µg/L. The fact that hexavalent chromium was found in many samples collected during the Dames & Moore RI, while total chromium was below the detection limit, was attributed by Dames & Moore to a probable interference problem in the analysis. The USAEC method used for hexavalent chromium did not require the removal of interfering constituents such as iron.

Analysis for oil and grease was performed at EHA7, DM4, and DM5, but this parameter was only detected in one well, DM4, at 6,000 µg/L. Volatile organic compounds (VOCs), except for tetrahydrofuran, were found at comparable levels in both ground water samples and blanks. They were, therefore, attributed to laboratory contamination. The detection of tetrahydrofuran at 10 µg/L in EHA7 was attributed to a possible well construction error. Tetrahydrofuran is a component of polyvinyl chloride (PVC) solvent, used for joining sections of PVC pipe. Although AEHA specified flush-threaded joints for joining sections of PVC well casing, all EHA wells were found to be constructed with PVC pipe and couplings during the existing-well evaluation performed by OHM. PVC solvent may have been used during unsupervised well construction. This hypothesis casts doubt on the results from the EHA wells in general.

The maximum concentrations found for semivolatile organic compounds (BNAs) were cyclohexanol at 10 µg/L, bis(2-ethylhexyl) phthalate at 3,000 µg/L, di-n-octyl phthalate at 10 µg/L, dioctyl adipate at 100 µg/L, and nonspecific phthalates at 100 µg/L. These compounds were not found in blanks and may be site-related. However, with the exception of bis(2-ethylhexyl)phthalate at 3,000 µg/L found in DM4, the phthalates and dioctyl adipate are common laboratory artifacts at the concentrations detected. These compounds are used as plasticizers.

Nitrate, detected at 500 µg/L, and sulfate, detected at 33,700 µg/L, were tested for in EHA7 only; therefore, no comparison with DM4 and DM5 was possible. These concentrations may indicate background levels at the installation.

Dames & Moore concluded that the presence of generally low levels of metals, VOCs, and BNAs, not otherwise attributable to background conditions or laboratory procedures, might indicate minimal contamination of shallow ground water at AOC A4 as a result of the disposal of general refuse. The positive detections in EHA7 were attributed to a possible source in the northeast part of AOC A4 or from SA P14.

There were no compounds detected in surface water sample SW15. The compound royal demolition explosive (RDX) was listed as an unconfirmed detection in sample SED15 at a reported concentration of 3 µg/g. Other laboratory results were not reported for SED15 because of matrix interference from organic material that interfered with the analyses.

Further details of the Dames & Moore investigation may be found in their 1984 report. The previous investigations found no indication of a contamination source at AOC A4. However, these earlier results suggested that further study of AOC A4 was warranted.

2.1.1.4 Past Site Usage

AOC A4 has been occupied since before 1685 (PAL, 1985). The earliest use was almost certainly for agricultural purposes. From approximately 1685 until 1815, the site was also used as a tavern and stopping place for stagecoaches on the Boston-Lancaster Route. It was again used for farming and poultry raising from 1815 until the early 1940s when the land was acquired by the federal government.

Sometime before 1943, an orchard was established between AOC A4 and SA A3 (Figure 2-2). The 1943 photographs show a mature, well established orchard in this location. This is of significance to this study for two reasons. The first is that many of the pesticides, fungicides, and herbicides historically used on orchards prior to 1940 contained lead, arsenic, copper, cyanide, and sulfur. Many of these compounds are persistent in the environment. The second is, the location of the orchard upgradient of and adjacent to the wetland area now present northwest of AOC A4. Agricultural chemicals used at the orchard could have been introduced into the wetland area by surface runoff or transported by ground water flow. Chemicals may also have been spilled in the orchard, or been disposed of in the lowland.

The site was reportedly used as a gravel pit, chemical burial area, dumping area, and training area from 1940 until the mid 1980s.

2.1.1.5 Previous Remedial Actions

No records or reports were found indicating that any remedial actions have been performed in Area A4.

2.2 TECHNICAL APPROACH AND FIELD WORK PERFORMED

The Phase II SI/RI included the removal of a galvanized steel water tank from the basement of Rice Tavern, confirmatory surface soil sampling from beneath the tank, tank contents sampling, test pit excavations with subsurface soil sampling, a monitoring well installation with subsurface soil sampling, ground water sampling of four wells, and surface water and sediment sampling in the wetland adjacent to AOC A4. Table 2-1 contains a summary of area-specific activities and sampling.

2.2.1 Surface Soil Sampling

One Phase II surface soil sample, designated A4SO5B, was collected in AOC A4 (Table 2-1). This surface soil sampling location is shown on Figure 2-1.

2.2.1.1 Rationale and Locations

Following removal of a galvanized steel tank located in the cellar hole of the Rice Tavern, one surface soil sample was collected to determine if the tank had introduced contamination to the area.

2.2.1.2 Physical Results

The soil sample was collected from directly beneath where the tank was located. It consisted of a brown-to-black, organic-rich, fine-to-coarse sand with silt and was submitted for analysis of TCL BNAs, TCL VOCs, TAL metals, polychlorinated biphenyls (PCBs)/Pesticides (PCB/Pest), organophosphorus (OP) Pesticides (OP Pest), and explosives. No photoionization detector (PID) or radiological readings above background were detected during sample collection.

2.2.2 Test Pits and Trenches

Four test pits, designated A4TPD through A4TPG, were excavated and sampled in November 1993. Test pit locations are shown on Figure 2-1 and the test pit logs are presented in Appendix B. Two test trenches, designated A4TTA and A4TTB, were also excavated in the northeast corner of AOC A4.

2.2.2.1 Rationale and Locations

Test pit A4TPD was excavated to investigate subsurface conditions in the vicinity of confirmatory drum samples A4CD1 and A4CD2, which were collected during the Phase I SI/RI. Pesticides and metals were detected in these samples at elevated levels.

Test pits A4TPE, A4TPF, and A4TPG were excavated within the depression used as a surface dump in the southwest end of AOC A4. These test pits were located to investigate a cluster of other geophysical anomalies identified during the Phase I geophysical survey of AOC A4-C.

Test trenches A4TTA and A4TTB were located to investigate geophysical anomalies identified during the Phase I SI/RI. These anomalies were interpreted as indicating the presence of a buried ceramic pipe.

2.2.2.2 Physical Results

The ground surface at location A4TPD was littered with plastic bags, empty food and beverage cans, empty paint cans, demolition debris, and glass. From the surface to 1 foot BGS, an organic-rich dark brown loam was encountered, along with discarded soft drink cans and an empty paint can. What appeared to be a burn horizon was encountered from 6 feet to 6.5 feet BGS, overlying a moist, very fine grained silty sand. Soil samples were collected from 2, 4, and 6 feet BGS for analysis of TAL metals, PCB/Pest, and OP Pest (Table 2-1). No PID or radiological readings above background were detected.

Test pit A4TPE was excavated within the depression and completed at 6 feet BGS without encountering any metallic debris. The section from the ground surface to 6 feet BGS consisted of tan, fine-to-medium grained sand with some coarse sand and silt, and many cobbles and small boulders. Based on a magnetometer scan of the excavation, it appears that iron-rich cobbles and boulders were the source of the anomaly at this location. Soil samples were collected from 2, 4, and 6 feet BGS for analysis of TCL BNAs,

TAL metals, PCB/Pest, OP Pest, and total petroleum hydrocarbons (TPH) (Table 2-1). No PID or radiological readings above background were detected.

Test pit A4TPF was excavated within the depression and completed at 6 feet BGS. Several burned and blackened items were recovered from 5 to 6 feet BGS. The items recovered were wire rings approximately 30 inches in diameter, a flexible fabric and rubber material, and brown fibrous packing or ticking. Soil samples were collected from 2, 4, and 6 feet BGS for analysis of TCL BNAs, TAL metals, PCB/Pest, OP Pest, and TPH (Table 2-1). No PID or radiological readings above background were detected.

Test pit A4TPG was also excavated within the depression and completed at 6 feet BGS. Metallic debris, domestic trash, demolition debris, and broken glass were recovered from the ground surface to 1 foot BGS. Soil samples were collected from 2, 4, and 6 feet BGS for analysis of TCL BNAs, TAL metals, PCB/Pest, OP Pest, and TPH (Table 2-1). No PID or radiological readings above background were detected.

Test trenches A4TTA and A4TTB were excavated to bedrock which was encountered at depths ranging from 5 to 7 feet BGS. No evidence of a ceramic pipe, or any other buried material, was found. The section was composed of a tan, medium-to-coarse grained sand with a trace of silt. Many cobbles and several large boulders were also present. No unusual odors or staining were noted, and no PID or radiological readings above background were observed. No samples were collected from either of the trenches.

2.2.3 Monitoring Well Installation with Subsurface Soil Sampling

One shallow monitoring well, designated OHM-A4-50, was installed in AOC A4. Monitoring well installation was completed on October 26, 1993, and the well developed on November 16, 1993. Completion details, survey data, boring logs, and well construction diagrams are contained in Appendix B.

2.2.3.1 Rationale and Location

Monitoring well OHM-A4-50 was installed hydraulically downgradient of the shallow depression at the southwestern end of the area. It was placed at that location to assess whether the waste dumped in the upgradient depression had impacted soil and/or ground water quality. The monitoring well location is shown on Figure 2-1.

2.2.3.2 Physical Results

The well boring was completed at a depth of approximately 14.5 feet BGS due to auger refusal. The subsurface section was composed of a medium-to-coarse sand with pebbles overlying fine and fine-to-medium sands with silt. The top of water was encountered at approximately 8 feet BGS in the boring and the well was completed with 10 feet of screen.

Subsurface soil sample A4SB50B was collected from 8 to 10 feet BGS for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, OP Pest, and total organic carbon (TOC). Since the temperature blank in the shipping cooler containing this sample was reportedly received at the laboratory at a temperature of 8°C, the samples submitted for organic analyses were rejected by the USAEC chemist. As a result, subsurface soil sample A4SB50C was collected on November 15, 1993, from 8 to 10 feet BGS in a new boring located as close as possible to OHM-A4-50. This sample was submitted for analysis of TCL BNAs, TCL VOCs, PCB/Pest, OP Pest, and TOC. No odors were noted and no PID or radiological readings above

background were detected during either sample collection event. A geotechnical sample representative of the screened interval was obtained from 13 to 14.5 feet BGS for grain-size analysis. Grain-size analysis results are provided in Appendix B.

Well OHM-A4-50 was developed on November 16, 1993. The well was surged with a 2-inch-diameter bailer and then pumped at a rate of approximately 0.25 gallons per minute (gpm) due to poor recharge.

2.2.4 Ground Water Sampling

One set of ground water samples was collected in AOC A4 from monitoring wells OHM-A4-4, OHM-A4-5, OHM-A4-50, and DM4. Table 2-1 contains the AOC A4 Phase II SI/RI sampling record, and Appendix A contains the detailed sample collection record. In order to assess the impact that particulate matter may have had on ground water metals concentrations reported for previous sampling events, both filtered and unfiltered ground water samples were submitted for metals analysis.

Analytical results from two previous rounds of ground water sampling performed by OHM in AOC A4 (June and October 1992) indicated the presence of acetone, toluene, bis(2-ethylhexyl) phthalate, the insect repellent N,N-diethyl-3-methylbenzamide (DEET), lead, mercury, and the pesticides heptachlor epoxide and beta-endosulfan. However, these metals and compounds were not clearly determined to be contaminants, since all were found in only one of the sampling events.

2.2.4.1 Rationale and Locations

OHM-A4-4 was sampled on two previous occasions. Mercury was detected at a concentration of 0.881 µg/L in the sample collected in June 1992. This result is unconfirmed because a metals sample was not collected from this well in October 1992 due to insufficient water volume. Toluene was detected at 3.2 µg/L in the June 1992 sample, but was not detected in the sample collected for VOC analysis in October 1992. This well was resampled during the Phase II SI/RI in December 1993 for analysis of TCL BNAs, TCL VOCs, PCB/Pest, OP Pest, filtered TAL metals, and unfiltered TAL metals.

OHM-A4-5 was also sampled during the June and October 1992 sampling events. Lead, at a concentration of 190 µg/L, was detected in the sample collected in October, but was not detected in the sample collected the previous June. It has been suggested that the lead detection may be the result of particulate matter bypassing, or passing through, the filter medium. In order to assess the impact that particulate matter may have on the reported metals concentrations, both filtered and unfiltered samples were submitted for metals analysis during the Phase II sampling event. The ground water sample was also submitted for analysis of TCL BNAs, TCL VOCs, PCB/Pest, and OP Pest.

OHM-A4-50 was sampled in order to assess the ground water quality immediately downgradient of the shallow depression at the southwestern end of AOC A4. Ground water collected from this well was submitted for analysis of TCL BNAs, TCL VOCs, filtered TAL metals, PCB/Pest, and OP Pest.

Monitoring well DM4 was sampled to confirm the presence of bis(2-ethylhexyl) phthalate, which was detected at a concentration of 7.8 µg/L during the October 1992 sampling event. The sample collected during the Phase II sampling event was submitted for analysis of TCL BNAs, filtered TAL metals, and unfiltered TAL metals.

2.2.4.2 Physical Results

Due to the poor recharge rate of the monitoring wells in AOC A4, purging preceding sampling followed USAEC specifications for slow recharge wells. These specifications allow less than the preferred 3 to 5 well volumes to be removed prior to ground water sampling.

OHM-A4-4 was purged and sampling was begun on December 1, 1993. Due to the slow recharge, 1 well volume (approximately 2.5 gallons) was removed at 0830. The well was then allowed to recharge for 7 hours and sampling was begun at 1530 that afternoon. At this time, the well had recharged to approximately half its initial volume and the samples for TCL BNAs, TCL VOCs, and PCB/Pest were collected before the well was bailed dry. The well was allowed to recharge overnight, and at 0645 on December 2, 1993, additional ground water was collected for the OP Pest, filtered TAL metals, and unfiltered TAL metals analyses. No odors or PID readings above background were noted during this sampling event.

Prior to sampling, OHM-A4-5 was purged of two well volumes, OHM-A4-50 was purged of 2.5 well volumes, and monitoring well DM4 was purged of approximately 3 well volumes. No odors or PID readings above background were noted in any of the wells during this sampling event. OHM-A4-50 was sampled for TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, and OP Pest. OHM-A4-5 was also sampled for these parameters plus unfiltered TAL metals. Well DM4 was sampled for TCL BNAs, filtered TAL metals, and unfiltered TAL metals.

2.2.5 Surface Water and Sediment Sampling

A total of 7 surface water and sediment samples were collected by OHM from 6 locations in AOC A4. Stratified sediment samples were collected at sample locations A4SW/SD5, A4SW/SD6, and A4SW/SD7 during the Phase II investigation. Surface water/sediment samples were collected from five locations in SA A3/P5. The locations of all surface water/sediment sampling locations in and around AOC A4 and SA A3/P5 are shown on Figure 2-6.

2.2.5.1 Rationale and Locations

High-melting explosive (HMX) was detected at a concentration of 0.91 µg/g in Phase I surface sediment sample A4SD2A. Surface water/sediment sample A4SW/SD4B was collected during the Phase II SI/RI to confirm the original analytical results.

Three surface water and stratified sediment sampling points, designated A4SW/SD5, A4SW/SD6, and A4SW/SD7 (Figure 2-6), were established to assess the lateral and vertical extent of acetone, methylene chloride, arsenic, and manganese. These contaminants were detected in samples collected during the Phase I SI/RI.

2.2.5.2 Physical Results

Surface water sample A4SW4B and surface sediment sample A4SD4B were submitted for explosives analysis (Table 2-1). No odors were noted, and no PID or radiological readings above background were detected during the sampling event.

Surface water samples from locations A4SW5B, A4SW6B, and A4SW7B were collected from the wetland adjacent to AOC A4 (Figure 2-6). Stratified sediment samples were also collected at each of these sampling points from the sediment surface to 1 foot BGS, from 1 to 2 feet BGS, and from 2 to 3 feet BGS. All surface water/sediment samples were submitted for analysis of TCL BNAs, TCL VOCs, PCB/Pest, TAL metals, OP Pest, and explosives. Sediment samples from locations A4SW/SD6 and A4SW/SD7 were also analyzed for TOC.

It should be noted that water levels were very low during the Phase II sampling event in the wetland. In order to obtain a sufficient amount of surface water for analysis, shallow holes were dug and allowed to fill with water. After the suspended particles had settled, the surface water sample was collected from the hole. As a result, a higher than normal amount of suspended sediment was present in the surface water samples.

2.2.6 Tank Sampling

One sample, designated A4AT1B, was collected from the tank located in the cellar hole. The tank sampling location is shown on Figure 2-1.

2.2.6.1 Rationale and Location

Sample A4AT1B was collected to characterize the contents of the galvanized steel tank that was removed from the basement of Rice Tavern. After the tank was removed and sampled, it was staged at the old Massachusetts Fire Fighting Academy (MFFA).

2.2.6.2 Physical Results

The tank removed from the basement was constructed of heavy-gauge galvanized steel, 6.5 feet tall by 2.5 feet in diameter, and had a capacity of approximately 240 gallons (Figure 2-7). Two-inch-diameter ports with plugs installed were centered in the convex top and concave base. Two threaded plumbing ports 1.5-inch in diameter were located opposite each other near the base of the tank, and a sight glass to monitor the level of the contents was installed in the upper third of the tank. The plumbing ports in the base of the tank were open and the sight glass was broken. The structure and configuration of the vessel suggest that it was used as a pressurized water tank for the Rice Tavern water system.

The tank was sampled through one of the open plumbing ports in the base of the tank. Tank contents were poured directly from the tank into sample jars. The rust-colored liquid appeared to be water colored by rust from the tank interior. No odors were noted, and no PID or radiological readings above background were detected during sample collection. The sample was submitted for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, and OP Pest (Table 2-1).

2.2.7 Hydrogeological Assessment

Hydrogeologic conditions at AOC A4 were characterized by the installation of two monitoring wells, two soil borings, and one staff gage, the collection of three rounds of water level measurements, and by the interpretation of the results of slug tests performed at three locations. The information obtained during the OHM investigation was used to refine the existing hydrogeologic characterization for the area developed by

previous investigations (AEHA, 1981; Dames & Moore, 1984). The overburden zone was the primary water-bearing unit investigated.

Ground water gauging data have been used to construct a map showing the overburden ground water elevation and flow direction for April 27, 1994 (Figure 2-8). The flow direction was westward towards the wetlands and Puffer Pond. This flow direction is consistent with previous observations made by OHM in 1992 and 1993 (OHM, 1994).

2.3 NATURE AND EXTENT OF CONTAMINATION

The following nature and extent of contamination section summarizes the analytical results for all surface soil, test pit, subsurface soil, ground water, surface water, sediment, and tank samples collected by OHM during the remedial investigation of AOC A4 (Phase I and Phase II). All AOC A4 sample locations are shown on Figure 2-1.

2.3.1 Surface Soil Sampling Results

OHM collected two confirmatory drum and six surface soil samples (including one field duplicate) from AOC A4. All samples were collected from a depth of 0 to 6 inches BGS and were submitted for TCL VOC, TCL BNA, PCB/Pest, chlorinated herbicides, explosives, and TAL metals analysis. Only the sample collected in November 1993 (A4SO5B) was analyzed for OP Pest. Herbicides and OP Pest were not detected. A list of all detected compounds is provided in Appendix D, Table D-1. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 2-3. Analytes detected at concentrations above ESAT soil criteria of potential ecological concern are summarized in Table 2-4.

Neither of the two VOCs identified in these surface soil samples is considered to be a contaminant of concern in AOC A4. Acetone was detected in the sample collected from A4CD2 at a concentration of 0.015 µg/g, which is below the MCP S-1/GW-1 soil standard of 3 µg/g. Methylene chloride was detected in 3 of 7 samples (maximum 0.016 µg/g) at concentrations below both the maximum background level and the MCP S-1/GW-1 soil standard (Table 2-3). There are no ESAT values for either of these compounds. Five unknown VOCs were also detected in these surface soil samples at concentrations ranging from 0.01 to 0.07 µg/g (Appendix D, Table D-50).

BNAs were primarily detected in the sample collected from beneath the galvanized tank that was removed from the basement of Rice Tavern (A4SO5). Eight polycyclic aromatic hydrocarbons (PAHs) and bis(2-ethylhexyl)phthalate (DEHP) were detected at this sample location. Of the nine BNAs detected, only chrysene (0.91 µg/g) slightly exceeds its MCP S-1/GW-1 soil standard (0.7 µg/g). This concentration does not exceed the ESAT soil value of 5 µg/g. Due to the low frequency of detection (1 of 7 samples) and the concentration being below ESAT criteria, this compound is not considered to be a potential contaminant of concern. The PAHs fluoranthene and phenanthrene were the only TCL BNAs detected at A4CD1 and concentrations of both compounds are below MCP S-1/GW-1 standards and ESAT soil criteria. Di-n-butyl phthalate was detected in 5 of 7 samples. However, this compound is a common field sampling and laboratory contaminant and was detected in 10 of the 12 background samples collected by OHM. None of the di-n-butyl phthalate concentrations detected in AOC A4 surface soil exceed the maximum background soil value; therefore, this BNA is not a potential contaminant of concern. Thirty-four unknown BNAs were

also detected at concentrations ranging from 0.1 to 53 µg/g (Appendix D, Table D-50). Most of these unknowns were found in the sample collected from beneath the galvanized tank (A4SO5B).

ppDDT (5 of 7 samples) and ppDDE (3 of 7 samples) were the only pesticides detected. Concentrations of these pesticides ranged from 0.01 to 0.45 µg/g, which are below both MCP S-1/GW-1 soil standards and ESAT soil criteria.

There were no confirmed detections of explosives in these samples. HMX (A4SO5) and RDX (A4SO3) were reported as unconfirmed analytes and should be considered as undetected (Appendix D, Table D-1). In an unconfirmed analysis, a compound tentatively identified on a primary gas chromatographic column does not behave like that compound on the second column run which is required for positive identification. Unconfirmed results for explosives are included because they suggest the presence of unidentifiable compounds with some properties consistent with the reported compounds. RDX was also present in the laboratory blank at approximately the same concentration as the sample which suggests that this unidentifiable compound is probably a laboratory contaminant.

The metals detected in the surface soil samples are listed in Appendix D, Table D-1. Lead and zinc were detected in the sample collected from beneath the galvanized tank (A4SO5) at concentrations above MCP S-1/GW-1 soil standards. Lead was detected in this field sample at a concentration of 520 µg/g and in the duplicate sample collected from this same location at a concentration of 890 µg/g. Zinc was detected in the duplicate sample at 2,550 µg/g which slightly exceeds the MCP S-1/GW-1 soil standard of 2,500 µg/g. The concentration detected in the field sample, 2,420 µg/g, does not exceed this standard. None of the other metals detected in these soil samples exceed MCP S-1/GW-1 standards. There are no MCP S-1/GW-1 soil standards for barium and copper which were detected at A4SO5 at concentrations above maximum background (Table 2-3). However, these metals do not exceed ESAT soil criteria.

Several metals, including antimony (1 of 7 locations), arsenic (4 of 7 locations), cadmium (2 of 7 locations), lead (1 of 7 locations) and zinc (2 of 7 locations) were detected at concentrations above ESAT soil criteria (Table 2-4). Antimony was detected in the sample from A4CD2 at a concentration of 9.43 µg/g which only slightly exceeds the ESAT value of 8.8 µg/g. This antimony concentration is below the MCP S-1/GW-1 soil standard of 10 µg/g. No other compounds were detected at concentrations above screening levels at this sample location. Arsenic concentrations exceeding ESAT criteria ranged from 5.4 to 8.6 µg/g which are below background soil levels (background arsenic concentrations exceed ESAT criteria). Cadmium and zinc exceed ESAT criteria at sample locations A4CD1 and A4SO5. As discussed above, lead concentrations were elevated at A4SO5 and exceed both MCP S-1/GW-1 and ESAT soil criteria. The sample from A4SO5 was collected near the bottom of a stone-lined foundation (former basement of Rice Tavern). Access to this sample location is limited by an approximately 6-foot drop between the ground surface and the sample point. The remaining metals listed in Table 2-3 were either detected at concentrations below maximum background or are naturally occurring essential elements (i.e., calcium and potassium).

2.3.2 Test Pit Sampling Results

A total of 16 soil samples, including one field duplicate, were collected by OHM from seven test pit locations during the remedial investigation of AOC A4. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, OP Pest (November 1993 samples only), explosives, and TAL metals. Some samples were also analyzed for TPH. No explosives, herbicides, or OP Pest were

detected. Table D-2 in Appendix D lists all positive detections. Analytes which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 2-5.

Alpha-pinene was detected in the sample collected from A4TPA at a concentration of 0.27 µg/g. This is a naturally occurring terpene and its detection in this test pit sample is not considered to be site-related. One unknown VOC was also detected in the sample from A4TPA at a concentration of 0.04 µg/g (Appendix D, Table D-50). No other VOCs were detected.

The only BNA identified in these test pit samples was di-n-butyl phthalate at two locations (Appendix D, Table D-2). The concentrations detected (maximum 0.42 µg/g) are well below the background 95 percent UCL value of 3.8 µg/g. Di-n-butyl phthalate is a common field sampling and laboratory contaminant associated with plastic materials and was detected in 10 of the 12 background soil samples collected by OHM (maximum 9 µg/g). Thirty-four unknown BNAs were also detected in these test pit samples at concentrations ranging from 0.08 to 9 µg/g (Appendix D, Table D-50).

Low concentrations of the pesticides alpha-endosulfan, ppDDE, and ppDDT were detected in some of these test pit samples (Appendix D, Table D-2). Alpha-endosulfan was only detected at A4TPB at a concentration of 0.0185 µg/g which is below the MCP S-1/GW-1 soil standard for total endosulfan of 0.2 µg/g. ppDDE (3 of 7 test pits) and ppDDT (4 of 7 test pits) were detected at concentrations below maximum background levels and MCP S-1/GW-1 standards (Table 2-5).

TPHs were detected in 1 of 3 samples collected from A4TPF (34.9 µg/g) and in the duplicate sample collected from A4TPG (26.8 µg/g). TPHs were not detected in the three field samples collected from A4TPG. These TPH concentrations do not exceed the MCP S-1/GW-1 soil standard of 500 µg/g.

Arsenic, beryllium, and lead were the only metals detected at concentrations above MCP S-1/GW-1 soil standards. Arsenic was detected at one location (A4TPG) at a concentration (40 µg/g) above the MCP S-1/GW-1 soil standard of 30 µg/g. This seemingly high arsenic concentration (in comparison with background values) may actually be representative of naturally elevated arsenic levels in northeastern Massachusetts. The elevated arsenic concentration at A4TPG was detected in the sample collected from a depth of 4 to 6 feet. Arsenic concentrations in the two shallower samples collected from this test pit were considerably lower; 4.2 µg/g (0 to 2 feet) and 4.6 µg/g (2 to 4 feet). No other elevated arsenic concentrations were detected in these test pit samples.

Beryllium was detected in 9 of 16 test pit samples at concentrations ranging from 0.3 to 0.64 µg/g. Although concentrations of eight of these positive detections exceed the MCP S-1/GW-1 soil standard of 0.4 µg/g, these concentrations fall within the range of background soil samples (0.28 to 0.64 µg/g). The concentrations being comparable to background soil levels, the consistency of the values, and the lack of any obvious source suggests that these test pit values are representative of background beryllium concentrations.

Lead was detected at A4TPC at a concentration of 570 µg/g. Scrap metal, possibly from an old car, a wrought iron post, and a glass bottle were found at this test pit location. The MCP S-1/GW-1 soil standard for this compound is 300 µg/g. Lead was not detected at elevated levels in any of the other test pit samples. Therefore, based on test pit data, this elevated lead concentration represents an isolated hotspot. The remaining metals listed in Table 2-5 were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements.

2.3.3 Subsurface Soil Sampling Results

OHM collected seven boring samples from five locations within AOC A4. Sample depths are listed in Appendix D, Table D-3. Most of these samples were submitted for TCL VOC, TCL BNA, PCB/pesticide, explosives, chlorinated herbicide, TOC, and TAL metals. Only the sample collected in October 1993 during the installation of OHM-A4-50 was analyzed for OP Pest. Herbicides and OP Pest were not detected. A list of all detected compounds is provided in Appendix D, Table D-3. Analytes detected at concentrations above background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 2-6.

Methylene chloride was detected in 5 of 6 samples submitted for VOC analysis at concentrations ranging from 0.01 to 0.03 µg/g. These detected concentrations do not exceed the MCP S-1/GW-1 soil standard (Table 2-6). Five unknown VOCs were also detected in these boring samples at concentrations ranging from 0.04 to 0.7 µg/g (Appendix D, Table D-50).

DEHP was detected in 3 of 5 of the samples submitted for BNA analysis at concentrations (maximum 0.57 µg/g) well below the MCP S-1/GW-1 soil standard of 100 µg/g. Concentrations of di-n-butyl phthalate (4 of 5 samples) ranged from 1.4 to 2.9 µg/g. These concentrations are below the background soil 95 percent UCL value (3.8 µg/g) and, as mentioned above, di-n-butyl phthalate is a common field sampling and laboratory contaminant. An additional 30 unknown BNAs were detected in these samples at concentrations ranging from 0.09 to 25 µg/g (Appendix D, Table D-50).

ppDDE was detected at a concentration of 0.013 µg/g in the sample collected during the installation of monitoring well OHM-A4-50. This concentration is below both background soil levels and the MCP S-1/GW-1 soil standard. No other PCB/Pest were detected.

There were no confirmed detections of explosives in these samples. 2-Nitrotoluene was reported as an unconfirmed analyte in the sample collected from OHM-A4-4 and should be considered as undetected.

The metals detected in these boring samples are listed in Appendix D, Table D-3. Arsenic and beryllium were detected at concentrations equivalent to their respective MCP S-1/GW-1 soil standards at OHM-A4-4. Although beryllium was detected at a concentration equivalent to its MCP standard (0.4 µg/g), this concentration is below the maximum background value of 0.64 µg/g. Therefore, the concentration of beryllium detected in this sample is considered to be representative of background levels. The elevated arsenic concentration may also be representative of natural variability in the geology of the area. No other metals were detected at concentrations equal to or greater than MCP S-1/GW-1 soil standards. Barium (83.7 µg/g) and copper (22.6 µg/g) were detected at OHM-A4-4 at concentrations slightly above maximum background (Table 2-6). There are no MCP S-1/GW-1 soil standards for either metal. However, these concentrations do not exceed ESAT ecological screening criteria for surface soil samples. The remaining metals listed in Table 2-6 were either detected at concentrations below maximum background levels or are naturally occurring essential elements.

2.3.4 Ground Water Sampling Results

OHM collected 17 ground water samples from six monitoring well locations in AOC A4. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/pesticides, chlorinated herbicides, explosives, and TAL metals. Three of the four samples collected in November 1993 were also analyzed for OP Pest.

Chlorinated herbicides and OP Pest were not detected. Table D-4 in Appendix D contains a list of all detected compounds. Analytes which exceed ground water criteria are summarized in Table 2-7.

Acetone was detected in 1 of 2 samples collected from EHA7 at a concentration of 9 µg/L. There is no MCL for this compound, but this acetone concentration does not exceed the MCP GW-1 standard of 3,000 µg/L. Acetone was not detected in the subsequent sample collected from this well in October 1992. Toluene was detected in samples collected from OHM-A4-4 and OHM-A4-5 at concentrations below the MCL of 1,000 µg/L. Toluene was detected in the June 1992 sample collected from OHM-A4-4 at a concentration of 3.2 µg/L. This compound was not detected in the samples collected from this well in October 1992 or December 1993. The October 1992 sample from OHM-A4-5 contained toluene at a concentration of 1.8 µg/L, but this compound was not detected in the sample collected from this well in November 1993. Two unknown VOCs were also detected in these ground water samples at concentrations of 3 and 6 µg/L (Appendix D, Table D-50).

DEHP was detected at a concentration (7.8 µg/L) slightly above the MCL of 6 µg/L in the October 1992 sample collected from DM4. However, this compound is a common field sampling and laboratory contaminant associated with plastics and was not detected in the other two samples collected from this well in June 1992 and November 1993. Therefore, this single detection of DEHP may be the result of contamination during sampling and analysis rather than an indication of its presence in AOC A4 ground water.

The insect repellent DEET was detected as part of the BNA analysis in one of the samples collected from AOC A4 in June 1992 (EHA7). This compound was also detected in ground water samples collected from AOC A9 during this same sampling round. DEET was not detected in any wells during subsequent sampling rounds when sampling personnel were not wearing the compound as an insect repellent. Therefore, the detection of DEET in AOC A4 ground water is not considered to be site-related. Nine unknown BNAs were also detected in these ground water samples at concentrations ranging from 2 to 14 µg/L.

The detection of PCB/Pest was limited to monitoring well locations OHM-A4-4 and OHM-A4-5. Heptachlor epoxide was detected in the June 1992 samples collected from OHM-A4-4 and OHM-A4-5 at concentrations (maximum 0.02 µg/L) below the drinking water standard (0.2 µg/L). This compound was not detected in subsequent samples collected from these wells. Beta-endosulfan was detected in 1 of 3 samples collected from OHM-A4-5 at a concentration (0.05 µg/L) below the MCL (0.4 µg/L). No other pesticides were detected.

There were no confirmed detections of explosives in these ground water samples. 1,3,5-Trinitrobenzene was reported as an unconfirmed analyte in 1 of 2 samples collected from DM4 and should be considered as undetected.

Several metals were detected in these ground water samples and are listed in Appendix D, Table D-4. Only lead, in one sample, exceeds the MCL. Lead was detected in the October 1992 sample collected from OHM-A4-5 at a concentration of 190 µg/L. Lead had not been detected in the previous sample collected from this well (June 1992). Therefore, two samples (one filtered, the other unfiltered) were collected from this well in November 1993 to confirm the presence or absence of lead. Lead was not detected in the filtered sample and the concentration detected in the unfiltered sample (5.2 µg/L) is well below the MCL of 15 µg/L. These results confirm that lead levels are not elevated in AOC A4 ground water. Mercury was detected in monitoring well OHM-A4-4 at a concentration of 0.881 µg/L in June 1992. This level is below both the

USEPA MCL and MCP GW-1 criteria of 2 µg/L. Mercury was not detected in this well during a subsequent sampling event performed in December 1993.

Aluminum, iron, and manganese concentrations exceed Secondary Maximum Contaminant Levels (SMCLs), which are based on aesthetics, at several locations (Table 2-7). Aluminum was detected in only 1 of 13 filtered ground water samples submitted for TAL metals analysis at a concentration of 349 µg/L in monitoring well DM4 during the June 1992 Phase I sampling event (Table D-4). Both filtered and unfiltered samples were submitted for metals analysis from monitoring wells DM4, OHM-A4-4, and OHM-A4-5 during the Phase II sampling event in November 1993. The filtered samples were all non-detects, while the unfiltered samples contained aluminum at concentrations of 19,800 µg/L in DM4, 2870 µg/L in OHM-A4-4, and 10,900 µg/L in OHM-A4-5. Based on the Phase II results, its apparent that aluminum is associated with the particulates present in the unfiltered samples, and that the single Phase I detection was probably the result of particulate matter in the filtered ground water sample. Iron was detected in 6 of 7 filtered samples from previously installed wells DM4, DM5, and EHA7 at concentrations ranging from 231 to 2720 µg/L, but was not detected in the 6 filtered samples from the recently installed wells OHM-A4-4, OHM-A4-5, and OHM-A4-50 (Table D-4). Three sets of filtered and unfiltered ground water samples were submitted for metals analysis during the Phase II sampling event in November 1993. The results for iron were 2190 (filtered) and 37,000 µg/L (unfiltered) for DM4, ND (filtered) and 2810 µg/L (unfiltered) for OHM-A4-4, and ND (filtered) and 14,000 µg/L for OHM-A4-5. Again, it is apparent that some of the iron detections are the result of particulate matter in the ground water samples. It is also apparent that dissolved iron concentrations appear to be higher in the previously installed wells. This could be the result of iron oxidation occurring within the casings or filter packs of these wells. High manganese concentrations in ground water are characteristic of the entire region (Perlmutter, 1962; Pollock et al., 1969). The remaining metals detected in these ground water samples were either detected at concentrations below MCL standards or are naturally occurring essential elements.

2.3.5 Surface Water and Sediment Sampling Results

Two out of five Phase I, and all 7 Phase II surface water/sediment samples collected in conjunction with the site investigations of AOC A4 and SA A3/P5, were taken from the same wetland (Figure 2-6). Therefore, all surface water/sediment samples collected in SA A3/P5 and AOC A4 are discussed in this section to more completely assess environmental conditions in the wetland area.

All Phase I surface water and sediment samples from AOC A4 were submitted for analysis of TCL VOCs, TCL BNAs, PCB/Pest, explosives, herbicides, TOC (sediment only), and TAL metals. Phase II surface water and stratified sediment samples were not analyzed for herbicides, but were analyzed for OP Pest. Phase II sample A4SW/SD4B, collected from Phase I sampling location A4SW/SD2, was submitted for explosives analysis only. All compounds detected in these surface water and sediment samples are listed in Appendix D, Tables D-5 and D-6, respectively. A summary of detected unknowns is listed in Appendix D, Table D-50.

Both Phase I samples collected in SA A3/P5 were submitted for analysis of TCL BNAs, PCB/Pest, explosives, TAL metals, and TOC (sediment only). The 3 Phase II samples were analyzed for TAL metals. All compounds detected in these surface water and sediment samples are listed in Tables D-7 and D-8, respectively. All compounds detected during the Phase I and II investigations exceeding surface water and sediment criteria for both AOC A4 and SA A3/P5 are summarized in Tables 2-8 and 2-9, respectively.

Phase I surface water and sediment analytical results are summarized in sections 2.3.5.1 and 2.3.5.2, respectively, of this report. Complete discussions regarding the Phase I surface water/sediment analytical results from AOC A4 and SA A3/P5 are presented in Sections 4.3.5 and 7.3.5, respectively, of the Final Report for the Site/Remedial Investigation (OHM, 1994).

2.3.5.1 Surface Water

No TCL VOC, TCL BNA, explosive, or PCB/Pest compound was positively detected during the Phase I SI/RI investigation. The herbicide dacthal was detected in surface water sample A4SW3A at a concentration of 0.437 μg/L. There are no surface water screening criteria for this compound. Arsenic was detected in excess of maximum background (3.15 μg/L) and AWQC human health (0.14 μg/L) screening criteria in samples A2SW1A (9.19 μg/L), A4SW1A (7.38 μg/L), and A4SW2A (5.52 μg/L). These arsenic detections do not exceed the AWQC chronic screening value 190 μg/L. Lead was detecting in all 5 Phase I surface water samples at concentrations ranging from 1.77 to 10.5 μg/L. The maximum detection slightly exceeds the background screening value of 10.3 μg/L, while all detections exceed the ESAT surface water and AWQC chronic aquatic screening values of 0.55 μg/L.

Phase II Analytical Results

No TCL VOC, TCL BNA, or OP Pest compounds were positively detected during the Phase II SI/RI investigation. Endrin aldehyde was detected at a concentration of 0.161 μg/L in sample A4SW6B. This detection does not exceed the AWQC human health criteria of 0.81 μg/L, the only screening criteria available for this compound. ppDDT was detected in sample A4SW5B at a concentration of 0.0285 μg/L, exceeding both the AWQC chronic aquatic (0.001 μg/L) and AWQC human health (0.00059 μg/L) criteria.

Metals were detected in the Phase II surface water samples at concentrations above surface water screening criteria (Table 2-8). Many of these elevated metal concentrations may be due to suspended sediments present as a result of the way in which the surface water samples were collected. As discussed in Sections 2.2.5.2 of this document, there was very little surface water in this wetland area when the Phase II samples were collected in November 1993. Therefore, all samples were collected by digging into the sediment until water was encountered. As a consequence, these "surface water" samples contained more suspended sediment than was present in the Phase I surface water samples. The analytical results reflect this difference in that the Phase II surface water samples contained a wider variety of metals at higher concentrations than did the Phase I samples (Tables D-5 and D-7).

Lead was detected at concentrations above maximum background in five of the six Phase II samples collected in November 1993. Concentrations ranged from 18 to 140 μg/L. Phase I lead concentrations were approximately equivalent to or less than background levels in all samples, although all exceeded the ESAT and chronic AWQC value of 0.55 μg/L. The highest lead concentration was detected at A4SW5 (140 μg/L). As discussed in the Ecological Assessment (Section 2.5.4) this lead concentration is consistent with the sediment concentration of 18 μg/g at this location, assuming 1 percent suspended particulate matter in the surface water sample. That is, 18 mg lead/kg sediment x 0.01 kg sediment/liter of water x 100 μg/mg = 180 μg/L. This assumption is supported by data on other metals that suggests that ratios between the water and sediment concentrations are fairly consistent.

In addition to lead, the other metals detected above ESAT surface water and/or AWQC chronic aquatic criteria were aluminum (6 of 6 samples, 174 - 24,400 μg/L), chromium (1 of 6 samples at 17.3 μg/L), copper

(1 of 6 samples at 89.4 µg/L), and zinc (6 of 6 samples, 453 - 713 µg/L). The chromium, copper, maximum aluminum, and maximum lead detections were all found in sample A4SW5B. This suggests that this "surface water" sample may have contained more suspended sediment than the other samples. Zinc, however, was detected in the method blank and all seven rinsate blanks analyzed within the same analytical lot at concentrations ranging from 201 to 615 µg/L. Therefore, these elevated zinc detections are most likely the result of laboratory contamination and are not considered to be site related.

Arsenic was detected in five of the six Phase II surface water samples collected at concentrations ranging from 5.4 to 27 µg/L. Arsenic detections do not exceed AWQC chronic aquatic criteria. However, they do exceed the maximum background surface water and AWQC human health values of 3.15 and 0.14 µg/L, respectively.

The remaining metals listed in Table 2-8 were detected at concentrations above maximum background. These metals are all naturally occurring, and their presence at concentrations above background levels may either be due to natural variability or the presence of suspended particulate matter in the samples.

2.3.5.2 Sediment

During the Phase I investigation, acetone was detected at 2 of 5 sample locations. In sample A4SD3A acetone was reported at a concentration of 0.1 µg/L, and in sample A3SD1A at 0.021 µg/L. Methylene chloride was detected in all 5 samples at concentrations ranging from 0.014 to 0.05 µg/L. No VOC detection exceeded screening criteria.

Di-n-butyl phthalate, a common sampling and/or laboratory contaminant, was detected in all 5 Phase I sediment samples at concentrations ranging from 2 to 10 µg/g. There is no screening criteria available for this compound. The explosive cyclotetramethylenetetranitraminie (HMX) was a confirmed detection in sediment sample A4SD2 at a reported concentration of 0.912 µg/g.

The maximum observed beryllium concentration in sediment was detected in sample P5SD1A at a concentration of 3.38 µg/g. Beryllium was also detected in sample A3SD1A at 0.319 µg/g. Both of these detections exceed the background screening value of 0.18 µg/g. Sample P5SD1A also had the only positive selenium detection at a reported concentration of 4.83 µg/g. This detection exceeds the background screening value of 0.2 µg/g and the ESAT sediment screening value of 1 µg/g. Arsenic was detected in four out of five Phase I samples at concentrations ranging from 6.27 to 36 µg/g. All detections exceed background (2.03 µg/g) and ESAT (6 µg/g) screening values. Lead was detected in five out of five samples at concentrations from 5.3 to 13 µg/g, while chromium was detected in 4 out of 5 samples at 13.4 to 16.1 µg/g. All lead and chromium detections slightly exceed their respective background screening values, but none exceeds its respective ESAT sediment screening value.

Phase II Analytical Results

Acetone was detected in 3 out of 9 samples at 0.1 to 0.6µg/g, while methyl ethyl ketone was detected in 4 out of 9 samples at concentrations ranging from 0.0069 to 0.13 µg/g. Benzene was detected in sample A4SD5B1 at a concentration of 0.0081 µg/g. These compounds were not detected in background sediment samples and there are no other sediment criteria available. Three unknown VOCs were also detected in sediment samples at concentrations ranging from 0.01 to 1.3 µg/g (Appendix D, Table D-50).

Bis(2-ethylhexyl) phthalate, a common sampling and/or laboratory contaminant, was detected in 5 out of 9 samples at concentrations ranging from 0.74 to 4.6 μg/g. There are no sediment criteria for this compound. A total of 116 unknown BNAs were detected in sediment samples from this area at concentrations ranging from 0.09 to 67 μg/g (Appendix D, Table D-50).

The pesticides ppDDD and ppDDE were each detected in 1 of 14 samples. ppDDD was detected in the sample A4SD5B1, collected from 0 to 1 foot BGS, at a concentration of 0.0231 μg/g. ppDDE was not detected in either of the two deeper samples collected from 1 to 2 feet and 2 to 3 feet BGS at this location. ppDDE was detected in sample A4SD6B1, also collected from a depth of 0 to 1 foot BGS, at a concentration of 0.0983 μg/g. Both of these pesticide detections exceed the ESAT sediment criteria of 0.002 μg/g for these pesticides. No other pesticides were detected.

HMX was reported as a confirmed analyte in Phase I sediment sample A4SD2A at a concentration of 0.912 μg/g. Phase II sediment sample A4SD4B was collected from this same location to confirm the presence of this explosive. However, due to laboratory error, this sediment sample was never analyzed. Therefore, the presence of this explosive could not be confirmed. However, no explosives were detected in the other 14 sediment samples collected during the Phase I and II investigations of AOC A4 and SA A3/P5.

Arsenic was detected in 4 out of 12 samples at concentrations ranging from 2.4 to 4.9 μg/g. These detections exceed the background value of 2.03 μg/g, but do not exceed the ESAT sediment value of 6 μg/g. Beryllium was only detected in samples A4SD6B2 (1.51 μg/g) and A4SD7B3 (6.57 μg/g). Both of these detections exceed the background value of 0.18 μg/g. Chromium was detected in 7 out of 12 samples at 6.53 to 25.4 μg/g. Six of these detections exceed the background value of 10.66 μg/g, and none exceed the ESAT sediment criteria of 26 μg/g. Lead was detected in 11 out of 12 sediment samples at concentrations of 7.1 to 68 μg/g, exceeding the background value of 4.48 μg/g. Four of these samples, A4SD6B1 (31 μg/g), A4SD7B1 (32 μg/g), P5SD3B (68 μg/g), and P5SD4B (33 μg/g), exceed the ESAT sediment criteria for lead of 31 μg/g. Barium was detected in 11 of 12 samples at concentrations of 13 to 231 μg/g. Eight of the 11 positive detections exceeded the ESAT criteria of 20 μg/g and the background value of 23.9 μg/g. Copper was detected at sample location A4SD7 at a concentration of 29.5 μg/g, exceeding the ESAT value of 16 μg/g. Nickel was detected at sample A4SD7B3 at a concentration of 59 μg/g. This detection exceeds background screening level of 5.92 μg/g, and the ESAT sediment criteria of 16 μg/g. This sample was collected from a depth of 2 to 3 feet; nickel was not detected in either of the two shallower samples collected at this location.

Selenium was detected in 9 out of 12 sediment samples at concentrations of 0.65 to 6.1 μg/g. All 9 detections exceed the background value of 0.2 μg/g, and 8 of the 9 detections exceed the ESAT sediment criteria of 1 μg/g. Selenium was considered to be a potential contaminant of concern in the wetland due to its detection in Phase I sediment sample P5SD1A at 4.83 μg/g. It was particularly notable because it was the only selenium detection among the 76 sediment samples collected during the Phase I investigation of the Annex. However, during the Phase II investigation, a different laboratory performed the metals analyses using a different method to analyze for selenium. As a result, selenium was detected in 16 out of 19 sediment samples collected at the Annex during the Phase II investigation. The 20 total detections range in concentration from 0.65 to 6.1 μg/g. Since these detections were noted site-wide, and there is no indication that site-related activities resulted in selenium contamination, the positive detections are interpreted to be representative of background concentrations and, therefore, selenium is no longer considered to be a potential contaminant of concern.

Other metals were detected at concentrations above maximum background. These metals include aluminum (11 of 12 samples at 5470 to 18,400 μg/g), calcium (12 of 12 samples at 772 to 28,500 μg/g), iron (1 of 12 samples at 12,000 μg/g), magnesium (2 of 12 samples at 2180 and 2260 μg/g), manganese (4 of 12 samples at 72.2 to 123 μg/g), and vanadium (5 of 12 samples at 17.7 to 37.5 μg/g). There are no ESAT sediment values for these metals. These are naturally occurring metals and their detection at concentrations above background is probably due to natural variation, as the maximum background sediment value was based on only two sample locations.

2.3.6 Tank Sampling Results

One liquid sample was collected from the tank that was removed from the foundation (basement) of Rice Tavern. This sample was submitted for TCL VOC, TLC BNA, PCB/Pest, OP Pest, explosives, and TAL metals analysis. Due to laboratory error, the explosives sample was never analyzed. Since this tank is believed to have been a pressurized water tank or reservoir for the Rice Tavern water system, the lack of explosives data is not likely to represent a significant data gap. No TCL VOCs, TCL BNAs, PCB/Pest, or OP Pest were positively identified in this sample. However, one unknown BNA was detected at a concentration of 6 µg/L (Appendix D, Table D-50). The metals detected in this tank sample are listed in Appendix D, Table D-9. As expected, the rust-colored liquid collected from the tank contained numerous metals with the highest concentration detected being iron (55,000,000 µg/L). Other metals detected in this sample include lead (33,000 µg/L) and zinc (660,000 µg/L). As discussed in Section 2.3.1, these two metals were found at elevated levels in the surface soil sample collected from beneath this former tank location. The presence of elevated lead levels suggests that lead piping or solder may have been used. The detection of elevated iron and zinc concentrations is not unexpected since the tank was comprised of galvanized steel.

2.4 CONTAMINANT FATE AND TRANSPORT

The major chemicals of concern for AOC A4 are metals, with lead, which was detected at elevated levels in soils at two locations, as the primary target compound. Elevated lead concentrations were also reported but not confirmed in ground water (one sample; additional samples from this same well did not confirm the elevated level), and surface water (the elevated surface water sample was an artifact of sampling technique). Several other metals, but in particular, arsenic and beryllium, were detected at elevated concentrations relative to site background in AOC A4 soils and sediments. The general chemical and physical properties of metals and mechanisms for their migration are discussed below.

2.4.1 Metals

Metals (including arsenic, which is actually a metalloid) are generally not considered to be very mobile in the environment and are likely to remain bound to site soils. However, the behavior of a particular metal is highly dependent on its form in the environment and infiltrating precipitation may leach the more soluble metal salts from soil and transport them into the ground water. Soil parameters that must be considered are clay and metal oxide content, fraction of organic matter, pH, and oxidation-reduction potential. Chemical partitioning between soil and water can be expressed by a soil-water distribution coefficient (K_d). K_ds may underestimate migration potential because site-specific migration is based on chemical adsorption and desorption reaching equilibrium. Lead, with a K_d of 900, is a relatively immobile metal while cadmium, with a K_d of 6.5, is generally more mobile in the environment. However, mobility can be enhanced by the presence of other chemicals such as naturally occurring humic materials. Since clays favor adsorption of

the metals, and clays are present in the soils and aquitards beneath the site, the metals are not expected to be very mobile.

Metals adsorbed to surface soil particles may migrate into the air as a component of windborne fugitive dust. However, at AOC A4 the release of large quantities of fugitive dust is not expected to occur because most of the area is covered by vegetation and the surrounding trees and local climate should further reduce the potential for windborne dust.

2.4.2 Summary - AOC A4

The contaminants of primary concern in AOC A4 are metals, which were detected in soils and sediments. The metals are not very mobile in the environment and are likely to remain in place. Ultimately, if no remedial action is taken, the metal concentrations will equilibrate with the surrounding soils, but equilibration may take hundreds of years under natural conditions.

2.5 BASELINE RISK ASSESSMENT SUMMARIES

A Baseline Risk Assessment (BRA) for the Annex was finalized in January 1994 (OHM, 1994). This risk assessment evaluated the current and potential future health risks to individuals who may use AOC A4. The BRA was developed based on the data collected by OHM during the Phase I SI/RI. An addendum to the human health risk assessment was prepared to evaluate data collected during the Phase II SI/RI to determine whether or not findings from this investigation modify the risk estimates reported in the January 1994 risk assessment. The addendum is included as Appendix C to this report. Results of the BRA, the addendum, and an overall evaluation of the potential for health risks at AOC A4 are summarized below.

2.5.1 Previous Human Health Risk Assessment Results

The contaminants identified during the Phase I SI/RI in AOC A4 included:

- Soil samples contained metals, organochlorine pesticides, a VOC, two PAHs, and a phthalate ester
- Ground water contained trace levels of solvents, pesticides, and insect repellant
- Dacthal was detected in a surface water sample from AOC A4
- Sediment samples contained solvents and metals.

Risks were estimated in the January 1994 BRA for Area A4 under both current use and future use scenarios. Based on USEPA guidance, lead was evaluated separately. The results of the assessment for the different scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.02	0.05

Soil Ingestion (cont.)

	Average	Maximum
Cancer Risk	1×10^{-8}	2×10^{-8}

(These estimates excluded risks associated with metals considered to be present only at background levels, specifically arsenic and beryllium)

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.1	0.3
Cancer Risk	1×10^{-7}	3×10^{-7}

(excluding background metals)

Sediment Ingestion

	Average	Maximum
Hazard Index	0.07	0.1
Cancer Risk	1×10^{-5}	3×10^{-5}

Ground Water Use

	Average	Maximum
Hazard Index	0.1	0.5
Cancer Risk	2×10^{-5}	6×10^{-5}

AOC A4 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and contacting soil and using water from a private well on the site is:

Total Systemic and Cancer Risk Residential Use Scenario

	Average	Maximum
HI	0.2	0.8
Cancer Risk	2×10^{-5}	6×10^{-5}

Lead

For exposure to lead, risks were evaluated using USEPA's Uptake/Biokinetic (UBK) Model, Version 0.5. Concentrations in AOC A4 environmental media were used as input values in the model and the estimated blood lead levels from the model were compared with blood lead levels considered to be of concern for children (10 µg/dl). Lead levels reported for AOC A4 were:

Soils: average conc. = 20 mg/kg; max conc. = 53 mg/kg
(570 mg/kg was detected in subsurface soils)
Sediment: average conc. = 11 mg/kg; max conc. = 15 mg/kg

Ground Water: average conc. = 23 µg/L; max conc. = 190 µg/L
(Average without the single high value is 2 µg/L)

Based on the UBK model, continuous consumption of water containing the maximum lead level detected (190 µg/liter) would raise blood lead levels in children to above the target level (10 µg/dl) in approximately 2 years. Excluding this single value, lead levels in AOC A4 do not produce blood lead levels above the USEPA target blood lead level.

Discussion

Actual risks are likely to be substantially lower than indicated by this estimate. Arsenic, quite possibly at background levels, was the largest contributor to risks for AOC A4. Arsenic was present at background levels in soils and was only detected once in AOC A4 ground water at a concentration (3 µg/L) that is well below the MCL (50 µg/L). Background arsenic levels in ground water were not determined specifically for this site, but the level detected at AOC A4 is similar to levels reported as background in Ft. Devens ground water. Lead was elevated in the October 1992 sampling round (190 µg/L) but was not detected (CRL = 1.5 µg/L) in the June sampling of this same well. Further sampling to evaluate the presence of lead in this well was determined to be necessary before any final conclusion could be reached.

2.5.2 Phase II Findings

Results of the Phase II SI/RI conducted by OHM in late 1993 are described in detail in Section 2.3. Chemicals detected at concentrations that were significantly elevated, or that were of interest because of their relationship to results of the Phase I sampling, include lead (surface soil and ground water), DEHP (ground water), arsenic (test pits), and beryllium (test pits and sediments).

Lead was detected in a surface soil sample at a concentration of 520 mg/kg (890 mg/kg in the associated duplicate), a level in the same range as the previous maximum for AOC A4 of 570 mg/kg. The Phase II sampling confirmed that lead is present as a hotspot in AOC A4 but is not widespread in site soils. Lead was not detected in a filtered ground water sample from the well which had previously yielded conflicting results (190 µg/liter in November 1992; less than 1.5 µg/liter in June 1993). Low levels of lead (5.2 µg/liter) were detected in an unfiltered sample from this well further confirming that the single high hit was anomalous and probably associated with lead in suspended particulate matter.

DEHP was not detected in ground water during the Phase II SI/RI. This chemical is a common laboratory and field blank contaminant and its presence in 1 of 7 previous ground water samples may be a result of laboratory contamination rather than an indication of its presence on site.

Arsenic was detected in a subsurface soil sample and in a sediment sample from the Phase I SI/RI at levels that were elevated compared with site-specific background, but that were considered to be a possible indication of variability in the geology of the area. High, naturally-occurring arsenic levels in northeastern Massachusetts and the Annex may be derived from rocks with high arsenic content. A single elevated arsenic concentration (40 mg/kg) was reported in the Phase II sampling, a finding that is consistent with the Phase I sampling results, and may be indicative of naturally elevated arsenic levels in this area. Surrounding areas were also used for agriculture prior to ownership by the military and arsenic was a common constituent of pre-World War II pesticides.

Beryllium was detected in 6 of 12 test pit samples, with all detected concentrations ranging from 0.4 mg/kg to 0.64 mg/kg. These levels are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.4 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values are probably indicative of background beryllium concentrations. Beryllium was also detected in 2 of 9 sediment samples at 6.6 and 1.5 mg/kg. These values are higher than other beryllium results for AOC A4 and for the Annex as a whole.

2.5.3 Human Health Risk Characterization

In AOC A4, lead levels were elevated in an October 1992 ground water sample but not in the June 1992 sample from the same well. The Phase II sampling confirmed that the high value was anomalous and that lead is not a concern in ground water in AOC A4. A single high lead concentration in soils (570 mg/kg) was reported close to this well in the Phase I SI/RI and another hotspot, associated with the water tank in the basement of the Vose Farm, was reported in the Phase II sampling. However, elevated lead levels do not appear to be widespread in this SA.

DEHP was not detected in Phase II sampling, suggesting that the previous single detected concentration was not site related. Arsenic continues to be detected infrequently at levels above site-specific background. It is suspected that these occasional hits are indicative of naturally elevated arsenic, but it is not possible to make a definitive determination of the source based on available information.

Beryllium was detected in test pit soils and in sediments at levels somewhat higher than previously reported for the area. Risks posed by beryllium under the residential scenario in the BRA were 2×10^{-6} at a maximum concentration of 0.35 mg/kg. Assuming that contact with test pit soils was possible, risks posed by beryllium (maximum concentration of 0.64 mg/kg) would be up to twice as high as listed in the BRA, or 4×10^{-6}, above the target risk level of 10^{-6}, but well within the target risk range for remediation of 10^{-4} to 10^{-6}. As noted previously, these beryllium concentrations appear to be indicative of background levels for the area.

Beryllium was detected in two sediment samples at levels substantially higher than levels reported elsewhere on the site. Risk associated with the maximum concentration detected (6.6 mg/kg) under the exposure scenario for residential contact with sediments would be 1×10^{-5}.

As noted in the BRA, the primary purpose of the investigations in this area was to locate drums that had allegedly been buried in the area. No evidence of such disposal was found and overall, this area appears unlikely to pose significant health risks. It should also be noted that the residential use scenario may well be inappropriate for this area, given its potential historical significance.

2.5.4 Ecological Risk Assessment

A basewide ecological risk assessment (ERA) was finalized in January 1994. A supplemental ERA was prepared to evaluate data collected during the Phase II SI/RI at the Annex. This supplemental ERA complements the basewide assessment by focusing more closely on the three RI areas, AOCs A4, A7, and A9. The supplemental ERA is included in Appendix C to this report. Results of the assessment specific to AOC A4 are summarized below.

At AOC A4, lead, the chemical of primary concern, was present in soil at two hotspots and in surface water samples collected from the wetlands located west of the area. Contact with the two surface soil

hotspots is unlikely to occur with sufficient frequency or duration to pose a risk to organisms using the site. The elevated lead levels reported for the surface water samples are considered to be an anomaly caused by sampling technique and are not considered indicative of a potential risk in the area. Arsenic was also detected at an elevated concentration in a sediment sample at AOC A4. This elevated arsenic concentration may be associated with pre-military pesticide use in the apple orchard that formerly existed north of (upgradient from) the wetland area. Because spraying of these orchards probably stopped over 50 years ago, the residual arsenic at the site is likely to be less available than when first applied. Considering this fact, and the infrequent detection of arsenic which suggests that contact with elevated arsenic levels will be unlikely, arsenic is considered unlikely to pose a substantial risk to organisms in the wetlands portion of Area A4. No other chemicals were detected at the site at levels that were considered to pose a threat to wildlife in the area. The primary effects of man on AOC A4 appears to be the development of fields (which are becoming overgrown but currently provide habitat for species that frequent edges), and the development of the marsh located to the west of AOC A4, which provides habitat for wetlands organisms.

2.6 SUMMARY AND CONCLUSIONS

Prior to the federal government's acquisition of this site in the early 1940s, AOC A4 had been used for agricultural purposes and was the site of an old tavern. Between 1940 and the mid-1980s the site was reportedly used as a gravel pit, chemical burial area, dumping area, and training area. A surface dump in a depression containing metallic and other solid debris is located at the southwest end. A building foundation is present at the northeast end of AOC A4 which has been identified as the site of the Rice Tavern or Vose Farm and may be an area of potential historical significance (PAL, 1985).

This section provides a brief summary of the nature and extent of contamination detected during Phase I and Phase II investigations of AOC A4. Conclusions regarding the significance of the compounds detected and recommended future actions are also provided.

2.6.1 Contamination Assessment

2.6.1.1 Soils

During the Phase I and Phase II sampling, 8 surface soil and 23 subsurface soil samples were collected. In general, these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Some samples were also tested for OP Pest, and TPH.

VOCs were only detected in the Phase I samples at low levels (parts per billion) and the compounds detected were either common laboratory contaminants (acetone and methylene chloride) or naturally occurring terpenes (alpha-pinene). Acetone and methylene chloride concentrations did not exceed MCP S-1/GW-1 soil standards.

Chrysene was detected at a concentration of 0.91 µg/g, which slightly exceeds the MCP S-1/GW-1 soil standard of 0.7 µg/g, in the surface soil sample collected from beneath the galvanized tank, after the tank had been removed from the basement of Rice Tavern (A4SO5). However, this concentration does not exceed the ESAT soil value of 5 µg/g. Due to the low frequency of detection (1 of 24 samples) and the concentration being below ESAT criteria, this compound is not considered to be a potential contaminant of concern. All other BNAs were detected at concentrations below screening levels.

Pesticides were detected at residual levels and all concentrations were below MCP S-1/GW-1 soil standards and ESAT soil criteria. PCBs were not detected in any of the samples analyzed.

TPHs were detected at two test pit locations, A4TPF and A4TPG, at a maximum concentration of 35 µg/g. The concentrations detected do not exceed the MCP S-1/GW-1 soil standard of 500 µg/g.

There were no confirmed detections of explosives in these samples. 2-Nitrotoluene, RDX, and HMX were reported as unconfirmed analytes and should be considered as undetected.

Elevated lead concentrations were detected at two isolated locations. Lead was detected in Phase I test pit A4TPC at a concentration of 570 µg/g. Scrap metal, possibly from an old car, a wrought iron post, and a glass bottle were found at this test pit location. The other elevated lead concentration was detected in the surface soil sample (A4SO5) collected from beneath the galvanized tank (520 µg/g in the field sample and 890 µg/g in the associated field duplicate). These lead concentrations exceed both the MCP S-1/GW-1 soil standard and the ESAT criteria. Lead was not detected at elevated levels in any of the other soil samples which indicates that while lead is present at hotspots in AOC A4, it is not widespread in site soils.

Zinc was also detected in the duplicate sample collected from beneath the galvanized tank at a concentration of 2,550 µg/g which slightly exceeds the MCP S-1/GW-1 soil standard (2,500 µg/g) and exceeds the ESAT value of 1,200 µg/g. The concentration detected in the field sample, 2,420 µg/g, does not exceed the MCP S-1/GW-1 standard. The presence of elevated zinc levels at this sample location is not unexpected since the tank was constructed of galvanized steel. All other metals were detected at concentrations below screening criteria or at concentrations representative of background levels.

2.6.1.2 Ground Water

A total of 17 ground water samples were collected from 6 monitoring well locations in AOC A4. Ten of these samples were collected during the Phase I SI/RI from five monitoring well locations. The remaining seven samples were collected in Phase II SI/RI from three monitoring wells. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Three of the samples collected during the Phase II SI/RI were also analyzed for OP Pest. The Phase II samples were collected to confirm the presence or absence of compounds detected in the Phase I SI/RI at monitoring well locations DM4, OHM-A4-4, OHM-A4-5, and to sample the newly installed well OHM-A4-50.

VOCs were not detected in any of the ground water samples at concentrations above screening criteria. Toluene was detected in 1 of 2 samples collected during the Phase I SI/RI from monitoring wells OHM-A4-4 and OHM-A4-5 at concentrations well below the MCL of 1,000 µg/L (maximum concentration detected was 3.2 µg/L). Both wells were re-sampled as part of the Phase II SI/RI to confirm the presence of toluene. Toluene was not detected in samples from either well which confirms that toluene is not a contaminant of concern (COC) in AOC A4 ground water.

DEHP, a common field sampling and laboratory contaminant associated with plastic materials, was detected in one of the two Phase I samples collected from DM4. Since the concentration detected in this sample, 7.8 µg/L, slightly exceeded the MCL of 6 µg/L, and higher DEHP levels had been detected during the Dames & Moore investigation, an additional sample was collected from this well during the Phase II SI/RI. DEHP was not detected in this sample. Therefore, the single detection of DEHP is probably the result of contamination during sampling and analysis rather than an indication of its presence in AOC A4 ground

water. It is, therefore, not considered to be a COC. No other BNAs were detected at concentrations above screening criteria.

PCBs were not detected in any ground water sample. Low levels of pesticides were detected at OHM-A4-4 and OHM-A4-5 at concentrations below MCLs.

There were no confirmed detections of explosives. 1,3,5-Trinitrobenzene was reported as an unconfirmed analyte in one of the two samples analyzed from DM4 and should be considered as undetected.

Lead was detected in the October 1992 Phase I sample collected from OHM-A4-5 at a concentration of 190 µg/L. Lead had not been detected in the previous sample collected from this well in June 1992. Therefore, two samples, one filtered and the other unfiltered, were collected from this well during the Phase II SI/RI. Lead was not detected in the filtered sample and the concentration detected in the unfiltered sample, 5.2 µg/L, is well below the MCL of 15 µg/L. The Phase II sampling results confirm that lead levels are not elevated in AOC A4 ground water. Aluminum, iron, and manganese were detected in several wells at concentrations above SMCLs which are based on aesthetics. No other metals were detected at concentrations above screening criteria. Mercury was detected in the October 1992 Phase I sample collected from OHM-A4-4 at a concentration of 0.881 µg/L, below its MCL of 2 µg/L. The presence of mercury was not confirmed during a subsequent sampling event in December 1993.

Monitoring well OHM-A4-50 was installed during the Phase II SI/RI to assess ground water quality immediately downgradient of the surface dump located in a depression at the southwest end of AOC A4. Manganese was detected at a concentration above the SMCL. No other compounds were detected at concentrations above screening levels in the sample collected from this well.

2.6.1.3 Surface Water

Seven surface water samples were collected from AOC A4 during the Phase I and Phase II SI/RI. The surface water/sediment samples collected during the SA A3/P5 SI were taken from the same wetland as most of the A4 samples. Therefore, data from the five surface water samples collected from SA A3/P5 were evaluated with the AOC A4 data to more completely assess environmental conditions in this wetland. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, herbicides, and TAL metals. The samples collected from AOC A4 during the Phase II SI/RI were also analyzed for OP Pest but none were detected.

There were no VOCs or BNAs positively identified in these surface water samples. The pesticide endrin aldehyde was detected at one sample location, A4SW6, at a concentration (0.16 µg/L) below the human health AWQC (0.81 µg/L). ppDDT was detected at a concentration of 0.03 µg/L at A4SW5 which exceeds both the chronic aquatic and human health AWQC. Pesticides were not detected in any of the other surface water samples analyzed.

The herbicide dacthal was detected at A4SW3 at a concentration of 0.44 µg/L. The are no surface water screening criteria for this compound. Herbicides were not detected in the other two samples analyzed.

There were no confirmed detections of explosives. 3-Nitrotoluene was reported as an unconfirmed analyte in all four samples collected in April 1992 from AOC A4 and SA A3/P5 and should be considered

as undetected. This unidentifiable compound, with some properties consistent with those of 3-nitrotoluene, was also found at a comparable concentration in the method blank associated with these field samples.

Metal concentrations exceeded screening criteria at several sample locations. However, many of these elevated metal concentrations may be due to suspended sediment present due to the manner in which they were collected. There was not enough surface water in this wetland area when the Phase II samples were collected. Therefore, all Phase II samples were collected by digging into the sediment until water was encountered. Consequently, these samples contained more suspended sediment than would be expected in a typical surface water sample. Lead was detected at concentrations above maximum background (18 to 140 µg/L) in 5 of 6 Phase II samples. Although lead levels also exceed chronic AWQC in the five samples collected during the Phase I SI/RI, all concentrations detected were below maximum background levels. Aluminum (9 of 11 samples), chromium (1 of 11 samples), and copper (1 of 11 samples) concentrations also exceeded ESAT criteria and/or chronic AWCQ. The maximum lead, aluminum, chromium, and copper concentrations were detected at sample location A4SW5. In general, this sample location contained the greatest number and highest concentrations of metals. This suggests that this "surface water" sample may have contained more suspended sediment than the other samples. Metal concentrations detected at this sample location were compared with the sediment data. Based on this comparison, metal concentrations detected in this surface water sample (including lead) are consistent with the sediment concentrations at this location, assuming 1 percent suspended particulate matter.

Elevated zinc levels in these surface water samples were due to laboratory contamination, as the method blank and all seven rinsate blanks analyzed with the same analytical lot as these surface water samples contained similar zinc concentrations. Although arsenic levels are below the chronic AWQC (190 µg/L), all concentrations detected exceed the human health AWQC (0.14 µg/L). Arsenic concentrations in these samples ranged from 5 to 27 µg/L.

2.6.1.4 Sediment

Sediment samples were collected from 11 locations during the Phase I and Phase II investigations of AOC A4 and SA A3/P5 (Figure 2-6). Stratified sediment samples were collected at sample locations A4SD5, A4SD6, and A4SD7. All surface water/sediment data from AOC A4 and SA A3/P5 were evaluated to more completely assess environmental conditions in the wetland areas. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, herbicides, and TAL metals. Phase II samples collected from AOC A4 were also analyzed for OP Pest but none were detected.

The VOCs and BNAs detected in these sediment samples are all common laboratory contaminants. Acetone, methylene chloride, benzene, and methyl ethyl ketone were detected at low concentrations ranging from 0.007 to 0.6 µg/g. Di-n-butyl phthalate (Phase I samples only) and DEHP (Phase II samples only) were the only BNAs detected. There are no screening values for these organic compounds.

ppDDD (A4SD5, 0.0231 μg/g) and ppDDE (A4SD6, 0.098 μg/g) were detected once each above the ESAT sediment value of 0.002 μg/g. Both pesticides were detected in the samples collected from 0 to 1 foot.

HMX was reported as a confirmed analyte (0.912 μg/g) in Phase I sample A4SD2A. Sediment sample A4SD4B was collected from this location during the Phase II SI/RI to confirm the presence of this explosive. However, due to laboratory error, this sediment sample was never analyzed. The Phase II surface water sample from this location was analyzed for explosives and none were detected. Since explosives were not

detected in any of the other sediment samples collected from this wetland area, it appears as though the presence of HMX is not widespread.

Many metals, including arsenic, beryllium, barium, copper, lead, nickel, and selenium, were detected at concentrations above background sediment levels or ESAT criteria (see discussion in Section 2.3.5.2 of this report). However, several factors suggest that these exceedences are not a cause for concern. Metal concentrations in samples from the Assabet River show the same pattern of frequent exceedences of screening criteria and, in general, the river concentrations are slightly higher than the AOC A4 and SA A3/P5 levels. Also, the background sediment samples were collected from natural streams which are likely to have high organic matter and low mineral levels. The wetland between AOC A4 and SA A3/P5 was previously a lowland terrestrial environment and therefore, background soil concentrations may be more appropriate for comparison. A comparison of background soil concentrations with sediment concentrations in this marsh area shows substantially fewer exceedences. The vertical distribution of contaminants in the stratified sediment samples suggest that runoff from AOC A4 is not the source. If runoff from AOC A4 was transporting contaminants resulting from recent site activities, it would be expected that the contaminant concentrations would decrease with depth. However, this is not the case. Further discussion of this subject can be found in the Supplemental Ecological Risk Assessment, Appendix C, Chapter 3.

2.6.2 Site Summary

A foundation at the northeast end of AOC A4 was identified as Rice Tavern or Vose Farm and is of potential historical significance. At the opposite end of the site is a surface dump within a depression in which metallic and other solid debris was disposed of. Surface and subsurface soil sampling data indicate that organic chemicals have not been dumped in this area. Lead was present at two hotspots in site soils. Ground water at the site contains levels of aluminum, iron, and manganese at concentrations above MCLs. Additional ground water sampling indicates that lead levels are not elevated in AOC A4 ground water. The elevated metal concentrations detected in the Phase II surface water samples are probably the result of suspended sediment present as a result of the manner in which the samples were collected.

2.6.3 Conclusions

The primary purpose of the investigation in AOC A4 was to locate drums that had allegedly been buried at this site. After geophysical and subsurface investigations, no evidence of such disposal was found during either Phase I or II field activities. Although no drums have been found, metallic and other solid debris have been disposed of at this site, primarily in a depression at the southwest end of the site.

In general, sporadic detections of compounds above screening levels show no widespread contamination. Disposal of solid debris does not seem to have resulted in contaminated soil. Although lead has been detected in soil at two isolated locations at concentrations above screening levels, the UBK model shows that lead levels at the site will not pose a risk to children under a residential scenario. Phase II filtered and unfiltered ground water sample results confirm that lead is not a contaminant in ground water. Previous detections of phthalates in ground water are likely to be laboratory-related since phthalates were not present in the Phase II samples. Ground water contains aluminum, iron, and manganese at concentrations above SMCLs which are standards based on aesthetics.

Although concentrations of some compounds in surface water exceeded AWQC, the site does not seem to have contributed to the exceedences. The analytical data indicate that the elevated metal concentrations

are related more to how the sample was collected, rather than where the sample was collected, since the Phase II samples from AOC A4 and SA A3/P5 generally contained the greatest number and highest concentrations, presumably as a result of suspended solids in the samples. Additional surface water/sediment sampling could be performed to verify that elevated levels of metals in surface water were the result of suspended solids.

Using both Phase I and Phase II SI/RI data under several exposure pathways, the BRA shows that the site does not pose a risk, and that no action under CERCLA is required. However, the site may require solid waste closure under Massachusetts state regulations since there is solid debris at the site.

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3.0 REMEDIAL INVESTIGATION OF AOC A7

AOC A7, Old Gravel Pit Landfill, is located along the northern boundary of the installation overlooking the Assabet River (Figure 1-1). Now inactive, this area was apparently used between 1941 and the mid-1980s for the disposal of solid waste, drums, chemicals, containers, and demolition debris. In addition, easy access to the site led to its use as a dumping ground by the public.

3.1 AREA CHARACTERISTICS AND BACKGROUND INFORMATION

Access to AOC A7 is obtained by traveling north on a dirt trail originating at Patrol Road (Figure 3-1). The trail is slightly overgrown and is approximately 200 feet in length. Demolition debris, scrap metal, spent shotgun shells, clay targets, and other solid waste is scattered across much of the area. The central portions of the site are cleared of vegetation, while the peripheral areas are heavily vegetated. The steep northward-dipping slope on the northern boundary of the area is heavily vegetated and debris is visible on, and protruding from, the slope. Prior to enclosing the area with a security fence in October 1991, unauthorized persons used the area for recreational activities such as shooting, hunting, and dirt biking.

A surface dump with discarded furniture and debris is located at the east end of AOC A7 in a wooded area approximately 100 feet north of Patrol Road. This area, which has previously been referred to as SA P8, was reported as a possible transformer disposal site. SA P8 is now considered to be a part of AOC A7, not as a separate SA, and has been included in the AOC A7 investigation.

3.1.1 Area-Specific Background Information

The area-specific background information is organized into several sections. These include sections on past site usage, previous environmental investigations and physical results, the nature and extent of contamination as determined from prior work, and historical remedial actions. Information regarding past land usage, environmental investigations, remedial actions, and physical and chemical results have been obtained from aerial photographs, maps, reports, correspondence, memorandums, records reviews, and interviews. Each section is arranged in chronological order.

3.1.1.1 Historical Aerial Photographs and Site Maps

Seven sets of aerial photographs, taken between 1939 and 1992 (Table 2-2),and one set of low oblique, color infrared photographs taken in 1981 (USEPA, 1982) have been examined. These photographs were used in conjunction with three maps prepared by OHM (1992a: Figures 3-2, 3-3, and 3-4) that summarize Ft. Devens site maps for the period 1942 to 1979. This was done in order to assess past site usage, physical changes, and developments that have occurred in AOC A7. No attempt was made to locate or obtain other aerial photographs. The following discussion presents the results of this preliminary examination.

1939

AOC A7 was a cleared field on a wooded slope above the Assabet River. The cleared area was roughly triangular in shape, narrow in the west and widens to the east. A stone wall bordered the site on the east, while cleared and lightly wooded fields extended to AOC A9 on the east and past SA P26 on the

south. The south side of the area was also bordered by a stone wall and wooded sloped rise up to the southwest. Wooded slopes bordered the site to the west and north.

1943

AOC A7 appeared to be a recently opened and active borrow pit in these photographs (Figure 3-2). The shape of the pit was nearly identical to the shape of the cleared field noted in 1939. The borrow area appeared flat and featureless, however, the southern side had several new excavation pits. The area access road was located at the far eastern end, approximately at what is now the center of the current site. A wide swath had been cleared between the borrow pit and Patrol Road apparently in preparation for installing a security fence.

1952

These photographs show that the AOC A7 borrow pit had been extended to the east, while continued excavation had deepened the central portion. The area entrance was located in its present position (Figure 3-3). A steep cut face was evident at the northern end of the former access way, and numerous ground scars indicated continued activity in the center. It is apparent that a large volume of material has been removed from this area and that the current topographic configuration was created during this process. The northern and western portions of the pit appear to have been partially revegetated, probably with grasses and low shrubs.

1963

In the western and central areas, new excavations have been dug to the north (Figure 3-4). The eastern side of the area had been expanded towards the southeast and abuts Patrol Road where a second access way was present. Ground stains located in the north central area and in the south central area just east of the access road appear to have been caused by fires. The slope to the south, rising upward to Patrol Road, was cleared of all trees across the entire width of the area.

1978

The general configuration of AOC A7 was essentially unchanged from 1963. A small, square-shaped clearing was present to the south in the far western portion of the area, and it appears that some revegetation at the edges of the excavation had occurred. The photo scale (1:41,326) and the lack of a stereo pair prevent any other details from being seen.

1981

A low oblique, color infrared photo of AOC A7 was taken on May 13, 1981, and was presented as Photo C by the USEPA (1982). This area was designated Natick Laboratory Sudbury Annex Site 2, the Dump, and was described as having debris visible in the southwestern and eastern portions of the site. The ground was scarred and darkened, and dead vegetation was visible near the center of the site.

Photo C also shows mounds northwest of the site entrance, and piles of debris immediately to the east of the site entrance and in the center of the site. Debris was also present to the west in SA P8. Numerous ground scars were present in the far western end and north central portions of the site.

1986

The general site configuration had remained unchanged since 1963, and the debris present in the 1981 photograph was still evident. Additional debris had been deposited east of the entrance road and in the far eastern portion of the site. Much of the slope south of the site had been revegetated and vegetation was becoming re-established within the site. Vehicle tracks, and what appeared to be fresh ground scars, suggest that the site was still being used as a dumping ground and unauthorized recreation area.

1992

The sixth set of aerial photographs was taken in March 1992, by Bionetics under contract to the USEPA's EPIC group. These photographs, along with numerous ground control targets and control points used to establish horizontal and vertical control, and supplemental higher-altitude aerial photographs, were used to produce an updated topographic site map of the Annex.

Much of the debris located east of the access road has been relocated to a staging area in the center of the site. This was performed by OHM in preparation for a geophysical survey. The eastern and western areas show that significant revegetation has occurred between 1986 and 1992, and the slope to the south is more heavily vegetated.

3.1.1.2 Previous Investigations and Results

1980 - USATHAMA

Environmental investigations were initiated at the Annex in 1980 under the IRP in order to address the environmental impact from past land usage. USATHAMA conducted a preliminary site assessment consisting of a detailed records search (USATHAMA, 1980). USATHAMA identified 22 known or suspected locations of waste materials in their preliminary site assessment, one of which was designated Location 12, the Old Gravel Pit (1941)/Laboratory Dump/General Refuse (1970s). The location was also described as a burning area. The area was reported to have been used as a dumping and burial ground for tentage, cloth, chemicals, trash, general construction debris, and old metal. The chemical disposal was reported to have occurred between the late 1950s to 1971. No data were available concerning the nature or volume of the chemicals disposed of at the site.

1982 - USEPA

The USEPA's EPIC group, under an interagency agreement (IAG) between the USEPA and the U.S. Army, subcontracted Bionetics to aerially photograph portions of the Annex, and to analyze the photos to identify possible AOCs. The USEPA (1982) analyzed color and color-infrared photographs of the Annex taken in May 1981. Twenty-seven anomalous areas, including AOC A7, were identified in this study. Area-specific results are discussed in Section 3.1.1.1 above.

1983 - AEHA

The AEHA conducted a Hydrogeological and Subsurface Investigation for the AOCs identified by USATHAMA (1980). The purpose of this investigation included evaluating the hydrogeologic setting and ground water quality.

Shallow monitoring well EHA2 was installed to evaluate the ground water quality in AOC A7. This monitoring well is located in the north central portion of the area, a position assumed to be downgradient from suspected waste burial sites. The boring was completed at refusal at a reported depth of 25 feet BGS. The boring log indicates that the soils consisted primarily of sand with a trace of silt and a few cobbles. Ground water recharge was insufficient to perform continuous pumping during well development, so the well was pumped dry, allowed to recharge, and then pumped again until the water was clear.

The reported total depth of EHA2 is questionable based on observations by Dames & Moore (1986). The original reported depth to the base of the cased well was 23.5 feet BGS, but Dames & Moore measured it to be 19.5 feet BGS. Dames & Moore stated in their report that all AEHA wells were installed without proper supervision or quality control and that, therefore, all records concerning well construction are suspect.

1984 - Dames & Moore

As part of an RI initiated by Dames & Moore in 1984, monitoring well DM12 was installed near the east end of the area, upgradient of SA P8. The boring was completed at 14.5 feet BGS and encountered fine-to-medium sand with minor amounts of silt, gravel, and cobbles. The well was developed by hand bailing.

Ground water was measured at an elevation of 195.15 MSL at DM12 during August 1984. Monitoring well EHA2 was dry. Dames & Moore assumed the local ground water flow direction to be toward the Assabet River and the unnamed stream on the eastern edge of the area based on the area topography. In order to assess whether contaminants were migrating into the unnamed stream to the east, one surface water/sediment sample (SW8/SD8) was collected.

EHA2 and DM12 were vandalized following the Dames & Moore investigation. The lock on EHA2 was broken and the protective cap was removed. The lock on DM12 was broken off and the well casing was filled with sections of rock cores.

3.1.1.3 Nature and Extent of Contamination Determined from Previous Investigations

Prior information for this area was obtained from the two monitoring wells and the surface water/sediment samples described above. The wells are located approximately 300 feet apart from one another.

1983 - AEHA

Monitoring well EHA2 was sampled in 1983 by the AEHA. This sample was analyzed for drinking water parameters. The only positive detections were 0.29 mg/L of fluoride and 2 μg/L of nitrite/nitrate (NO_2+NO_3 as N). This well was dry during the Dames & Moore investigation and was not resampled.

1984 - Dames & Moore

A ground water sample collected from monitoring well DM12 during the Dames & Moore RI contained relatively high concentrations of plasticizers, specifically 1,000 μg/L of dioctyl adipate, 500 μg/L of DEHP, and 60 μg/L of unidentified phthalates. These are common contaminants resulting from the use

of plastic in the sampling and analysis process, but the concentrations are high enough to suggest that they could indicate actual ground water contamination. The only VOCs found were a total of 200 μg/L of unidentified compounds. Manganese was found at 60 μg/L and the zinc level was elevated at 354 μg/L. The only other positive detections were copper at 2 μg/L and hexavalent chromium at 10 μg/L. These results indicate that significant ground water contamination is not present in this specific area. However, DM12 is located approximately 50 feet hydraulically upgradient of SA P8 and cross gradient from the main dump area in AOC A7. No information was collected from downgradient locations during this investigation.

One surface water/sediment sample (SW8/SD8) was collected from the unnamed stream adjacent to AOC A7. The sampling location was at its distal end by the installation boundary. The only metal detected in surface water sample SW8 was iron at 300 μg/L. Total VOCs (192 μg/L) included 6 μg/L acetone, 40 μg/L methylene chloride, 10 μg/L dimethoxydimethylsilane, 30 μg/L hexamethylcyclotrisiloxane, and 106 μg/L of unknown VOCs. Siloxane isomers are indicative of chromatographic column bleed and do not signify the presence of environmental contamination. Acetone is also a common laboratory contaminant, and methylene chloride was found at similar concentrations in QC blanks. The only BNAs detected were 200 μg/L of dioctyl adipate and 20 μg/L of DEHP. These concentrations are probably the result of contamination derived from plastic materials used during the sampling and analysis process.

Sediment sample SED8 had detectable arsenic at 30 μg/g, lead at 15.5 μg/g, and zinc at 32.4 μg/g. The arsenic level is somewhat higher than expected but not necessarily above background, and the other concentrations are normal background levels. The sample contained the PAHs acenaphthylene at 0.3 μg/g, benzo[a]pyrene at 0.2 μg/g, benzo[g,h,i]perylene at 0.2 μg/g, benzo[k]fluoranthene at 0.3 μg/g, indeno[1,2,3-cd] pyrene at 0.1 μg/g, naphthalene at 0.2 μg/g, and phenanthrene at 0.2 μg/g. The PAHs are formed during the incomplete combustion of hydrocarbons and are commonly encountered along roadways and in burned forest areas. The other detectable compounds were high molecular weight alcohols at 5 μg/g, phenol at 1 μg/g, 3-(t-butyl)phenol at 7 μg/g, isophorone at 0.1 μg/g, hexadecanoic acid at 0.9 μg/g, tetradecanoic acid at 0.6 μg/g, diethyl phthalate at 0.2 μg/g, di-n-butyl phthalate at 0.1 μg/g, miscellaneous other aliphatic hydrocarbons at 10 μg/g, and unknown BNAs at 1.4 μg/g. The source of these contaminants could not be determined. Some are probably naturally occurring compounds and others, such as the phthalates, are probably laboratory artifacts.

No soil samples were collected in this area during previous studies and the extent of potential soil and ground water contamination in this area was not determined. AOC A7 was considered to warrant additional sampling and was designated as an AOC in the IAG based on information gathered during record searches and based on the general lack of data. The OHM investigation provided this additional sampling.

3.1.1.4 Past Site Usage

This section combines information presented in the previous three sections with information obtained through interviews and records searches. Some of the information gathered during this study is inconsistent with regard to dates and reported activities. The summary of past site usage presented in this report contains all available information that is consistent with reported analytical results, aerial photograph interpretation, and historical site maps.

Now inactive, this area was apparently used between 1941 and the mid-1980s for the disposal of solid waste, drums, chemicals, containers, and demolition debris. AOC A7 was used as a general solid-waste dumping and burial ground from 1941 until the mid-1980s. General refuse, such as tentage, cloth, trash, facility demolition debris, scrap metal, drums, and rock cores have been dumped on the surface and have also been buried. Burning of flammable waste was also reported as a volume reduction measure.

Laboratory chemical dumping and burial reportedly took place between the late 1950s and the mid-1970s. Reports from Natick Laboratory personnel involved in this activity indicate that quart- to gallon-sized metal and glass containers were disposed of on a weekly basis. Disposal reportedly included discharging the chemicals onto the ground followed by the breakage or burial of the containers. Test pit results showed that unbroken containers with contents intact were also buried in AOC A7.

This site has also been used as a recreational area by local residents. Dirt bike tracks, shotgun shells, bullet riddled waste, and hunters have been noted in this area. As a control measure, the area was enclosed by a 10-foot-tall chain link fence in October 1991 in an attempt to eliminate unauthorized use by the public. This measure has been only partly successful since vandals removed, and continue to remove, parts of the fence to allow access. Repeated repairs to the fence and increased security patrols have not yet entirely limited access to the site.

3.1.1.5 Previous Remedial Actions

Surface debris was collected and staged by OHM personnel during the investigative phase. This debris, and other surface debris in cleared areas, was removed by Fort Devens in 1994.

3.2 TECHNICAL APPROACH AND FIELD WORK PERFORMED

Figure 3-1 is a map of AOC A7 showing the locations of all investigative work performed and samples collected. All media types and analytical parameters of samples collected during the Phase II SI/RI of AOC A7 are presented in Table 3-1.

3.2.1 Geophysical Study

A supplementary Phase II geophysical study was conducted in AOC A7 in preparation for additional subsurface investigation. The objectives, field procedures, and results of this study are detailed below.

During previous site investigations conducted in 1991 and 1992, a geophysical study conducted at AOC A7 identified several large areas which contained subsurface debris. Test pits were excavated and soil samples obtained and analyzed as described in the Final Site/Remedial Investigation Report (OHM, 1994). One test pit, A7TPK, uncovered laboratory glassware and liquid-filled glass bottles. The lateral limits of the laboratory wastes were not investigated and estimated quantities were not calculated, during the Phase I SI/RI. Since these estimates were required for the Feasibility Study (FS), OHM was tasked with obtaining this information.

In conjunction with the U.S. Army, USEPA, MADEP, and USAEC, it was decided to excavate two test trenches perpendicular to each other. The location of these test trenches was determined after revisiting the area and conducting a reconnaissance magnetic study. On October 28, 1993, the geophysics crew conducted the study in the vicinity of test pit A7TPK to determine the location and length of each of

the two proposed test trenches. A scanning magnetometer was used to identify the approximate limits of the buried metal in this area. Since the magnetometer is unable to detect nonmagnetic objects such as glass, the ends of the proposed test trenches were located 5 to 10 feet beyond the limits of the buried metal.

The location and alignment of the two test trenches are shown on Figure 3-1. These test trenches (A7TTA and A7TTB) are oriented perpendicular to each other, with their intersection at test pit A7TPK. The test pit excavation procedures and results are discussed in Section 3.2.3.

3.2.2 Surface Soil Sampling

One surface soil sample, designated A7SO13B, was collected during the Phase II SI/RI of AOC A7. This surface soil sampling location is shown on Figure 3-1.

3.2.2.1 Rationale and Locations

Several PAHs were detected in a surface soil sample collected during the Phase I SI/RI from a location (A7SO6) which appeared to be stained with motor oil. Surface soil sample A7SO13 was collected from this same sample location to evaluate the potential toxicity of leachate emanating from soil in the area.

3.2.2.2 Physical Results

Soil collected from A7SO13 was described as a fine-to-coarse sand, and no evidence of motor oil staining was observed. The sample was submitted for TCLP extraction and analysis for semivolatile organic compounds. No PID readings above background were detected.

3.2.3 Test Pits and Trenches

Four test pits, designated A7TPQ through A7TPT, and two exploratory trenches (A7TTA and A7TTB) were excavated in November 1993. Test pit locations are shown on Figure 3-1. Soil classification logs are included in Appendix B.

3.2.3.1 Rationale and Locations

Test pit A7TPQ was excavated near soil boring A7B8 to determine the vertical extent of elevated levels of ppDDT and ppDDD previously detected in the boring soil sample. A7TPR was excavated near the location of drum confirmatory sample A7CD1 to determine the nature and extent of soil contamination associated with the drums at this location.

Two test pits were excavated within the area formerly referred to as SA P8. Test pit A7TPS was completed near the location of soil boring A7B11 to assess the extent of the elevated levels of ppDDT, ppDDE, chlordane, mercury, cadmium, and zinc detected in the soil sample from the boring. Test pit A7TPT was excavated between soil borings A7B1 and A7B11 to determine the distribution of pesticides and the presence or absence of PCBs in SA P8.

Two narrow trenches (A7TTA and A7TTB) were completed to determine the lateral extent of the buried laboratory debris encountered in soil boring A7B4 and test pit A7TPK. The locations of these two

trenches were based on the Phase I SI/RI results and a geophysical screening of the area prior to excavation.

Air monitoring was performed as part of the Phase II SI/RI of AOC A7 in accordance with the procedures described in Section 3.18.2 of the Final Site/Remedial Investigation Report (OHM, 1994). Six air samples were collected during the test pit operations performed in November 1993. These samples were sent to MDS Laboratories in Reading, Pennsylvania where they were analyzed for the presence of asbestos. All sample results were less than 0.01 fibres/cc. Air monitoring results are presented in Appendix B.

3.2.3.2 Physical Results

Test pit A7TPQ was excavated to a depth of 6 feet BGS. Subsurface soil was comprised of medium-to-coarse sand and silt. Layers of coarser, more permeable material, containing small amounts of water were encountered during excavation at depths of 3.5 to 4 and 5.5 to 6 feet BGS. It appears that one of these water zones was incorrectly interpreted as the top of water in soil boring A7B8. Grab soil samples were collected from 2, 4, and 6 feet BGS for PCB/Pest and OP Pest analysis. A layer of black, sticky material was encountered at 5 to 5.5 feet BGS, and PID readings of 8 ppm were obtained at this layer. An extra soil sample, designated A7TPQ4, was collected from this layer and submitted for PCB/Pest and OP Pest analysis. No radiological readings above background levels were recorded. A soil sample was also collected from a depth of 4 to 6 feet BGS and analyzed for pesticide and semivolatile organic compounds following TCLP extraction, to evaluate the leachability of chemicals from soil in the area, and to determine if wastes would be characterized as hazardous under RCRA.

Two 55-gallon drums, one 5-gallon pail, and a blue 1-gallon pail were observed at the ground surface of test pit location A7TPR. A broken, dark brown glass bottle containing liquid was encountered at a depth of approximately 2 feet BGS during excavation of this test pit. Fumes were leaking out of the container and PID readings of 100 ppm were measured. A 5-gallon can inside a bucket was also observed at this same depth and a clear liquid material was noted dripping off the 5-gallon can. Many other empty and broken bottles were found during excavation. Excavation was terminated at 3.5 feet BGS to avoid breaking the ½-pint, 1-pint, quart-, and gallon-sized bottles with contents up to three-fourths full that were being uncovered. Grab soil samples were collected from 0 to 2 and 2 to 3.5 feet BGS for analysis of metals, PCB/Pest, OP Pest, BNAs, VOCs, herbicides, explosives, and phosphate. An additional sample, A7TPRTC, was collected from a depth of 0 to 2 feet BGS and analyzed for volatile and semivolatile organic compounds following TCLP extraction to provide information on the potential for the chemicals to leach from soils. No radiological readings above background levels were detected.

Test pit A7TPS was excavated to a depth of 6 feet BGS. Numerous glass sample jars containing rock and soil samples were encountered from the ground surface to a depth of approximately 4 feet. These jars appeared to contain geotechnical samples as many rock core fragments and wooden rock core boxes were observed in the immediate area. Grab samples were collected at 2, 4, and 6 feet BGS and submitted for PCB/Pest, OP Pest, and metals analysis. An additional soil sample was collected from a depth of 2 to 3 feet BGS and analyzed for pesticides and metals following TCLP extraction to provide information on the potential for the chemicals to leach from soils. No PID or radiological readings above background were detected.

Test pit A7TPT was completed at 6 feet BGS. Domestic trash, glass bottles, steel cable, and foam rubber padding were recovered from the ground surface to 2 feet BGS. An empty 55-gallon drum and a 5-gallon plastic pail were found at 2 to 4 feet BGS. Miscellaneous items, including steel tubing, plastic bottles, air conditioner filters, canvas strapping, and car parts were encountered from 2 to 6 feet BGS. Soil samples were collected from 2, 4, and 6 feet BGS for PCB/Pest and OP Pest analysis. No PID or radiological readings above background were detected.

Test trench A7TTA was excavated in a north to south direction between boring A7B4 and test pit A7TPK. Several 5-gallon cans, 1-gallon jugs, brown laboratory bottles, broken glass, and burned debris were encountered during excavation. The total length of A7TTA was 95 feet. A second trench, A7TTB, was completed perpendicular to A7TTA and extended west to east through sample locations A7B4 and A7TPK. Assorted metallic debris, trash, small cans, and broken glass containers were found during excavation. Discolored and stained soil horizons were also noted. A7TTB was 91 feet in length. During excavation of both trenches, the points at which laboratory-related debris was encountered were marked. Based on these observations, the area encompassed by laboratory-related debris is estimated to be approximately 940 square feet. Since these trenches were excavated solely to visually determine the lateral extent of the buried debris, no environmental samples were collected for analysis.

3.2.4 Subsurface Soil Sampling

Eight soil borings, designated A7B13 through A7B20, and two hand auger samples (A7HA3 and A7HA4) were collected during the Phase II SI/RI of AOC A7. All soil borings were completed between November 12 and 15, 1993. Although designated hand auger samples (HA), a pick axe and shovel had to be used to excavate the holes because the numerous rocks and cobbles at these two locations prevented auger penetration. After the initial holes had been excavated, a clean sample scoop was used to scrape down the sides and extend the hole an additional 0.5 feet. A second clean sample scoop was then used to collect the soil sample submitted for analysis. All sample locations are shown on Figure 3-1.

3.2.4.1 Rationale and Locations

The sample container for PCB/Pest analysis that was collected during the Phase I SI/RI from boring A7B3 broke during transport to the laboratory and could not be analyzed. Therefore, soil boring A7B13 was completed at this same location during the Phase II SI/RI and sample material was submitted for PCB/Pest and OP Pest analysis to complete the analytical information for this location.

The drum location (where test pit A7TPR was excavated) is the suspected source of contamination detected in water from monitoring well OHM-A7-46. However, to determine if there is another source of this contamination not yet identified, a soil boring (A7B14) was placed upgradient of the partially exposed drums.

Pesticide residues were detected in ground water samples collected from monitoring well OHM-A7-45 but, an upgradient source was not identified by the geophysical survey. Therefore, in an attempt to find a source of these pesticides, two soil borings (A7B15 and A7B16) were completed at the western end of AOC A7, upgradient of OHM-A7-45.

Test pit location A7TPK was identified as a hot spot during the Phase I SI/RI. Soil boring A7B17 was completed at this location and a soil sample was collected and analyzed for the full TCLP extraction

suite of chemicals to provide information on the potential for chemicals to leach from soils and to determine if the soils would be characterized as hazardous under RCRA.

Soil borings A7B18, A7B19, and A7B20 were completed near confirmatory drum sample location A7CD2 to determine the extent of pesticide contamination. A7B18 was placed upgradient and the remaining two borings were completed downgradient of this former drum location.

Two hand auger samples were collected to provide toxicity information for hot spots identified during the previous investigation. Hand auger sample A7HA3 was collected from the location of test pit A7TPE, and A7HA4 was collected from the location of drum confirmatory sample A7CD2.

3.2.4.2 Physical Results for Soil Borings

Soil boring A7B13 was advanced to a depth of 8 feet BGS. The subsurface section was composed of fine-to-coarse sand with some gravel and a trace of silt. No PID or radiological readings above background levels were recorded. A soil sample was collected from 6 to 8 feet BGS for PCB/Pest and OP Pest analysis.

Soil boring A7B14 was completed to a depth of 4 feet BGS. The subsurface section was comprised of a fine-to-medium sand with gravel and a trace of silt. Subsurface soil sample A7SB14B was collected from 2 to 4 feet BGS for PCB/Pest and OP Pest analysis. No PID or radiological readings above background levels were detected.

Soil borings A7B15 and A7B16 were completed upgradient of monitoring well OHM-A7-45 to depths of 16 and 12 feet BGS, respectively. The subsurface sections of both borings consisted of fine-to-coarse sand with some gravel and a trace of silt. Silty clay was also encountered from 10 to 12 feet BGS in boring A7B16. Soil sample A7SB15B was collected at a depth of 14 to 16 feet BGS from borehole A7B15. The sample from A7B16 (A7SB16B) was taken from 10 to 12 feet BGS. Both samples were analyzed for PCB/Pest and OP Pest. A geotechnical sample representative of the screened interval was also collected from A7B16 at 8 to 10 feet BGS for grain-size analysis. Grain-size analysis results are provided in Appendix B. No PID or radiological readings above background were detected during the drilling of either borehole.

Soil boring A7B17, completed at the location of test pit A7TPK, extended to a depth of 6 feet BGS. Glass fragments were encountered during drilling from 0 to 3 feet BGS, and black-stained soil was observed from 2 to 3 feet BGS. More black staining and a sheen in the split spoon were noted at 4 to 4.5 feet BGS. PID readings of 3.5, 40, and 14 ppm were recorded at depths of 2, 2 to 3, and 4 to 4.5 feet BGS, respectively. A soil sample (A7SB17B) was collected from 4 to 6 feet BGS for full TCLP extraction analysis. Soil from this same depth was also collected for grain-size analysis. Grain-size analysis results are provided in Appendix B. No radiological readings above background were detected.

A7B18 was placed upgradient of confirmatory drum sample location A7CD2 and two borings, A7B19 and A7B20, were placed downgradient of this former drum location. The subsurface sections of all three borings consisted of fine-to-coarse sand and gravel with some silt. Silty clay was also encountered near the bottom of borings A7B18 and A7B20. PID readings of 0.5 and 14 to 20 ppm were detected at depths of 0 to 2 and 4 to 6 feet BGS, respectively during the drilling of A7B18. PID readings of 1.0 (2 to 4 feet BGS) and 0.5 ppm (4 to 6 feet BGS) were recorded during the completion of A7B19. A PID

reading of 2.5 ppm was measured at 2 to 4 feet BGS during the installation of A7B20. Also during the excavation of A7B20, gray-stained soil was observed at a depth of 5 feet BGS and a PID reading of 120 ppm was measured. No other stained soil was observed during the drilling of the three borings. Soil samples were collected from 4 to 6 feet BGS from borings A7B18 and A7B19 and 6 to 8 feet BGS from A7B20. All three soil samples were submitted for PCB/Pest and OP Pest analysis. Geotechnical samples for grain-size analysis were also collected from each of these borings. Samples were collected from 0 to 2, 2 to 4, and 6 to 8 feet BGS for borings A7B18, A7B19, and A7B20, respectively. Results of these grain-size analyses are provided in Appendix B. No radiological readings above background were detected.

3.2.4.3 Physical Results for Shallow Subsurface Soil Sampling

Hand auger sample A7HA3A was collected from the location of test pit A7TPE where numerous metal objects were encountered during the Phase I SI/RI. The soil sample from location A7HA3 was comprised of sand and cobbles. No metal objects were found during the Phase II sampling. Soil sample A7HA3A was collected from a depth of 2.5 feet BGS and was submitted for TCLP metals extraction analysis. No PID or radiological readings above background were detected during sample collection.

Hand auger sample A7HA4A was collected from Phase I confirmatory drum sample location A7CD2. Soil at this location consisted of sand with numerous rocks and pebbles. Soil was collected from a depth of 2 feet BGS and was submitted for TCLP extraction and pesticides analysis. No PID or radiological readings above background were detected.

3.2.5 Monitoring Well Installations and Boring Samples

Two shallow monitoring wells, designated OHM-A7-51 and OHM-A7-52, were installed in AOC A7. Monitoring wells OHM-A7-52 and OHM A7-51 were installed on October 27 and 28, 1993, respectively. Development of both wells was completed on November 17, 1993. Completion details, survey data, boring logs, and well construction diagrams are contained in Appendix B.

3.2.5.1 Rationale and Locations

Monitoring well OHM-A7-51 was installed hydraulically downgradient of monitoring well OHM-A7-8 to assess the migration of contaminants previously detected in this well. Monitoring well OHM-A7-52 was placed downgradient of monitoring well OHM-A7-46 to determine if the chlorinated pesticides, previously detected in samples from this well, are migrating. The monitoring well locations are shown on Figure 3-1.

3.2.5.2 Physical Results

Both monitoring wells were continuously sampled with a split-spoon sampler from ground surface to the top of ground water and at 5-foot intervals within the saturated zone during drilling. Each well was screened across the top of ground water with 15 feet of 4-inch diameter 10-slot SCH-40 PVC screen and completed using SCH-40 PVC pipe.

Monitoring well OHM-A7-51 was installed on October 28, 1993. The top of water was encountered at approximately 10 feet BGS during drilling and the boring was terminated at 21 feet BGS. The

subsurface section was composed of well-graded sands and gravel overlying silty fine sand to sandy silt with a trace of clay. Subsurface soil sample A7SB51B was collected from 8 to 10 feet BGS for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, OP Pest, and TOC. A geotechnical sample representative of the screened interval was obtained from 15 to 16.3 feet BGS for grain-size analysis. Grain-size analysis results are presented in Appendix B. No PID or radiological readings above background were detected.

The installation of monitoring well OHM-A7-52 started on October 26, 1993, and was completed the following day. The water table was encountered at approximately 14.5 feet BGS during drilling and the well was completed at a depth of approximately 21 feet BGS. Subsurface materials consisted of silty sands, silt, and clayey silt. A subsurface soil sample (A7SB52B) was collected from a depth of 20 to 21 feet BGS for PCB/Pest, OP Pest, and TOC analysis. A sample for grain-size analysis was collected from 9 to 11 feet BGS. Grain-size analysis results are provided in Appendix B. No PID or radiological readings above background were detected; however, no monitoring of soil samples between 17 and 21 feet BGS could be conducted due to heavy rainfall.

Both wells were initially developed on November 9,1993. However, due to the slow recharge rates of these wells, the fine silt around the sand-packed portions of the annulus could not be fully removed. Therefore, the two wells were developed again on November 17, 1993. The wells were surged with a 2-inch diameter bailer and then pumped at a rate of approximately 0.25 gpm due to poor recharge. Potable water was injected into both wells during development. The volumes of water injected into OHM-A7-51 and OHM-A7-52 were approximately 30 and 10 gallons, respectively.

3.2.6 Ground Water Sampling

Five ground water samples were collected in AOC A7 from monitoring wells OHM-A7-8, OHM-A7-45, OHM-A7-46, OHM-A7-51, and OHM-A7-52. Table 3-1 presents a summary of the AOC A7 Phase II sampling record, and Appendix A contains the detailed sample collection record.

Analytical results from two previous rounds of ground water sampling performed by OHM in AOC A7 (June and October 1992), indicated the presence of pesticides, chlorinated solvents, and acetone. The chlorinated pesticides detected in AOC A7 ground water during the Phase I SI/RI are generally not very water soluble and are more likely to bind to suspended soil particles in the sample water. In an attempt to distinguish between dissolved compounds and constituents sorbed on suspended solids, both filtered and unfiltered ground water samples from each well were submitted for PCB/Pest analysis.

3.2.6.1 Rationale and Locations

Several pesticides and VOCs were detected in ground water samples from OHM-A7-8 during the June and October 1992 sampling events. Two BNAs (di-n-butyl phthalate and naphthalene) were detected in the October sampling round only. In order to confirm the presence or absence of these compounds in ground water, an additional sample was collected from this well during the Phase II SI/RI for TCL VOCs, TCL BNAs, filtered PCB/Pest, unfiltered PCB/Pest, and OP Pest analysis.

Pesticides were also detected in ground water samples from wells OHM-A7-45 and OHM-A7-46 during the Phase I SI/RI. These detectable levels of pesticides were believed to be associated with suspended solids in the sample rather than with the ground water itself. Therefore, filtered and unfiltered

samples were collected from these two wells for PCB/Pest analysis during the Phase II SI/RI. An additional sample volume was collected from each well for OP Pest analysis.

OHM-A7-51 was sampled in order to assess the ground water quality downgradient of OHM-A7-8. Ground water collected from this well was submitted for analysis of TCL BNAs, TCL VOCs, filtered PCB/Pest, unfiltered PCB/Pest, and OP Pest.

Monitoring well OHM-A7-52 was sampled in order to determine whether pesticides detected in OHM-A7-46 have migrated downgradient. The sample collected during the Phase II sampling event was submitted for filtered PCB/Pest, unfiltered PCB/Pest, and OP Pest analysis.

3.2.6.2 Physical Results

Due to poor recharge rates of the monitoring wells in AOC A7, wells were purged prior to sampling in accordance with USAEC specifications addressing slow recharge wells. These specifications allow less than the preferred 3 to 5 well volumes to be removed prior to ground water sampling.

All monitoring wells in AOC A7 were pumped dry, allowed to recover, and then sampled, due to slow recoveries. The recharge rate of OHM-A7-46 was so slow that it was purged and allowed to recover for six hours before sampling began. No odors or PID readings above background levels were noted during any of the sampling events.

3.2.7 Surface Water and Sediment Sampling

One surface water/sediment sample (A7SW3/A7SD3) was collected in AOC A7 during the Phase II SI/RI. This sample location is shown on Figure 3-1.

3.2.7.1 Rationale and Locations

This surface water/sediment sample was collected from the stream bordering the eastern edge of AOC A7, downgradient of SA P8 to assess the stream quality downstream of this dump area. Samples were analyzed for TCL VOCs, TCL BNAs, explosives, TAL metals, phosphate, PCB/Pest, OP Pest, and herbicides.

3.2.7.2 Physical Results

Surface water and sediment samples A7SW3B and A7SD3B were collected on November 2, 1993, approximately 100 feet upstream of surface water/sediment sample location A7SD1/A7SW1. The sediment sample from A7SD3 was collected from a depth of 0 to 0.5 feet and described as a dark brown, poorly sorted sand with some cobbles. Due to laboratory error during the sample extraction process, the herbicide sediment sample could not be analyzed. Consequently, an additional sediment sample (A7SD3C) was collected from this same location on November 15, 1993, and was submitted for herbicide analysis.

3.2.8 Hydrogeological Assessment

Hydrogeologic and subsurface lithologic conditions at AOC A7 were investigated through the installation of 11 monitoring wells, 21 soil borings, and 1 staff gage (Figure 3-5). Aquifer characteristics

were investigated through the collection of four rounds of water level elevations, and by the interpretation of slug test data collected at 6 locations and 23 grain-size analyses (Appendix B). The data obtained during the OHM investigation have been used to refine the hydrogeologic characterization of the area developed during previous investigations (AEHA, 1983; Dames & Moore, 1986). Two water-bearing zones, overburden and bedrock, were investigated.

The overburden is the primary water-bearing unit and has been characterized as an unconfined, water-bearing zone consisting of a glacial kame terrace overlying glacial till deposited during the Pleistocene epoch (Hansen, 1956). Boring and slug test results from AOC A7 indicate that the overburden zone is generally less than 21 feet thick, shows considerable lithologic variation, and has a wide range of hydraulic conductivities. It has been subdivided into upper and lower aquifer units based on lithologic and hydrogeologic characteristics.

Glacial kame terrace was encountered from ground surface to 10 feet BGS and varied in observed thickness from 1 foot to 10 feet. This unit is an unconsolidated fine grained sand and silty sand with some medium sand and minor amounts of coarse sand, gravel, and cobbles. Boulders were also encountered in this unit during test pitting operations. In the central and western sections of AOC A7, portions of the kame terrace deposits were removed for borrow material, and much of the remainder was reworked during debris disposal. The glacial kame terrace has been designated the upper aquifer unit.

Glacial till was encountered between 1 foot and 21 feet BGS, and varied in observed thickness from 2 feet to 20 feet. The till is composed of a hard, well compacted heterogeneous mixture of clay-to-sand sized particles with some gravel and is interpreted to be a basal till. The glacial till has been designated the lower aquifer unit.

Bedrock cores recovered during this investigation have been classified as belonging to the Carboniferous-aged Nashoba formation and Gospel Hill gneiss (Hansen, 1956). Bedrock in this region has been characterized as dense, hard, lacking primary openings, and containing water mainly in openings along joints and to a lesser extent in openings along cleavage planes and irregular fractures (Perlmutter, 1962). Due to low yields, bedrock formations in this area are a minor source of water (Perlmutter, 1962; Pollock, et. al., 1969). Flow conditions in the bedrock aquifer have not been fully characterized.

Geologic cross-sections of the area were constructed using data obtained during the subsurface investigation. The locations of all cross-sections are presented on Figure 3-5, and the cross-sections are presented as Figures 3-6 through 3-8.

3.2.8.1 Hydraulic Conductivities

Slug tests were performed on six monitoring wells in AOC A7 to determine the hydraulic conductivity of the overburden or bedrock penetrated by each well. Test data were evaluated using the Bouwer and Rice (1976) method for unconfined aquifers. A summary of the OHM and E&E slug test results is presented in Appendix B, while all original OHM slug test data, graphical analyses, and calculations for each slug test are contained in Appendix A of the Final Site/Remedial Investigation Report (OHM, 1994).

Two slug tests were performed on wells screened in the upper aquifer unit, or glacial kame terrace. The hydraulic conductivities were 0.0007 ft/min at OHM-A7-9 and 0.03 ft/min at OHM-A7-10. The lower

hydraulic conductivity at OHM-A7-9 was expected, based on the larger fraction of fine-grained soil encountered during drilling at that location. Using these values, the geometric mean hydraulic conductivity of the upper aquifer unit is calculated to be 0.004583 ft/min. Results were not rounded off to the proper number of significant figures until final results were calculated.

Three slug tests were performed on wells screened in the lower aquifer unit, or glacial till. The hydraulic conductivities for monitoring wells OHM-A7-8, -12, and -45 were, respectively, 0.00006 ft/min, 0.0003 ft/min, and 0.00008 ft/min. Using these values, the geometric mean hydraulic conductivity for the lower aquifer unit is calculated to be 0.0001 ft/min. The hydraulic conductivity of the lower aquifer unit is actually slightly lower than the value presented. The overlying upper aquifer unit provided a minor amount of water during the rising-head test performed on OHM-A7-12, thus inflating the value for that location.

One slug test was performed on the bedrock aquifer at monitoring well OHM-A7-11. The slug test data were evaluated using the Bouwer and Rice (1976) method and the graphical method developed by Cooper et. al. (1967). Both methods yielded a hydraulic conductivity of 0.00002 ft/min for the bedrock zone at this location. The actual hydraulic conductivity of the formation will be lower than the value represented by the slug test results as the well is a flowing artesian well. Laboratory measurement of core sections or a long-duration pump test would be required to calculate a more precise hydraulic conductivity value.

3.2.8.2 Ground Water Flow

Depth to ground water and surface water elevation measurements were collected on June 15 and October 23, 1992, January 8, 1993, and April 27, 1994, to determine ground water flow directions and gradients in this area. Depth to water measurements and top of ground water elevations for all gaging events are contained in Appendix B. Ground water maps for the first three gaging events are presented as Figures 5-18 through 5-20 in the Final Site/Remedial Investigation Report (1994), while the ground water map for the April 27, 1994, Phase II gaging event is presented as Figure 3-5 of this report.

All four gaging events consistently show that the water table elevations generally mimic the site topography, decreasing towards the north and east. The primary direction of ground water flow is northward towards the Assabet River with a minor component flowing eastward towards the unnamed stream on the east border of the site. This small stream also flows into the Assabet River.

Horizontal hydraulic gradients in the overburden were determined from the four gaging events. The hydraulic gradients were found to be 0.08, 0.07, 0.1, and 0.09, respectively. The average horizontal hydraulic gradient is 0.085.

Bedrock monitoring well OHM-A7-11 is a flowing artesian well. The artesian effect may be observed when a well penetrates a confined or semiconfined aquifer where the potentiometric surface elevation across the screened interval exceeds the topographic elevation of the ground surface at that point above the aquifer. This situation is created when an overlying low permeability confining layer (an aquitard or aquiclude) reduces the upward flow energy of ground water and prevents ground water in the confined aquifer from flowing upward. In AOC A7, the hard, dense basal till in the overburden section functions as a confining layer.

A vertical ground water gradient has been calculated by comparing observed ground water elevation differences (the pressure head differential) to well screen elevation differences (the elevation head differential) for monitoring well couplet OHM-A7-10 and -11 (Table 3-2). Monitoring well OHM-A7-11 is screened within the bedrock from 160.10 feet to 150.10 feet AMSL, while OHM-A7-10 is screened across the top of the saturated zone from 177.64 feet to 169.64 feet AMSL. The maximum observed difference in ground water elevations between these two wells was observed on October 23, 1992. At that time, ground water from OHM-A7-11 was flowing slowly out of the riser pipe which has an elevation of 181.64 feet AMSL. The ground water elevation in OHM-A7-10 was 176.48 feet AMSL, a pressure head differential of 5.16 feet. Because the observed ground water elevations represent the average of all the potentials across the saturated screened interval, the midpoint of the saturated interval was used to represent the elevation head. The midpoint elevations of the saturated screened intervals were 155.10 feet in OHM-A7-11 and 173.06 feet in OHM-A7-10, an elevation head differential of 17.96 feet. Dividing the pressure head differential by the elevation head differential yields a vertical gradient of 0.29. It should be recognized that this is a minimum value for the vertical hydraulic gradient because well OHM-A7-11 was flowing and, therefore, the ground water elevation used in the calculation was less than the actual pressure head elevation. This is of significant interest since the vertical hydraulic gradient at this observation point exceeds the horizontal hydraulic gradient by an order of magnitude.

The observed vertical hydraulic gradient represents a potential upward component to ground water flow from the fractured bedrock aquifer to the unconfined aquifer in the overburden. Actual ground water flow is inhibited by the dense basal till unit overlying the top of bedrock. Contaminants present in the upper unconfined aquifer would be inhibited by the same confining layer from flowing or migrating downward into the bedrock aquifer. In addition, even if fractures or faults were present in the confining till layer, ground water would flow from the bedrock aquifer below, to the unconfined aquifer above.

Average flow velocities (V) for each overburden aquifer unit have been calculated based on the geometric mean hydraulic conductivity (K) of each unit and an average hydraulic gradient (I) of 0.085. A storage coefficient value of 0.20, calculated using the results of a pump test performed on the unconfined aquifer in the southern portion of the installation (Perlmutter, 1962), was substituted for effective porosity (n_e).

Lower Aquifer Unit

$V = Ki/n_e$ = (0.000113 ft/min)(0.085)/0.20 = 4.8E-05 ft/min or 0.07 ft/day

Upper Aquifer Unit

$V = Ki/n_e$ = (0.004583 ft/min)(0.085)/0.20 = 1.95E-03 ft/min or 2.8 ft/day

3.2.8.3 Ground Water - Surface Water Relationship

The potential for hydraulic communication between ground water and surface water at AOC A7 was evaluated as part of the hydrogeologic investigation. Staff gage SG-6 was installed in the unnamed stream along the eastern margin of the site (Figure 3-1). Surface water elevation measurements were then collected in conjunction with depth to ground water measurements. These data, the ground water flow directions, and the hydraulic gradients indicate that a portion of the ground water flow in AOC A7 is discharging into the stream.

The climate, regional drainage patterns, general site configuration, ground water flow directions, and horizontal and vertical ground water gradients indicate that AOC A7 overlies a zone of ground water discharge to the Assabet River. In order to assess the environmental impact from contaminated ground water discharging into the Assabet River, discharge volumes have been estimated. The unnamed stream is not considered to be a significant receptor for ground water from AOC A7 and has been ignored for the purpose of these calculations.

3.2.8.4 Ground Water Discharge to Surface Water

Ground water discharge volumes have been estimated for the upper and lower aquifer units. This section describes the methods used to estimate the ground water discharge and summarizes the results. Discharge estimate results for each aquifer unit, total discharge volumes, and values for all variables used in the calculations are presented in Table 3-3.

The method used to estimate ground water discharge was to calculate ground water flow volume per unit time for 1 square foot of aquifer area, then to multiply this volume by the entire saturated cross-sectional area of each aquifer unit contributing to ground water flow. This method allows for quick recalculation of total flow volumes under varying aquifer conditions. The equation used to calculate the unit ground water flow is $Q = KAi$ where Q = the discharge volume, K = the hydraulic conductivity, A = the cross-sectional area, and I = the hydraulic gradient. This equation combines transmissivity with Darcy's law and is discussed in Heath (1989).

Saturated down-gradient cross-sectional areas for each aquifer unit were determined using strike-oriented cross-section A-A' (Figure 3-6) and ground water gaging data from April 27, 1994. The highest water levels observed in AOC A7 were during this gaging event, and these data were used so that maximum observed saturated aquifer thicknesses would be input into the discharge calculations. Using the maximum observed aquifer thickness leads to maximum ground water discharge volumes and ensures that discharge estimates are unlikely to be underestimated (i.e., that the actual contribution of water from the site to the river is likely to be lower than estimated). Cross-sectional area estimates input into the discharge calculations for the entire site and for the lab waste plume are presented in Table 3-4. The hydraulic gradient (I) used in the discharge calculations for both the lower and upper aquifer units was 0.0882. This value was determined using the ground water map constructed for April 27, 1994 (Figure 3-5). The hydraulic conductivities (K) used for the lower and upper aquifer units were, respectively, 0.000113 ft/min and 0.004583 ft/min.

Total ground water discharge from AOC A7 to the Assabet River is estimated to be 10,223 gallons/day (7.1 gal/min). Ground water discharge from the lab waste plume to the Assabet River contributes an estimated 2,521 gallons/day (1.8 gal/min) to this total.

3.3 NATURE AND EXTENT OF CONTAMINATION

The following section summarizes the analytical results for all surface soil, test pit, subsurface soil, ground water, surface water, and sediment samples collected by OHM during the SI/RI of AOC A7. All sample locations are shown on Figure 3-1. Surface water and sediment data collected by Dames and Moore and E&E from the unnamed stream adjacent to AOC A7 are also included in this section to more completely evaluate what impact, if any, AOC A7 has had on this stream environment.

3.3.1 Surface Soil Sampling Results

OHM has collected 14 surface soil samples (depths 0 to 6 inches) from AOC A7. Two of these samples (A7CD1A and A7CD2A) were confirmatory samples collected from beneath former drum locations. The remaining 12 samples were collected from soils which were either void of vegetation, stained, located beneath discarded piping, or appeared to have been disturbed. These samples were submitted for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals analysis. Explosives were not detected in any of these samples. A list of all detected compounds is provided in Appendix D, Table D-10. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 3-5. Analytes detected at concentrations above ESAT soil values of potential ecological concern are summarized in Table 3-6.

None of the five VOCs detected in the surface soil samples are considered to be COCs in AOC A7. Methylene chloride (6 of 14 samples), acetone (2 of 14 samples), and total xylenes (1 of 14 samples) were detected at concentrations below MCP S-1/GW-1 soil standards, and since methylene chloride and acetone are common laboratory contaminants, their detections may not be site-related. Although there are no MCP soil standards for n-propylbenzene and alpha-pinene, these compounds are also not considered to be potential contaminants of concern for surface soils. N-propylbenzene (0.011 μg/g) was only detected at sample location A7SO6 where the soil was observed to be stained with an oil-like substance. This staining was confined to a very small area and the detection of this compound is probably related to the oily material observed. Alpha-pinene is a naturally occurring compound and its detection at 1 of 14 sample locations is not likely to be site-related. Eleven unknown VOCs were also detected in these samples at concentrations ranging from 0.01 to 0.08 μg/g (Appendix D, Table D-50).

Although 21 unknown BNAs were detected at concentrations ranging from 1 to 200 μg/g (Appendix D, Table D-50), A7CD1 and A7SO6 were the only two sample locations where BNAs were positively identified. DEHP was detected at sample location A7CD1 at a concentration of 6 μg/g which is well below the MCP S-1/GW-1 soil standard of 100 μg/g. No other BNAs were identified at A7CD1.

Twelve BNAs were detected at sample location A7SO6 (oil-stained soil) where the petroleum-related VOCs mentioned above (xylenes and n-propylbenzene) were detected. Three of these BNAs (2-methylnaphthalene, benzo(a)anthracene, and benzo(a)pyrene) were detected at concentrations above MCP S-1/GW-1 soil standards (Table 3-5). Concentrations of benzo(a)anthracene and benzo(a)pyrene also exceed ESAT soil criteria (Table 3-6). No MCP soil standards are available for the three substituted benzene compounds and 1,5-dimethylnaphthalene detected at this location (Appendix D, Table D-10). However, the detection of these compounds appears to be confined to the limited area where an oil-like substance was observed on the ground surface and do not represent a site-wide problem. In fact, the collection of this soil sample resulted in the removal of all visible staining. The remaining BNAs listed in Table 3-5 were detected at concentrations below MCP S-1/GW-1 standards. Although phenanthrene was detected at a concentration (5 μg/g) below the MCP standard, its detected concentration is equivalent to the ESAT soil screening value (Table 3-6). However, as previously mentioned, the detection of this compound appears to be limited to a relatively small area around what appeared to be an oil spot and is therefore unlikely to have a significant impact on the local ecology of the area.

An additional surface soil sample was collected from A7S06 in October 1993. This sample, designated A7SO13B, was submitted for TCLP semivolatiles to evaluate the potential for chemicals to leach from soil in this area. However, due to laboratory error, this sample was never analyzed. The detection

of semivolatiles appears to be confined to this oil-stained area as none of the other soil (surface and test pit) samples collected within this general area contained these compounds. Also, as discussed above, after the soil sample from A7SO6 had been collected, no evidence of oil staining was visible. Due to the limited size of the area in which these semivolatiles were detected, the lack of TCLP results from this location is not likely to represent a major data gap.

PCB/Pest detected in these soil samples are listed in Appendix D, Table D-10. Concentrations of dieldrin (A7CD1), DDE (A7CD2), and ppDDT (A7CD2 and A7SO9) exceed MCP S-1/GW-1 soil standards (Table 3-5). The highest concentrations of ppDDT (380 μg/g) and DDE (86 μg/g) detected in AOC A7 surface soil were found at confirmatory drum sample location A7CD2. Concentrations of ppDDT and its metabolites ppDDD and ppDDE also exceed ESAT soil values at surface soil sample locations A7CD1, A7CD2, and A7SO9 (Table 3-6). Endosulfan sulfate (0.08 μg/g) exceeds maximum background (0.008 μg/g) at confirmatory drum sample location A7CD1. There is no MCP S-1/GW-1 standard or ESAT soil criteria for this compound. However, the concentration detected is below the MCP S-1/GW-1 soil standard for total endosulfan (0.2 μg/g). Concentrations of all other pesticides detected were either below maximum background levels or below MCP S-1/GW-1 soil standards. The PCB Aroclor 1260 was detected at A7CD1 at a concentration below the MCP S-1/GW-1 standard. However, this concentration (1.62 μg/g) exceeds the ESAT soil value of 1 μg/g.

Two herbicides, silvex and dacthal, were detected in two samples. No MCP S-1/GW-1 standards are available for these compounds. Silvex was detected at A7S06 at a concentration of 0.01 μg/g. The sample collected from A7CD1 contained dacthal at a concentration of 0.08 μg/g.

Metals detected in these surface soil samples are included in Appendix D, Table D-10. Lead was detected at one sample location (A7CD1) at a concentration of 400 μg/g, which is above the MCP S-1/GW-1 soil standard of 300 μg/g. None of the other metals were detected at concentrations above MCP S-1/GW-1 soil standards. Barium was detected at A7SO4 at a concentration (353 μg/g) above maximum background (54.7 μg/g). These lead and barium concentrations also exceed ESAT soil criteria (Table 3-6). Although all detections of arsenic in these surface soil samples are below both maximum background soil levels and MCP S-1/GW-1 soil standards, arsenic concentrations exceed ESAT soil values at 12 sample locations (Table 3-6). The remaining metals listed in Table 3-5 were either detected at concentrations below maximum background or, in the case of potassium which exceeds maximum background, is a naturally occurring essential element.

3.3.2 Test Pit Sampling Results

OHM has collected 53 soil samples from 19 test pit locations during the investigation of AOC A7 (Figure 3-1). Most of these samples were analyzed for VOCs, BNAs, PCB/Pest, chlorinated herbicides, explosives, and metals. Analysis for OP Pest was added to the 1993 Scope of Work (SOW). Consequently, only the 12 test pit samples collected in 1993 were analyzed for OP Pest. Table D-11 in Appendix D contains a complete list of all positive detections. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 3-7.

A total of 13 VOCs were identified in AOC A7 test pit samples (Appendix D, Table D-11). Thirty-nine unknown VOCs were also detected at concentrations ranging from 0.01 to 7 μg/g (Appendix D, Table D-50). Concentrations of 1,1,2-trichloroethane (20 μg/g), 1-2-dichloroethane (1 μg/g), chloroform (20 μg/g), and tetrachloroethylene (20 μg/g) exceed MCP S-1/GW-1 soil standards at test pit location

A7TPK where buried laboratory materials were encountered during excavation (Table 3-7). Tetrachloroethylene (PCE) concentrations also exceed the MCP S-1/GW-1 standard of 0.5 μg/g in one of the two samples collected from A7TPR, where additional laboratory-related materials were found. The sample containing the elevated PCE concentration (2.9 μg/g) was collected from a depth of 2 to 4 feet BGS. The concentration of PCE detected in the 0- to 1-foot sample collected from A7TPR was 0.049 μg/g. VOC concentrations above MCP S-1/GW-1 soil standards were not detected at any other test pit location.

Methylene chloride was detected in 7 of the 45 test pit samples submitted for VOC analysis (not all 53 test pit samples were collected for VOC analysis), at concentrations ranging from 0.0081 to 0.014 μg/g. Although methylene chloride concentrations exceed background soil 95 percent UCL values at several test pit locations (Table 3-7), none of these concentrations exceed maximum background (0.018 μg/g) or MCP S-1/GW-1 soil standards (0.1 μg/g). Therefore, methylene chloride is not considered to be a potential contaminant of concern.

Nonane and octane were each detected at one test pit location. There are no MCP S-1/GW-1 standards for these compounds. The presence of nonane at 0.033 μg/g (A7TPD) and octane at 6 μg/g (A7TPJ) are probably the result of releases of gasoline and oil. The remaining six VOCs listed in Appendix D, Table D-11 were detected infrequently (primarily where the buried laboratory debris was encountered) at concentrations below MCP S-1/GW-1 soil standards.

The nine BNAs detected in AOC A7 test pit samples are listed in Appendix D, Table D-11. The PAHs chrysene and 2-methylnaphthalene were the only compounds detected at concentrations above MCP S-1/GW-1 soil standards. Chrysene was detected in 1 of the 26 samples submitted for BNA analysis at a concentration of 0.79 μg/g (A7TPE) which slightly exceeds the MCP S-1/GW-1 soil standard of 0.7 μg/g. The detection of chrysene at this test pit location may be attributed to the buried burnt wood that was observed during excavation. No other compounds were detected at A7TPE at elevated concentrations. 2-Methylnaphthalene was detected in both samples collected from A7TPR at concentrations (2 and 3 μg/g) above the MCP S-1/GW-1 soil standard (Table 3-7). Anthracene, DEHP, and phenanthrene were also detected in these samples, but at concentrations below MCP S-1/GW-1 soil standards.

There is no MCP standard for di-n-butyl phthalate which was detected in 20 of 26 samples submitted for analysis. Di-n-butyl phthalate is listed in Table 3-7 because it exceeds the background soil 95 percent UCL value at one sample location, A7TPR. This compound is a common laboratory contaminant and was detected in 10 of the 12 background soil samples collected by OHM. Since the concentration of di-n-butyl phthalate detected at A7TPR (10 μg/g) only slightly exceeds the maximum background value (9 μg/g), the detection of this compound may not be site-related. Regardless of whether or not the detection of this compound is site-related, A7TPR has already been identified as an area containing buried laboratory-related materials and will require some remedial action.

The fatty acids palmitic acid (hexadecanoic acid) (100 μg/g) and stearic acid (700 μg/g) detected at A7TPK are naturally occurring compounds. However, the high concentrations indicate that these materials may have been used for organic synthesis in the laboratory and disposed of as laboratory waste in the broken bottles and cans. There are no MCP standards for these compounds. A total of 84 unknown BNAs were also detected in these test pit samples at concentrations ranging from 0.8 to 100 μg/g (Appendix D, Table D-50).

Many of the pesticides detected in AOC A7 surface soil samples were also detected in these test pit samples. ppDDD (2 of 36 samples), ppDDE (2 of 36 samples), ppDDT (4 of 36 samples), dieldrin (1 of 36 samples), lindane (2 of 36 samples), endrin (1 of 36 samples), heptachlor epoxide (1 of 36 samples), and total chlordane (2 of 36 samples) were present at concentrations that exceed MCP S-1/GW-1 soil standards. These exceedences of MCP standards were limited to test pit locations A7TPK, A7TPR, A7TPQ, and A7TPS (Table 3-7). Beta-endosulfan was detected at one test pit location (A7TPT) at a concentration above the background soil 95 percent UCL value but below both the maximum concentration detected in background soil and the MCP S-1/GW-1 standard and is not considered to be a potential contaminant of concern. Heptachlor was detected at A7TPK at 0.064 μg/g which is below the MCP S-1/GW-1 soil standard. The PCB Aroclor 1254 was detected at A7TPK at a concentration equivalent to the MCP S-1/GW-1 soil standard of 2 μg/g and at A7TPR at a concentration of 3.1 μg/g. PCBs were not detected at any other test pit location at concentrations above MCP standards.

The OP Pests Demeton-O, fenthion, and methyl parathion were detected in 2 of the 12 samples submitted for analysis. Both samples were collected from test pit location A7TPR where buried laboratory-related materials were found. The concentrations detected at this test pit location ranged from 0.11 to 2 μg/g. There are no MCP S-1/GW-1 soil standards available for these compounds.

Only two test pit samples were submitted for phosphate analysis. Phosphate was detected in A7TPR1 at 450 μg/g and A7TPR2 at 360 μg/g which exceed the maximum concentration detected in background soil samples (19.5 μg/g). There is no MCP S-1/GW-1 soil standard for phosphate.

There was only one confirmed explosives detection in the 25 samples submitted for analysis. RDX was detected in the sample collected from A7TPB at a concentration of 4.72 μg/g. No MCP S-1/GW-1 soil standard was found for this explosive.

Twenty metals, many of which occur naturally in soil, were detected in these test pit samples. Lead concentrations exceed the MCP S-1/GW-1 soil standard of 300 μg/g at two of the 19 test pit locations. Lead was detected at 3,900 μg/g in the sample collected from a depth of 2 feet at A7TPR. Lead concentrations of 330 and 520 μg/g were detected in samples collected from depths of 0 and 2 feet, respectively at test pit location A7TPS. No other metals were detected at concentrations above MCP S-1/GW-1 soil standards.

The remaining metals listed in Table 3-7 were detected at concentrations above background soil 95 percent UCL values. Except for potassium, calcium, copper, and vanadium, concentrations of the metals listed in this table do not exceed maximum background levels. Potassium and calcium are naturally occurring essential elements and their detection at concentrations above maximum background is probably not site-related. Elevated levels of copper, in comparison to background, were detected at test pit locations A7TPE, A7TPH, A7TPK, and A7TPS. The two highest copper concentrations (maximum 250 μg/g) were detected at A7TPH where rubber tubing, the top portion of a 55-gallon drum, first aid kits, and broken glass were encountered during excavation. Vanadium (145 μg/g) exceeds the maximum background concentration (51.2 μg/g) at A7TPS.

Samples from three of the test pits excavated in 1993 were submitted for TCLP analysis. All positive detections are included in Appendix D, Table D-12. A sample collected from A7TPR was submitted for volatile and TCLP semivolatiles. As mentioned above, VOCs and BNAs exceeding MCP S-1/GW-1 soil

standards were detected in samples collected from this test pit. However, there were no positive detections in the sample submitted for TCLP analysis.

A sample from A7TPQ was submitted for pesticide and semivolatile organic compound TCLP analysis. Elevated concentrations of ppDDT and its metabolites were detected in all three samples submitted for TCL PCB/Pest analysis. However, no positive detections were reported for the TCLP sample indicating that the pesticides detected at this sample location are not readily leached.

Barium (330 μg/L) and cadmium (5.5 μg/L) were the only compounds detected in the sample collected from A7TPS which was submitted for TCLP extraction and metals analysis. The reported concentrations of these metals are well below RCRA standards.

3.3.3 Subsurface Soil Sampling Results

A total of 27 boring and 2 hand auger samples have been collected from AOC A7. Most of these samples were submitted for VOC, BNA, PCB/Pest, explosives, chlorinated herbicide, TOC, and metals analysis. No explosives or herbicides were detected. The two boring samples collected in 1993 were also submitted for OP Pest analysis but no compounds were detected. A complete list of all positive detections is provided in Appendix D, Table D-13. Table 3-8 lists compounds which were detected at concentrations above background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards. Concentrations of compounds detected in the hand auger samples were also compared to ESAT soil criteria (Table 3-9).

The nine VOCs detected in these subsurface soil samples are listed in Appendix D, Table D-13. Chloroform and PCE were detected at one sample location, OHM-A7-8, at concentrations above MCP S-1/GW-1 soil standards (Table 3-8). The detection of these compounds may be attributed to the laboratory-related waste materials buried upgradient of this boring location. As discussed in Section 3.3.2, both of these compounds were detected in the test pit samples collected from this laboratory waste disposal area (A7TPK) at concentrations above MCP S-1/GW-1 soil standards. There are no MCP S-1/GW-1 soil standards for alpha-pinene and trichlorofluoromethane. Alpha-pinene is a naturally occurring compound and its detection at one of the boring locations is probably not site-related. Trichlorofluoromethane was detected at A7B3 at a concentration of 0.11 μg/g. None of the other VOCs detected exceed MCP S-1/GW-1 soil standards. Ten unknown VOCs were also detected in these samples at concentrations ranging from 0.001 to 0.35 μg/g (Appendix D, Table D-50).

Many of the BNAs detected in the test pit and surface soil samples were also detected in these subsurface soil samples. The 11 BNAs (primarily PAHs) detected in these samples are listed in Appendix D, Table D-13. Concentrations of BNAs exceeding MCP S-1/GW-1 soil standards were detected at sample locations A7B4 and A7B8. Benzo(a)pyrene and benzo(b)fluoranthene were the two compounds detected at A7B4 at concentrations above MCP standards. A7B4 was completed at the location of A7TPK to determine the vertical extent of the buried laboratory debris. 2-Methylnaphthalene was the only compound that exceeded MCP S-1/GW-1 standards at A7B8.

There is no MCP S-1/GW-1 standard for di-n-butyl phthalate which was detected in 13 of 21 samples submitted for analysis. Di-n-butyl phthalate is listed in Table 3-8 because it exceeds the background soil 95 percent UCL value at one sample location, A7B5. This compound is a common laboratory contaminant and was detected in 10 of the 12 background soil samples collected by OHM. Since the concentration of di-n-butyl phthalate detected at A7B5 (10 μg/g) only slightly exceeds the maximum background value

(9 μg/g), the detection of this compound may not be site-related. The remaining BNAs listed in Appendix D, Table D-13 were detected at concentrations below MCP S-1/GW-1 soil standards. Fifty-five unknown BNAs were detected at concentrations ranging from 0.08 to 41 μg/g (Appendix D, Table D-50).

The PCB/Pest detected in these subsurface soil samples are listed in Appendix D, Table D-13. The pesticides lindane (2 of 27 samples), ppDDD (2 of 27 samples), ppDDT (4 of 27 samples), and total chlordane (1 of 27 samples) exceed MCP S-1/GW-1 soil standards. These exceedences of MCP standards were limited to sample locations A7B4, OHM-A7-8, A7B8, A7B12, and A7B19. None of the other pesticides listed in Table 3-8 exceed their respective MCP S-1/GW-1 standards. No PCB was detected above MCP S-1/GW-1 soil standard.

Beryllium was the only metal detected at a concentration above the MCP S-1/GW-1 soil standard at sample location OHM-A7-51. However, the concentration at which it was detected, 0.52 μg/g, is below the maximum concentration detected in background soil (0.64 μg/g). Since the concentration of beryllium detected in this soil sample falls within the background range, its detection is probably not site-related. The other metals listed in Table 3-8 were detected at concentrations below maximum background, below MCP S-1/GW-1 standards, or are naturally occurring essential elements (i.e., potassium).

One boring and two hand auger samples were submitted for TCLP analysis. All positive detections are included in Appendix D, Table D-12. Barium (190 μg/L; 1,400 μg/L for duplicate), lead (1,200 μg/L; duplicate sample only), and mercury (6.58 μg/L) were the only metals detected in A7HA3A which was submitted for TCLP metals analysis. These metal concentrations do not exceed RCRA standards. Soil from A7HA4 was collected for TCLP pesticides analysis. A7HA4 was collected from the same location as A7CD2, where elevated pesticide concentrations were detected. No pesticides were detected in the TCLP extract.

A7B17 was completed at the location of test pit A7TPK, where buried laboratory debris was encountered. Barium, cadmium, chromium, lead, and the pesticide lindane were the only compounds detected in this sample which was submitted for full TCLP analysis (Appendix D, Table D-12). All concentrations detected are below RCRA limits.

3.3.4 Ground Water Sampling Results

OHM has collected 30 ground water samples from 10 monitoring well locations in AOC A7 (Figure 3-1). Most of these samples were submitted for VOC, BNA, PCB/Pest, chlorinated herbicides, phosphate, explosives, and metals analysis. Herbicides were not detected in any of the samples. Table D-14 in Appendix D contains a complete list of all positive detections. Compounds which exceed ground water standards are listed in Table 3-10. Analytes detected in AOC A7 ground water were also compared to surface water criteria as a preliminary evaluation of what impact ground water discharge from this area may have on the Assabet River. Compounds detected at concentrations above these criteria are listed in Table 3-11.

The 13 VOCs identified in AOC A7 ground water are listed in Appendix D, Table D-14. Five unknown VOCs were also detected in these samples at concentrations ranging from 3 to 40 μg/L (Appendix D, Table D-50). Of the 13 VOCs positively identified, concentrations of eight exceeded their respective MCLs (Table 3-10). Except for methylene chloride, the detection of VOCs at concentrations above MCLs was limited to monitoring well locations OHM-A7-8, OHM-A7-46, and OHM-A7-51.

Methylene chloride was detected at 5 of the 10 monitoring well locations (six samples) at concentrations above the MCL. However, methylene chloride is a common laboratory contaminant and its detection in AOC A7 ground water samples, especially those collected during the October 1991 sampling round, may be laboratory-related rather than site-related. Four of the six occurrences of methylene chloride at concentrations above its MCL were detected in samples collected during the October 1991 sampling round. These four samples were analyzed in sample lot VGM along with three other samples, two trip blanks, and one rinsate sample. Methylene chloride was detected in all ten samples in lot VGM at similar concentrations (Table 3-12) and therefore, the detections of this VOC are most likely due to laboratory contamination. The remaining two detections of methylene chloride at concentrations above the MCL occurred during the June 1992 sampling round at OHM-A7-11 and the upgradient well, OHM-A7-13. Methylene chloride was not detected in either of these wells during the subsequent sampling round in November 1992.

PCE (maximum 12 μg/L) was detected in two samples collected from OHM-A7-46 at concentrations above its MCL. This well was installed near several partially exposed 55-gallon drums, adjacent to the laboratory waste disposal area. No other VOCs were detected at concentrations above drinking water standards in this well.

PCE concentrations also exceeded the MCL of 5 μg/L in all three samples collected from OHM-A7-8 (maximum of 38 μg/L). This well was installed downgradient of the lab debris uncovered during the excavation of test pit A7TPK. In addition to PCE, 1,1,2-trichloroethane, carbon tetrachloride, and chloroform levels exceeded MCLs in the December 1993 sample collected from this well. No MCL is available for acetone. However, the concentration of acetone (9,000 μg/L) detected in the December 1993 sample exceeds the MCP GW-1 standard of 3,000 μg/L. Many of the VOCs detected in OHM-A7-8 ground water were also detected in the soil boring sample from this well location and the soil samples collected from A7TPK. No other VOCs were detected at concentrations above drinking water standards at this monitoring well location.

Four VOCs were detected in ground water from OHM-A7-51 at concentrations above MCLs. This monitoring well was installed to assess the ground water quality downgradient of OHM-A7-8. Chloroform (120 μg/L) and PCE (130 μg/L), which were also detected in OHM-A7-8, exceeded MCLs in the sample collected from OHM-A7-51. 1,1,2,2-Tetrachloroethane (200 μg/L) and trichloroethylene (50 μg/L) were the other two VOCs detected in this well at concentrations above MCLs (Table 3-10).

The three identified BNAs and 29 unknown BNAs (2 to 14 μg/L) detected in these ground water samples are listed in Appendix D, Tables D-14 and D-50, respectively. DEHP was detected in 1 of 21 samples collected for BNA analysis and this detected concentration exceeds the MCL of 6 μg/L. The single detection of this compound occurred in a sample collected from OHM-A7-13 which is located upgradient of AOC A7. DEHP is a common sample collection/laboratory contaminant and was detected in the November 1992 sample along with another common laboratory contaminant, di-n-butyl phthalate. Neither of these compounds were detected in the sample previously collected from this well in June 1992.

MCLs were not available for the other two BNAs detected in AOC A7 ground water (di-n-butyl phthalate and naphthalene). Di-n-butyl phthalate was detected in 6 of the 21 samples collected at concentrations ranging from 5.5 to 6.1 μg/L. All six positive detections of this compound were found in the samples collected during the November 1992 sampling round. Consequently, it is likely that the detection of this compound is sample collection- or laboratory-related. Since no MCL was available for

naphthalene, the concentration of this compound was compared to the MCP GW-1 standard. Naphthalene was detected in one sample (A7GW8B) collected from OHM-A7-8 at a concentration of 7.3 μg/L which is below the MCP GW-1 standard of 20 μg/L.

Lindane was the only pesticide detected in AOC A7 ground water at concentrations above MCLs. Exceedences of the MCL for this pesticide were limited to three monitoring well locations; OHM-A7-8, OHM-A7-46, and OHM-A7-51. As discussed above, these wells are located adjacent to or downgradient of the laboratory disposal area. Lindane was detected in all of the samples collected from OHM-A7-8, except for the filtered pesticides sample, at concentrations above the MCL. No pesticides were detected in the filtered sample collected from this well in December 1993. The detection of lindane in ground water at this location is consistent with the soil data from this monitoring well. As discussed in Section 3.3.3, lindane was detected in the boring sample collected from this monitoring well at a concentration above the MCP S-1/GW-1 soil standard. Several other pesticides were also detected in samples from this well (Table D-14). No MCL was available for ppDDD but, the concentrations at which it was detected in three samples from this well (maximum 0.445 μg/L), exceed the MCP GW-1 standard of 0.1 μg/L. ppDDD was also detected in the soil boring sample collected during the installation of this well at a concentration above the MCP S-1/GW-1 soil standard (Section 3.3.3). Alpha-hexachlorocyclohexane (2 of 4 samples) and endrin aldehyde (1 of 4 samples) were also detected in samples from this well (Appendix D, Table D-14). There are no MCLs or MCP GW-1 standards available for these compounds. Alpha-hexachlorocyclohexane, which is a component of technical hexachlorocyclohexane and can be formed during the biotransformation of lindane, was detected at a maximum concentration of 0.03 μg/L. Endrin aldehyde was detected at a concentration of 0.158 μg/L. None of the other pesticides detected in samples collected from OHM-A7-8 exceeded MCLs.

Lindane concentrations also exceeded MCLs in samples collected from OHM-A7-46 and OHM-A7-51. During the December 1993 sampling event, filtered and unfiltered samples were collected for PCB/Pest analysis from each of these wells to determine if the detected pesticides were associated with suspended solids in the water column or with the ground water itself. Concentrations of lindane in the filtered and unfiltered samples were comparable (Appendix D, Table D-14). No other pesticides were detected at concentrations above MCLs at either well location. Alpha-hexachlorocyclohexane, which has no drinking water standard, was detected in samples from OHM-A7-46 at a maximum concentration of 0.269 μg/L.

Phosphate was detected in 4 of 9 samples submitted for analysis (wells OHM-A7-11, OHM-A7-12, and OHM-A7-45). Concentrations of phosphate detected in these samples ranged from 11.6 to 57.9 μg/L (Appendix D, Table D-14). No drinking water standards were found for this compound.

The explosive 1,3,5-trinitrobenzene was reported as an unconfirmed analyte in the ground water sample collected from well OHM-A7-45 in November 1992, and should be considered as undetected. No confirmed detections of explosives were reported for AOC A7 ground water.

Lead was the only metal detected in AOC A7 ground water at a concentration above its MCL (15 μg/L). Lead was detected in 13 of 19 ground water samples collected and the single exceedence of the MCL occurred at well location OHM-A7-12. Lead was detected in the June 1992 sample collected from this well at a concentration of 18.7 μg/L. Concentrations of lead in the samples collected before and after June 1992 were considerably lower (6.99 μg/L in October 1991 and 4.26 μg/L in November 1992).

Concentrations of aluminum, iron, and manganese exceeded USEPA SMCLs, which are based on aesthetics, in AOC A7 ground water. High manganese concentrations in ground water are reportedly characteristic of the region (Perlmutter, 1962; Pollock et al. 1969).

Concentrations of compounds detected in all ten wells in AOC A7 were compared with surface water criteria as a preliminary screening tool to determine if ground water discharge from AOC A7 could adversely affect the water quality of the Assabet River. Compounds which exceeded surface water criteria are listed in Table 3-11. This table presents a straight comparison between concentrations detected in ground water samples and surface water criteria, and does not take into account the many factors which will affect the concentrations of compounds actually reaching the Assabet River, such as degradation, diffusion, advection, and dilution. The significance of these exceedences is discussed as part of the Ecological Assessment in Appendix C.

3.3.5 Surface Water and Sediment Sampling Results

OHM has collected seven surface water/sediment samples from the unnamed stream adjacent to AOC A7. Three of these samples were collected in conjunction with the site investigation of AOC A7 (A7SW1/SD1 - A7SW3/SD3). The other four samples were collected upgradient of AOC A7 as part of the site investigation of SA P9 (P9SW1/SD1 - P9SW4/SD4). These samples were submitted for TCL VOC, TCL BNA, PCB/Pest, chlorinated herbicides, explosives, TOC (sediment samples only), and TAL metals analysis. The surface water/sediment sample collected in November 1993 (A7SW3/SD3), was also analyzed for total phosphates and OP Pest.

In addition to the seven samples collected by OHM, two other samples have been collected from this unnamed stream by other contractors. Surface water/sediment sample SW8/SED8 was collected by Dames & Moore in 1984. E&E sample location E3-BCK-D03 was sampled in September 1993. Both of these samples were collected near OHM sample location A7SW2/SD2 (Figure 3-1). Data from these nine sample locations can be compared to determine if there are any significant differences in compounds and/or concentrations detected upstream and downstream of AOC A7. Positive detections for surface water samples are presented in Appendix D, Tables D-15 through D-17. Analytes detected in sediment are listed in Appendix D, Tables D-18 through D-20. Compounds which exceed surface water criteria are listed in Table 3-13. Table 3-14 summarizes all compounds detected at concentrations above sediment criteria. Unknown compounds (VOCs and BNAs) detected in the samples collected by OHM are listed in Appendix D, Table D-50. Surface water sampling data will be discussed first, followed by the sediment sampling results.

Of the nine surface water samples collected, positive detections of VOCs were only reported for the sample collected by Dames & Moore (SW8) in 1984. VOCs were not identified in the samples collected upstream (A7SW2) or downstream (E3-BCK-D03) of this sample location. Acetone (6 μg/L), methylene chloride (40 μg/L), dimethoxydimethylsilane (10 μg/L), and hexamethylcyclotrisiloxane (30 μg/L) were the VOCs detected in this sample. Siloxane isomers are indicative of chromatographic column bleed and do not signify the presence of environmental contamination. Methylene chloride, which is a common laboratory contaminant, was found at similar concentrations in the QC blanks and its reported concentration is below the human health AWQC. Acetone is also a common laboratory contaminant.

SW8 was also the only sample location with positive BNA detections reported. DEHP, another common laboratory contaminant, was detected at a concentration (20 μg/L) below ESAT surface water

criteria. Dioctyl adipate was the other BNA detected at this location. No surface water criteria are available for this compound.

Phosphate was detected at sample locations P9SW1, A7SW3, and E3-BCK-D03. Concentrations were highest in the upgradient sample (P9SW1, 151 μg/L) and lowest in the most downgradient sample (E3-BCK-D03, 25 μg/L). Phosphate was not detected in either of the two background surface water samples and there are no surface water criteria with which to compare these positive detections.

Several metals were detected in these surface water samples. Arsenic was detected at 2 of 9 sample locations (A7SW2 and E3-BCK-D03). Arsenic concentrations at both of these locations (maximum 9.44 μg/L) are below the freshwater chronic AWQC but above the human health AWQC (Table 3-13). Lead was detected at sample locations P9SW1, A7SW1, A7SW2, and E3-BCK-D03 at concentrations ranging from 1 to 5.3 μg/L. Although these concentrations exceed ESAT surface water and chronic AWQC, they are below maximum background surface water levels (10.3 μg/L). Zinc exceeds surface water criteria at A7SW3 (600 μg/L). However, zinc was also detected in the laboratory method blank and all seven rinsate blanks analyzed within the same analytical lot as this sample. Rinsate blank zinc concentrations ranged from 201 to 610 μg/L. Therefore, this elevated zinc concentration may not be site-related. Zinc was reported at less than 100 μg/L in surface water sample SW8 collected by Dames & Moore in 1984, and was detected at a concentration of 17.3 μg/l in E&E sample E3-BCK-D03 collected in September 1993. Aluminum exceeds the ESAT surface water value at sample locations A7SW2 (650 μg/L) and A7SW3 (140 μg/L). Background aluminum concentrations (maximum 400 μg/L) also exceed ESAT criteria. Aluminum was not detected in any of the upstream samples associated with SA P9. Calcium, magnesium, manganese, and potassium were detected at concentrations above maximum background levels but all are naturally occurring essential elements and their detections are not considered to be significant. In general, there were no major differences in metal concentrations between upstream and downstream sample locations.

VOCs were not detected in the sediment samples collected by E&E and Dames & Moore. Acetone, methyl ethyl ketone, and methylene chloride were detected in OHM's sediment samples. Acetone was detected at 2 of 7 OHM sample locations (maximum 0.3 μg/g). Methyl ethyl ketone was detected at A7SD3 (0.05 μg/g). Positive detections of methylene chloride were reported in 5 of 7 samples collected by OHM at concentrations ranging from 0.009 to 0.021 μg/g. No ESAT sediment values are available for these VOCs and all three are common laboratory contaminants.

Several BNAs were detected in the sediment samples. The greatest number of BNA compounds were reported for Dames & Moore sample location SED8. BNAs listed in Appendix D, Table D-22 were either detected at concentrations below sediment criteria, or there are no sediment screening values available for the compound. BNAs were not detected in E&E's sample which was collected immediately downstream of SED8 in 1993, nine years after the Dames & Moore sample was collected.

The BNAs DEHP (1 of 7 sample locations at 0.55 μg/g), di-n-butyl phthalate (5 of 7 sample locations, maximum 2.6 μg/g), N,N-bis(2-hydroxyethyl)dodecanamide (1 of 7 locations at 1.4 μg/g), N-nitrosodi-n-propylamine (1 of 7 locations at 1.7 μg/g), and sulfur (1 of 7 locations at 1.2 μg/g) were also detected at OHM sediment sample locations (Appendix D, Tables D-18 and D-19). Sediment criteria are not available for these compounds. Three of the five sample locations with positive BNA detections were located upstream of AOC A7 in samples collected from SA P9. DEHP and di-n-butyl phthalate are

common contaminants resulting from the use of plastics in the sampling and analysis process. N,N-bis(2-hydroxyethyl)dodecanamide is a component of coconut oil and was probably introduced by the samplers.

PCB/Pest were not detected in the three sediment samples collected by OHM from AOC A7. The 1984 sample collected by Dames and Moore was not analyzed for PCB/Pest. DDE (0.038 μg/g) and ppDDT (0.003 μg/g) were detected at concentrations above sediment criteria in the sample collected by E&E from AOC A7. Pesticides were also detected at two of the upstream sampling locations at concentrations above screening levels. Chlordane, ppDDD, and ppDDT were the pesticides detected at P9SD2 at concentrations above sediment criteria. P9SD3 contained chlordane, ppDDD, ppDDE, and ppDDT at concentrations above screening levels (Table 3-14).

Phosphate was detected at a concentration of 570 μg/g in the sample collected in 1993 from A7SD3. Phosphate was not detected in either of the two background sediment samples and there are no sediment criteria for this compound.

Chromium, lead, and zinc were detected at concentrations above background levels, but below ESAT criteria. Arsenic (maximum 35 μg/g) exceeds the ESAT sediment criteria at 6 of 9 sample locations. Arsenic concentrations in upstream samples P9SD1, P9SD2, P9SD3, P9SD4 were 11, 10, 2.66, and 3.94 μg/g, respectively. Sediment samples from AOC A7 contained arsenic at concentrations ranging from 2.95 to 35 μg/g. Arsenic levels in samples collected from the three most downstream locations in AOC A7 were quite variable. The furthest downstream sample (E3-BCK-D03) had an arsenic concentration of 2.95 μg/g which is only slightly above background levels and below the ESAT sediment value, while SED8 contained a much higher concentration (30 μg/g). The concentration detected at A7SD2 was between these two values (12 μg/g). Barium was detected at concentrations exceeding the ESAT sediment screening criteria of 20 μg/g (ESAT, 1993) at upstream sampling locations P9SD1 (34.1 μg/g), P9SD3 (29.1 μg/g), and P9SD4 (34.3 μg/g), and at downstream sampling locations A7SD1 (21.2 μg/g), A7SD2 (27.2 μg/g), and A7SD3 (66.4 μg/g). Selenium exceeded the ESAT screening criteria of 1 μg/g at only one sampling location, A7SD3, where it was detected at a concentration of 2.4 μg/g (2.2 μg/g in the duplicate sample). Copper (A7SD2), nickel (A7SD2), and selenium (A7SD3) each exceed ESAT concentrations at 1 (A7SD2) of 9 sample locations. The single exceedence of copper (17 μg/g) is essentially equal to the ESAT value (16 μg/g). The remaining metals listed in Table 3-14 exceed maximum background concentrations.

The unnamed stream discharges into the Assabet River. OHM collected three surface water and nine stratified sediment samples from this river in May 1992. Sample location FWISW14/SD14 was located upstream of AOC A7 near the south side of Crow Island. FWISW15/SD15 was collected close to where the unnamed stream drains into the Assabet. FWISW16/SD16 was located downstream of AOC A7 (Figure 1-2). Compounds detected in surface water and sediment samples are listed in Appendix D, Table D-21. All positive detections for sediment samples are listed in Appendix D, Table D-22 and compounds which exceed surface water criteria are listed in Table 3-15. Table 3-16 provides a summary of all analytes detected at concentrations above sediment criteria. A discussion of the compounds detected in these surface water and sediment samples is included in the Supplemental Ecological Risk Assessment in Appendix C.

3.4 CONTAMINANT FATE AND TRANSPORT

Chemicals of concern for AOC A7 consist primarily of chlorinated VOCs, OP Pest, and heavy metals. The general chemical and physical properties of these chemical groups and mechanisms for their migration are discussed below.

3.4.1 Chlorinated Volatile Organic Compounds

The chlorinated VOCs tend to be rather volatile in shallow soils (USEPA, 1985). The halogenated VOCs can be degraded by soil bacteria but biodegradation occurs slowly. The chemicals have fairly low octanol-water partition coefficients and are considered to be rather mobile in the subsurface environment. They are more dense than water and if large quantities migrate to ground water they will tend to move along subsurface formations and not necessarily in the same direction as ground water.

3.4.2 Organochlorine Pesticides

The principal environmental fate processes for the OP Pest are adsorption to soils, runoff into any nearby streams, subsequent deposition in sediments, or migration and redeposition as a component of windborne dust. Newly deposited pesticides are also somewhat volatile. The pesticides in this area has been exposed to high ambient temperatures, sunlight, and rain, and have been present for a considerable amount of time. It seems likely that during that time any pesticide in surface soil that was not tightly bound to the soils would have volatilized at least from the surface soil layer. Organochlorine pesticides still remaining in the soils are likely to be rather tightly bound to soil particles. These compounds may not be as readily bioavailable as freshly spilled pesticides. The organochlorine pesticides are not considered to be very mobile in the environment and are not likely to migrate with ground water. A possible exception is lindane, which is somewhat more water soluble than most organochlorine pesticides.

3.4.3 Metals

Metals are generally not considered to be very mobile in the environment and are likely to remain bound to site soils. However, the behavior of a particular metal is highly dependent on its form in the environment and infiltrating precipitation may leach the more soluble metals from the soil and transport them into the ground water. Soil parameters that must be considered are clay and metal oxide content, fraction of organic matter, pH, and oxidation-reduction potential. Chemical partitioning between soil and water can be expressed by a soil-water distribution coefficient (K_d). The use of K_ds predicting contaminant movement may underestimate migration potential because site-specific migration is based on chemical adsorption and desorption reaching equilibrium. As a rough estimate of relative mobilities, K_ds for the inorganic chemicals of concern can be compared. For example, cadmium has a low K_d of 6.5 whereas lead, with a K_d of 900, is much less mobile. However, mobility can be enhanced by the presence of other chemicals such as naturally occurring humic materials. Since clays favor adsorption of the metals being evaluated, and clays are present in the soils and aquitards beneath the site, the metals of concern are not expected to be very mobile.

Metals adsorbed to surface soil particles may migrate into the air as a component of windborne fugitive dust. Release of large quantities of fugitive dust is not expected to occur because much of the area

is covered by vegetation and the trees surrounding the site should act to decrease wind velocity. Therefore, migration of metals from the soil surface and subsequent exposure via inhalation is considered unlikely.

3.4.4 AOC A7 - Summary

As noted above, the behavior of the chemicals present in AOC A7 depends on both the chemical properties and the local environment. Chemicals have been in place at AOC A7 for over 20 years and their behavior will be influenced by the environmental weathering that has occurred over that time. For example, it is unlikely that volatile chemicals will be present in surface soils because these chemicals will either volatilize, or leach downward with infiltrating water. Pesticides and metals may occur at the surface, but are likely to be more tightly bound than freshly applied chemicals. The soils in the area consist of fill over fairly tight tills. Water and chemicals will move fairly readily through the fill material, but the characteristics of the tills will serve to limit the downward flow of water and, consequently, the downward flow of associated contaminants. However, some migration of chemicals with ground water is occurring at the site.

3.5 BASELINE RISK ASSESSMENT SUMMARIES

3.5.1 Human Health

A BRA for the Annex was finalized in January 1994 (OHM, 1994). This risk assessment evaluated the current and potential future health risks to individuals who may use AOC A7. The BRA was developed based on the data collected by OHM during the Phase I SI/RI at the Annex. An addendum to the human health risk assessment was prepared to evaluate data collected during the Phase II SI/RI to determine whether or not findings from this investigation modify the risk estimates reported in January 1994. This Addendum is included as Appendix C to this report. Results of the BRA, the addendum, and an overall evaluation of the potential for health risks at AOC A7 are summarized in the following section.

3.6 PREVIOUS RISK ASSESSMENT RESULTS

The following contaminants were detected in AOC A7 during the Phase I sampling effort reported in the January 1994 SI/RI report:

- Soil samples contained numerous organic and inorganic contaminants including heavy metals, organochlorine pesticides, herbicides, an explosive, PAHs, other semivolatile organic compounds, and chlorinated and non-chlorinated solvents
- Ground water sampling detected organochlorine pesticides, chlorinated solvents, and acetone
- Surface water samples contained elevated iron concentrations
- Sediment samples contained metals, an insect repellant (probably introduced during sample collection), a nitrosamine, and two solvents.

Risks estimated for AOC A7 under current use and future use scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.09	0.9
Cancer Risk	3×10^{-6}	3×10^{-5}

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.4	4
Cancer Risk	4×10^{-5}	3×10^{-4}

Sediment Ingestion

	Average	Maximum
Hazard Index	0.6	0.7
Cancer Risk	1×10^{-5}	2×10^{-5}

Ground Water Use

	Average	Maximum
Hazard Index	0.2	1
Cancer Risk	3×10^{-5}	2×10^{-4}

It should be noted that a third of the risk for ground water use was associated with a single detection of arsenic at a concentration (3 μg/L) that is well below the current MCL for this compound (50 μg/L). Also, the organochlorine pesticides (alpha-benzenehexachloride or BHC, dieldrin, heptachlor epoxide, and lindane) are not very soluble in water and were probably bound to suspended soil particles in the sample. These suspended particles would tend to settle out of water in a domestic well and consequently, exposure to the organochlorine pesticides is unlikely from a private well located on the site. It should also be noted that the compounds posing risks were detected infrequently.

AOC A7 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and contacting soil and using water from a private well on the site is:

Total Systemic and Cancer Risk Residential Use Scenario

	Average	Maximum
Hazard Index	0.2	1
Cancer Risk	7×10^{-5}	5×10^{-4}

Lead

For exposure to lead, risks were evaluated using USEPA's Uptake/Biokinetic (UBK) Model and results from the model were compared with an USEPA blood lead action level of 10 μg/dl. Lead levels reported for AOC A7 are:

Soil: average conc. = 70 mg/kg; max conc. = 400 mg/kg
Sediment: average conc. = 9 mg/kg; max conc. = 12 mg/kg
Ground Water: average conc. = 4 μg/L; max conc. = 19 μg/L

Based on the UBK model, lead does not pose a health risk in AOC A7.

Discussion

Much of the risk estimated for this area is associated with the presence of hotspots (areas of localized contamination). As a result, for risks of the magnitude estimated in this report to occur would require frequent contact with these hotspots. Such contact is unlikely, even in the equally unlikely event that a house were to be constructed on the site. Consequently, actual risks are probably substantially lower than risk estimates based on maximum exposure point concentrations. However, AOC A7 does consist of an old landfill that was used for the disposal of both laboratory and general refuse. It is likely that in addition to the hotspots noted in this investigation, other areas of the site also contain undetected residual contamination.

3.7 CURRENT FINDINGS

Results of the Phase II SI/RI conducted by OHM in late 1993 at AOC A7 are described in detail in Section 3.3. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I SI/RI, include lead (test pits), arsenic (sediments), beryllium (test pits and well borings), ppDDT (test pits), chloroform (ground water), 1,1,2,2-tetrachloroethane (PCA; ground water), tetrachloroethylene (PCE; ground water), and lindane (ground water). In addition to chemical findings, an approximately 20 feet by 20 feet area in the center of the western portion of the site was determined to contain laboratory glassware.

Lead (3,900 mg/kg), beryllium (0.48 mg/kg), ppDDT (610 mg/kg), and chlordane (30 mg/kg for alpha and gamma combined) were found at somewhat higher maximum concentrations in Phase II test pit samples than in Phase I soil sampling. Arsenic was also detected at a higher concentration in sediments (35 mg/kg). The lead and chlordane levels are approximately an order of magnitude higher than the maximum Phase I sampling results. ppDDT was present at a concentration only slightly higher than the Phase I sampling results. The arsenic and beryllium concentrations are slightly above site-specific background levels calculated in the BRA. However, natural levels of metals can vary substantially depending on local geology and the slight elevations in AOC A7 may be examples of natural variability in metal levels in the area of the Annex.

Levels of several chemicals were elevated in ground water in the Phase II SI/RI. Specifically, maximum concentrations of the chlorinated solvents chloroform (300 μg/L), PCA (200 μg/L), and PCE (130 μg/L) were substantially higher than reported in January 1994 (OHM, 1994). Lindane concentrations

were also elevated (maximum concentration of 3.6 μg/L) and in addition, lindane was detected more frequently (7 of 10 samples were positive).

3.8 RISK CHARACTERIZATION

As noted in the BRA finalized in January 1994, AOC A7 has been used as a dump for laboratory wastes, trash, and general debris. Numerous points of contamination were noted in soils, and elevated levels of several chemicals were detected in ground water. The Phase II SI/RI generally confirms these findings. Ground water and soils at the site show sporadic occurrences of elevated levels of contaminants, and further investigation would probably identify additional evidence of such hotspots.

The Phase II SI/RI also confirmed concerns about the potential for undiscovered hazards at the site. During test pit excavations, brown glass bottles were uncovered. These bottles were re-covered and their location noted. Other similar collections may be present at the site. Because the bottle contents are unknown, there is a possibility that unstable or shock sensitive materials may be in the landfill. If such materials are present, digging into the landfill may pose a substantial hazard to workers.

3.8.1 Ecological

A basewide ERA was finalized in January 1994 (OHM, 1994). A supplemental ERA was prepared to evaluate data collected during the Phase II SI/RI at the Annex. This supplemental ERA complements the basewide assessment by focusing more closely on the three RI areas, AOCs A4, A7, and A9. The supplemental ERA is included as Appendix C to this report. Results of the assessment specific to AOC A7 are summarized below.

One concern at AOC A7 is the elevated levels of lead and several organochlorine pesticides, including ppDDT, ppDDE, ppDDD, and chlordane, detected in soils. Based on a review of aerial photographs, AOC A7 had been cleared prior to 1939, had been used as a gravel pit and then as a disposal site, and recently has been recleared with much of the surface debris removed. The overall effect is that residual soils are of poor quality for supporting plant life and are unlikely to be a preferential habitat for any other terrestrial wildlife. Because of poor soils, and because lead and pesticides are detected infrequently at isolated locations (i.e., hotspots), ecological risks associated with these chemicals in soils are unlikely. A semi-quantitative screening-level evaluation of the potential for ecological harm further supports this conclusion.

The other major ecological concern at AOC A7 involves the possibility that chemicals released from the site may adversely affect organisms in the adjacent Assabet River. Levels of lindane in ground water from a well (A7-GW51) that is located close to the river exceed AWQC criteria and this pesticide may well be migrating to the river. However, several factors suggest that adverse effects are unlikely, or if they occur, will be minimal. Water from the site is released only slowly due to the consistency of the soils in the area. In addition, the small volume of water released from the site will be quickly diluted by the large volume of water in the river. Consequently, any impacts on river organisms will be very localized. River sediments have a higher organic carbon content than soils and this carbon may adsorb the contaminant, thereby further decreasing the bioavailability of lindane to aquatic organisms. Past industrial uses and pesticide releases from upstream apple orchards are likely to have already affected the Assabet River by eliminating organisms that are particularly sensitive to the effects of chemicals. Continuing releases of pesticides and nutrients from water treatment plants, lawn care, orchards, and the golf course located

directly across the river from AOC A7 are likely to prevent the reestablishment of sensitive organisms in the river. Consequently, even if lindane from AOC A7 migrates to the river, it is unlikely to have a significant impact on aquatic life in the Assabet.

3.9 SUMMARY AND CONCLUSIONS

AOC A7, the Old Gravel Pit Landfill, was used between 1941 and the mid-1980s for the disposal of solid waste, drums, chemicals, chemical containers, and demolition debris. The central portion of the site is cleared of vegetation, while the peripheral areas are heavily vegetated. The steep northward-dipping slope on the northern boundary of the AOC is heavily vegetated and debris is visible on, and protruding from, the slope. The eastern portion of the site also contains solid waste, both on the surface and buried. This eastern area was previously referred to as SA P8 and was a reported transformer disposal site. SA P8 is now considered to be a part of AOC A7 and was included in the AOC A7 investigation.

During the Phase I and Phase II SI/RI of AOC A7, 11 monitoring wells were installed, 19 test pits and 2 test trenches excavated, 20 soil borings drilled, and 14 surface soil, 87 subsurface soil, 4 hand auger, 30 ground water, 7 surface water (including SA P9), and 8 sediment (including SA P9) samples were collected. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, herbicides, explosives, and TAL metals. Some of the Phase II samples were also analyzed for OP Pest. During the Phase I SI/RI, one bedrock and seven shallow monitoring wells were sampled for TCL VOCs, BNAs, PCB/Pest, chlorinated herbicides, phosphates, explosives, and TAL metals. During the Phase II SI/RI, two additional shallow monitoring wells were installed and sampled, and three existing monitoring wells sampled for TCL VOCs, BNAs, and PCB/Pest analysis. Four additional test pits were excavated and sampled, two test trenches were dug in order to more accurately assess the limits of the laboratory waste burial area, and two hand auger samples were collected.

OHM collected seven surface water samples from the unnamed stream adjacent to and upstream of AOC A7. Three of these samples were collected in conjunction with the RI of AOC A7, while the remaining four samples were collected upgradient of AOC A7 during the Phase I SI/RI of SA P9. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Two other samples were collected from this stream by other contractors. E&E sample E3-BCK-DO3 was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, phosphate, and TAL metals. Dames & Moore sample SW8 was analyzed for VOCs, BNAs, and metals. Sediment samples were collected at each surface water sampling location.

Two distinct classes of landfills were discovered in AOC A7. These two landfill types are differentiated based on the character of the buried wastes, the types of soil contaminants associated with the known burial sites, the depth of waste burial relative to the top of ground water, the observed impact on ground water quality, and the potential human health and ecological risks. The first, and most hazardous, is the buried laboratory waste disposal area discovered in the western portion of the site. The second landfill type includes solid waste landfills in the central and eastern sections of the site, several surface dumping areas, and two sites where elevated levels of pesticides were detected in subsurface soil. The contamination assessment evaluates each of these two landfill types separately.

3.9.1 Laboratory Waste Area Contamination Assessment

Laboratory wastes were discovered and described during the excavation of test pits A7TPK, A7TPL, and A7TPR, test trenches A7TTA and A7TTB, and when sampling soil borings A7B3, A7B4, A7B17, and OHM-A7-8. The soil contamination assessment is based on the analytical results from these sampling points.

During test pitting and soil boring operations in the western section of AOC A7, several types of laboratory waste were discovered. Brown glass and clear glass jars and jugs of unknown chemicals, from ½-pint to 1-gallon in capacity, were found. Many of the jars contained unknown liquids and varied from empty to nearly full. Container labels were badly weathered and could not be read, and metal caps were corroded. Other buried debris included broken bottles, test tubes, fabric, crushed 5-gallon cans, scrap metal, and buried drums. PID readings during the excavations ranged from background to 100 ppm. All elevated PID readings were associated with buried laboratory waste. No organic wastes, other than wood, were found in this area.

Laboratory wastes, drums, and other materials were present at the ground surface and extended to a depth of 8 to 10 feet BGS. Drums were exposed in a ditch on the south side of this area near test pit A7TPR, while glass shards, cloth, and burned wood were noted in the split spoon sample collected from 8 to 10 feet BGS in the boring for monitoring well OHM-A7-8. Dark horizons, probably resulting from previous spills or chemical discharges in the area, were noted at depths of 4 to 5 feet BGS. The observed depth of burial places the base of the waste materials approximately 2 to 3 feet below the top of ground water. Therefore, ground water migrating through this burial area is in direct contact with the contaminated soils, buried debris, and laboratory wastes.

3.9.1.1 Soil Contamination

Soil contaminants exceeding screening criteria in the laboratory waste area consist primarily of pesticides and chlorinated VOCs. The organochlorine pesticides dieldrin (0.26 to 1.5 μg/g), lindane (0.29 to 0.67 μg/g), ppDDD (2.4 to 2.6 μg/g), and ppDDT (4.5 μg/g) were detected in excess of screening criteria. Chlordane, heptachlor, heptachlor epoxide, ppDDE, and PCBs were also detected. The organophosphorus pesticides Demeton-O (2 μg/g), Fenthion (0.13 μg/g), and methyl parathion (0.11 to 0.61 μg/g) were also detected. In the VOC analyses, 1,1,2-trichloroethane (20 μg/g), 1,2-dichloroethane (1 μg/g), chloroform (0.3 to 20 μg/g), and PCE (0.6 to 20 μg/g) were detected in excess of screening criteria. Acetone, chlorobenzene, ethylbenzene, trichloroethylene, and xylenes were also detected. Lead was detected in all 10 subsurface soil samples from this area at concentrations ranging from 1.02-93 μg/g in 9 of the samples, and at a concentration of 3,900 μg/g in sample A7TPR2, collected from a depth of 2-3.5 feet BGS.

3.9.1.2 Ground Water Contamination

Ground water quality in and around the laboratory waste area was assessed using monitoring wells OHM-A7-8, OHM-A7-45, and OHM-A7-46. The ground water quality downgradient (north) of this source area was assessed using monitoring wells OHM-A7-51 and OHM-A7-52. Exceedences of ground water screening criteria were primarily noted in source area wells OHM-A7-8 and OHM-A7-46, and in downgradient well OHM-A7-51. The majority of the contaminants detected in the ground water were also present at elevated levels in area soils.

The pesticides lindane (0.49-3.1 μg/L), ppDDD (0.203-0.445 μg/L), and dieldrin (0.101 μg/L), and the VOCs 1,1,2-trichloroethane (7.2 μg/L), acetone (9000 μg/L), carbon tetrachloride (16 μg/L), chloroform (5.4-300 μg/L), and PCE (5.1-38 μg/L), all detected at elevated levels in area soils, were detected in source area ground water at concentrations exceeding screening criteria. All of these contaminants, except for dieldrin, were detected in monitoring well OHM-A7-8. PCE and lindane were also detected at elevated levels in OHM-A7-46, while dieldrin was only detected in monitoring well OHM-A7-45 on one occasion. Chloroform (120 μg/L), PCE (130 μg/L), and lindane (3.5-3.6 μg/L) were also detected in downgradient monitoring well OHM-A7-51. Additionally, 1,1,2,2-tetrachloroethane and trichloroethylene were also detected in this well at concentrations of 200 μg/L and 50 μg/L, respectively. Lead was not detected above screening levels in any of the wells.

During the ground water sampling event conducted in December 1993, both unfiltered and filtered ground water samples were submitted for PCB/Pesticide analysis for all monitoring wells in, and downgradient of, the laboratory waste area. Pesticides were detected in both the unfiltered (U) and filtered (F) samples from monitoring wells OHM-A7-46 [alpha-benzene hexachloride (U-0.143/F-0.149 μg/L) and lindane (U-3.1/F-2.8 μg/L)], OHM-A7-51 [lindane (U-3.5/F-3.6 μg/L)], and OHM-A7-52 [lindane (U-0.0669/F-0.0793)]. Alpha-Hexachlorocyclohexane (0.03 μg/L), lindane (0.49 μg/L), and ppDDD (0.232 μg/L) were detected in the unfiltered sample from well OHM-A7-8, but were not detected in the filtered sample. No pesticides were detected in either ground water sample collected from monitoring well OHM-A7-45 during this sampling event.

3.9.1.3 Conclusions

Subsurface soil and ground water sampling has shown that buried laboratory wastes and chemical discharges have resulted in soil and ground water contamination. Downgradient ground water sampling results have shown that contamination has reached the site boundary and has probably migrated off site to the Assabet River. These results suggest that, given the hydrogeologic setting and the nature of the contaminant source, the buried waste and contaminated soil in this area will continue to impact subsurface soil, ground water, and local surface water unless removed.

3.9.2 Solid Waste Landfill Contamination Assessment

Solid waste was discovered during the site inspection, test pitting, and soil boring operations conducted in the central and eastern portions of AOC A7. A total of 16 test pits were excavated and 18 borings installed in the solid waste landfill areas. Analytical results from both surface and subsurface soil samples were used to characterize soils in the area, and downgradient monitoring wells were sampled to assess the impact that the solid wastes might have on ground water quality.

Test pits were excavated to investigate geophysical anomalies identified during the geophysical surveys conducted in AOC A7 (OHM, 1994). The geophysical survey results indicate that the buried solid waste is present in isolated locations on the top of the landfill area, and is continuous along the northward-dipping slope bordering the Assabet River. Food cans, plastic food wrappers, and first aid kits, probably resulting from product testing conducted by Natick Testing Laboratories, were discovered in test pits A7TPC and A7TPH. Indications of chemical disposal such as stained soil horizons, 55-gallon drums, elevated PID readings, and odors were found in test pits A7TPH, A7TPD, and A7TPQ, in soil boring A7B8 located near test pit A7TPQ, and in soil borings A7B18, A7B19, and A7B20 located around confirmatory drum sampling location A7CD2. Building demolition debris, household trash, auto parts,

metallic debris of all kinds, rock cores and geotechnical samples, broken glass, metal piping, and plumbing fixtures were found on the surface and buried throughout the area. Burnt wood, burnt paper, and burnt plastic were also found at several locations, supporting the report that incineration was used as a volume reduction measure.

Elevated PID readings were noted only in test pit A7TPQ (8 parts-per-million (ppm) at 5 feet BGS), and in borings A7B7 (150 ppm at 2 feet BGS), A7B18 (20 ppm at 6 feet BGS), and A7B20 (120 ppm at 5 feet BGS). In test pit A7TPQ the elevated PID reading was associated with a black, sticky layer noted at 5 to 5-½ feet BGS. In borings A7B18 and A7B20 the PID readings appear at or near the observed top of ground water, while in boring A7B7 the elevated PID reading appears to be the result of a surface spill. At no time was an elevated PID reading associated with buried debris. In general, no gas generation was noted in the landfill areas. This observation is consistent with the nature of the buried debris encountered. In addition, no evidence was noted indicating that subsidence of the landfill surface was occurring.

Ground water beneath the northern end of the landfill is at an approximate depth of 18 feet BGS as measured in monitoring well EHA-2 on April 27, 1994. This places the top of ground water well below the lowest observed depth of burial in this area.

3.9.2.1 Soil Contamination

Exceedences of screening criteria for ppDDT, ppDDD, and ppDDE were noted only in the south-central portion of AOC A7 in test pit A7TPQ, soil borings A7B8 and A7B19, confirmatory drum sample A7CD2, and surface soil sample A7SO9. Within this small area, ppDDT was detected above screening criteria 7 times at concentrations ranging from 3.8 to 610 μg/g, ppDDD twice at 64 and 210 μg/g, and ppDDE 3 times at concentrations ranging from 5.9 to 86 μg/g. The only other compound detected above screening criteria in this area was the BNA 2-methylnaphthalene at a concentration of 1.8 μg/g.

In the southeastern portion of AOC A7, exceedences of screening criteria for the pesticides endrin (4.1 μg/g), heptachlor epoxide (0.29 μg/g), and total chlordane (3.5 to 30 μg/g) were noted in samples from test pit A7TPS. An exceedence of total chlordane (2.61 μg/g) was also noted in the sample from soil boring A7B12. Lead was detected in test pit A7TPS at concentrations of 330 μg/g (0.0-2.0 feet BGS) and 520 μg/g (2.0-4.0 feet BGS).

BNAs were detected at levels above screening criteria at two closely spaced sampling locations in the north-central portion of AOC A7. Chrysene was detected at a depth of 2.0-4.0 feet BGS at 0.79 μg/g in test pit A7TPE. 2-Methylnaphthalene (10 μg/g), benzo(a)anthracene (3 μg/g), and benzo(a)pyrene (2 μg/g) were detected at surface soil sampling location A7SO6.

3.9.2.2 Ground Water Contamination

Ground water quality downgradient of the solid waste landfill areas was assessed using ground water samples collected from monitoring wells OHM-A7-9, OHM-A7-10, OHM-A7-11, and OHM-A7-12. A reported lead detection of 18.7 μg/L in ground water collected from monitoring well OHM-A7-12 during the June 25, 1995 sampling event slightly exceeded the MCL lead standard of 15 μg/L. However, this detection was not confirmed in other sampling events for this well where lead was detected at concentrations of 6.99 and 4.26 μg/L, respectively. Lead is therefore not considered to be a contaminant

of concern in ground water in this area. Methylene chloride was detected a total of 5 times in these wells at concentrations of 6.5 to 8.43 µg/L, slightly exceeding the MCL standard of 5 µg/L. Four of these detections occurred during the October 3, 1991 sampling event, while the fifth occurred in OHM-A7-11 during the June 25, 1992 sampling event. None of the methylene chloride detections were confirmed during other sampling events and the positive detections are considered laboratory artifacts. These analytical results indicate that buried solid waste in the central and eastern portions of AOC A7 is not significantly impacting ground water quality at this time.

3.9.2.3 Conclusions

Although a wide variety and large volume of buried solid waste was observed in this area, soil contamination appears to be limited to pesticides, lead, and several BNAs. Ground water analytical results show that these buried wastes have not yet significantly impacted ground water quality, indicating that leachate generation is minimal. Given the hydrogeologic setting and the nature of the buried waste, consolidation and capping of this area is appropriate. Capping would isolate the buried wastes, reducing the possibility of future contact with these materials, and would reduce or eliminate future leachate production, thereby preserving ground water quality.

3.9.3 Surface Water and Sediment Contamination Assessment

OHM collected seven surface water/sediment samples from the unnamed stream adjacent to AOC A7. Three of these samples were collected in conjunction with the RI of AOC A7, while the remaining four samples were collected upgradient of AOC A7 during the Phase I SI/RI of SA P9. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Two other samples were collected from this stream by other contractors. E&E sample E3-BCK-DO3 was analyzed for VOCs, BNAs, PCB/Pest, explosives, phosphate, and metals. Dames & Moore sample SW8 was analyzed for VOCs, BNAs, and metals.

3.9.3.1 Surface Water

VOCs and BNAs were only detected in sample SW8 collected by Dames & Moore in 1984. The organic compounds detected in the Dames & Moore sample are common laboratory contaminants, and the lack of confirmatory results from subsequent sampling suggests that these compounds are not contaminants of concern in the stream.

Arsenic was detected at A7SW2 and E3-BCK-DO3 at concentrations (maximum 9.44 µg/L) below the freshwater chronic AWQC but above the human health AWQC. Although lead was detected in several surface water samples from AOC A7 and SA P9 at levels above ESAT surface water and freshwater chronic AWQC criteria, all concentrations were below maximum background. Elevated zinc concentrations were attributed to laboratory contamination, as the rinsate blank concentrations were comparable to the field sample concentrations. Aluminum (maximum 650 µg/L) exceeded EAST criteria at A7SW2 and A7SW3. In general, there were no significant differences in metal concentrations between the upstream and downstream sample locations.

3.9.3.2 Sediment

Sediment samples were collected in conjunction with surface water samples and analyzed for TCL VOCs, BNAs, PCB/Pest, TAL metals, OP Pest, explosives, herbicides, and phosphate. VOCs were only detected in samples collected by OHM. The three VOCs detected (acetone, methyl ethyl ketone, and methylene chloride) are common laboratory contaminants and are not considered site-related detections. Several PAHs were detected at Dames & Moore's sampling location SED8 in 1984. PAHs were not detected in E&E's sediment sample which was collected immediately downstream of SED8 in 1993.

PCB/Pest were not detected in the three sediment samples collected by OHM from AOC A7. ppDDE (0.038 μg/g) and ppDDT (0.003 μg/g) were detected at concentrations above ESAT sediment criteria in the sample collected by E&E. ppDDT, ppDDD, and ppDDE were also detected at concentrations above screening levels in sediment samples collected from upstream locations at SA P9.

Arsenic, barium, nickel, and selenium were all detected at concentrations above ESAT sediment criteria. Arsenic concentrations ranged from 3 to 35 μg/g. The highest concentration was detected at A7SD3 (duplicate only). Barium was detected at concentrations ranging from 17.7 to 68.4 μg/g in samples from both AOC A7 and SA P9. Nickel (25.7 μg/g at A7SD2) and selenium (2.4 μg/g at A7SD3) each exceeded ESAT criteria at 1 of 9 sample locations.

3.9.3.3 Conclusions

Surface water and sediment samples were collected from the unnamed stream east of AOC A7 to assess the impact that past site activities may have had on stream quality. Although several compounds identified as contaminants of concern in AOC A7 were also detected in surface water and/or sediment samples, there were no significant differences between samples collected upstream of the site and samples collected downstream of the site. As a result, it does not appear that past site-related activities have impacted stream quality, or that the stream is functioning as a migration pathway for contaminants from AOC A7 to the Assabet River.

3.9.4 Conclusions

Under the exposure scenarios considered in the human health risk assessment prepared for the site, current use poses an average cancer risk of 3×10^{-6} and a maximum cancer risk of 3×10^{-5} , which is slightly above the USEPA risk goal of 10^{-6} but within the risk range of 10^{-4} to 10^{-6} commonly used by USEPA in making regulatory decisions. The noncancer health hazard was below the hazard index goal of 1. Risks associated with the unlikely future use scenario of residential use of the site poses an average cancer risk of 7×10^{-5} and a maximum cancer risk of 5×10^{-4}, above the USEPA risk goal of 10^{-6} and, for the maximum estimate, above the USEPA risk range of 10^{-4} to 10^{-6}. The hazard index for the residential use scenario was above the target level of 1. As noted in the risk assessment, much of the risks estimated for the site are based on frequent contact with hotspots, which is an unlikely occurrence. Consequently, actual risks are likely to be lower, and quite probably substantially lower, than those estimated in the human health risk assessment. Furthermore, any action or future use of the site that leads to lower exposure will also lead to lower risks. For example, deed restrictions to prevent construction of a residential dwelling on the site, or incorporation of the land into the nearby Great Meadows National Wildlife Refuge would lead to health risks that are probably below the USEPA goal level (10^{-6} risk) and at most, would be at the low end of the USEPA risk range.

Two exposure pathways were considered for ecological receptors in AOC A7. The first assumes that terrestrial organisms could be exposed to chemicals in soils, and the second assumes that aquatic organisms could be exposed to chemicals that migrate in ground water from AOC A7 to the Assabet River. Elevated levels of pesticides and lead were noted in surface soils at AOC A7, and regular contact with affected areas may pose an unacceptable risk. However, as noted in the Supplemental Ecological Risk Assessment, chemicals in soils at AOC A7 are present in hotspots and frequent contact with these hotspots is unlikely. Levels of lindane in ground water from monitoring well OHM-A7-51, located at the site boundary, exceed AWQC, and indicate that the chemical may be migrating to the Assabet River. However, several factors, including dilution, adsorption of chemicals by sediments, and historical and past uses of the river, suggest that contaminants migrating off site are unlikely to adversely impact the Assabet River. Consequently, the results of the ecological risk assessment, including a consideration of site conditions, a screening-level risk assessment, and bioassay of the stream on the eastern side of the site, suggest that AOC A7 is unlikely to pose significant ecological risks.

In the USEPA Directive (OSWER 9355.0-30; April 22, 1991) on the Guidance on the Use of Risk Assessment in Remedy Selection, USEPA notes that action is generally not warranted at a site if health risks for both current and future use are below a cancer risk level of 10^{-4} and a noncancer HI of 1, and if a site does not pose ecological risks. However, USEPA notes that exceptions to this rule are possible based on the discretion of the risk manager. At AOC A7, the presence of the undefined laboratory wastes in the disposal area in the west-central portion of the site poses an unknown hazard and warrants remediation. The remainder of the site is unlikely to pose significant health or ecological risks, particularly under anticipated future use options, and may not warrant risk-based remediation. However, action to address Massachusetts state solid waste regulations may be required.

Proposed actions for this site address both the laboratory waste area in the western portion of AOC A7, and the buried solid waste in the central and eastern portions of the site. Action at the laboratory waste area includes excavation and off-site disposal of all laboratory-related wastes and adjacent soils. This source removal action will require the removal of soil, solid waste, and laboratory waste from both above and below the water table. This removal will minimize or prevent the continuing release of contaminants to the subsurface and to the ground water.

A RCRA Subtitle C Landfill Cap (RCRA-C cap) that will satisfy Massachusetts state solid waste regulations has been proposed to cover the central and laboratory waste burial areas in AOC A7. Although no significant ground water contamination has been detected in the central area, the RCRA-C cap will prevent future ground water contamination by infiltration and generation of leachate resulting from contact with presently undiscovered hazardous materials in this waste burial area. An additional benefit is that solid wastes and contaminated soil from other areas on the Annex, such as SA P8 and AOC A9, can be consolidated under the cap to ensure their containment and control.

The source control, or soil operable unit (OU) has been separated from the management of migration, or ground water, OU for this area. In addition, although recommended alternatives for soils are discussed separately for AOCs A7 and A9 in this report, these areas have been consolidated into one OU and will be treated as one unit in the Proposed Plan and Record of Decision (ROD).

Remedial alternatives for the ground water OU will be addressed after further investigation is conducted to assess off-site ground water quality downgradient of AOC A7. In addition, the ground water

OU for AOC A7 has also been consolidated with AOC A9 to form one ground water OU that will address both AOCs.

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4.0 REMEDIAL INVESTIGATION OF AOC A9

AOC A9, the POL Burn Area, is located north of Patrol Road by the North Gate as shown on Figure 1-1. Now inactive, this area was reportedly in use between 1959 and 1984 for product testing, flame-retardant clothing and equipment testing, fire fighting training, and the incineration of confiscated fireworks.

Figure 4-1 is a map of AOC A9 showing the locations for all investigative work performed and samples collected. Table 4-1 lists all samples collected in AOC A9 during the Phase II SI/RI, the sample media, and analytical parameters requested.

4.1 AREA CHARACTERISTICS AND HISTORY

AOC A9 is level, nearly square, and covers approximately 7 acres. Tall grasses, shrubs, and small pine trees cover the majority of the area. A source removal area within A9 show signs of vegetation stress. The area is bounded on the south by Patrol Road, and on the east, north, and west by forest. The north side of AOC A9 slopes steeply down to Track Road and the Assabet River. An unnamed stream west of the area flows north towards the Assabet River.

Building T401 is one of two structures remaining on the site and is located by the entrance gate installed in the southeast corner. Building T402 is also located in the southeastern corner of the area and was reportedly used to store mannequins used for fireproof clothing burn tests. The fireproof clothing test facility is located near the center of the cleared portion of the area. This facility is lined with cinder block walls, has an asphalt base, and is bounded on the north by a large, freestanding, concrete wall with metal doors.

The area perimeter is enclosed by a fence and a berm (Figure 4-1). A culvert is installed through the berm in the southwest corner of AOC A9. Figure 4-2 is an enlarged inset of the southwest corner showing arsenic sampling locations and results. During the following discussions, site north is defined as the side parallel to the Assabet River.

4.1.1 Area-Specific Background Information

The area-specific background information is organized into several sections. These include past site usage, previous environmental investigations, the nature and extent of contamination, and past remedial actions. Background information has been obtained from aerial photographs, maps, reports, correspondence, memorandums, records reviews, and interviews. Each section is arranged in chronological order.

4.1.1.1 Historical Aerial Photographs and Site Maps

Seven sets of aerial photographs taken between 1939 and 1992 (Table 2-2), and one set of low oblique, color infrared photographs, taken in 1981 (USEPA, 1982), have been examined. These photographs were used in conjunction with three historical site maps prepared by OHM (1992A: Figures 3-2, 3-3, and 3-4) in order to assess past site usage, physical changes, and developments that have occurred in AOC A9. Due to the concern that contaminants from AOC A9 may have impacted SA P9 to the west, a description of SA P9 is also included in this section. The following discussion presents the results of this preliminary examination.

1939

The 1939 photograph shows that AOC A9 and the surrounding areas to the south were part of a farm. Farm buildings and two orchards were present south of AOC A9 along White Pond Road (SA A8) and a third orchard was present in AOC A9. Cleared fields, delineated by dirt roads and stone walls were present south and west of AOC A9, and wooded areas bordered the site to the northwest, north, and east.

1943

This set of photographs show the remnants of a once extensive orchard that occupied AOC A9 (Figure 3-2). Approximately 20 trees were present in the northeast corner of the area, and another 10 to 12 trees were scattered about the northwest corner. The orchard appeared to have extended from south of Patrol Road in SAs A8 and P10 where farm buildings, fields, and two orchards were present, to north of Patrol Road. This orchard appears to have occupied the majority of AOC A9. The photographs also show that a wide strip had been cleared north of Patrol Road, apparently in preparation for the installation of a security fence.

West of AOC A9, the unnamed stream now flowing through SA P9 was not present and there was no bridge installed on Patrol Road between AOCs A7 and A9. The topographic low area upgradient (south) of SA P9 had been cleared, possibly for agricultural purposes. It also appeared that narrow strips paralleling Patrol Road on the north side, just west of AOC A9, were being cleared and excavated for borrow materials.

1952

These photographs showed little change in AOC A9 itself. Outside of the area, the security fence had been installed south of AOC A9, and a wide borrow "strip" was evident to the west paralleling Patrol Road (Figure 3-3). The borrow strip had been excavated into the westward dipping slope upgradient of SA P9.

1955

Figure 3-3 from OHM (1992), the historical map for 1955, showed SA P9, just south of Patrol Road, labeled as Water Hole No. 25 (WH25). The northern end of the unnamed stream (by the installation boundary), that separated AOC A9 from AOC A7 was labeled as Water Hole No. 27 (WH27).

1963

These photographs show that substantial changes have occurred in AOC A9 between 1952 and 1963 (Figure 3-4). The area had been cleared, leveled, surrounded by an earthen berm, and enclosed by a fence. One building (T-401) had been erected by the entrance located on the southeast corner. What appeared to be several drums lying on their sides were present in the northwest corner of the area. Ground stains were also present in the upper northwest quadrant. What appeared to be 12 upright drums were lined up parallel to the north berm in the northeast corner along with other unidentifiable objects. No ground staining was evident in this area. What appeared to be one upright drum encircled by a ground stain was present in the southeast quadrant.

Outside of the area, a wide swath of cleared ground extended from the southwest corner of A9 to SA P9. It is not clear whether this was another borrow "strip", or if it was composed of excess surface soil generated during the clearing and leveling of AOC A9. The topographic low area upgradient of P9 was heavily vegetated with shrubs and trees. The unnamed stream west of A9 was evident near the Assabet River, but did not appear to be established in the P9 area.

1978

One site-wide aerial photograph was available from May 1978. It showed buildings T401, T402, and the fire proof cloth testing facility. Dark stains indicated that some type of activity occurred in the southwest quadrant of AOC A9. The photo scale (1:41,326) and the lack of a stereo pair prevented any other details from being seen. It was also not clear whether smaller structures or facilities such as pits, trenches, sheds, or concrete pads were present.

1981

A low oblique, color infrared photo of AOC A9 was taken on May 13, 1981, and is presented in the USEPA (1982) report as Photo D. AOC A9 was designated Natick Laboratory Sudbury Annex Site 3, the POL/Fire Test Facility. The area was described as having two, or possibly three, dark-toned pits, heavily stained ground, and scattered drums. Several smaller, unidentified structures were present north of the pits. Buildings T401, T402, the fire-retardant clothing test facility, and the fenced shed in former SA P12 were all present. The light-toned ground stain to the southwest of AOC A9 were interpreted as a washout area and was the same ground scar noted on the 1963 photos.

The area was nearly devoid of vegetation and showed evidence of frequent use. Photo D showed the flashback training trenches, the cinder block lined pit, and what were later to be described by Technology Management Inc. (TMI) in their report (TMI, 1986) as "other test equipment and two cages." The ground around the trenches, pit, and other test equipment was heavily stained, while the ground around the fire-retardent test facility was not. Numerous drums were scattered about the fire fighting training area, and at least four were present in the cinder block lined pit. Although no personnel were evident, the presence of a yellow school bus parked in AOC A9 suggests that the site was being used at the time the photograph was taken.

1986

The photographs by COL-EAST, Inc. (scale 1:5,418) are of particular interest because they were taken on 01 April 1986, approximately 5 months prior to the TMI soil sampling event in the fire fighting training area located in the southwest quarter of the site. They clearly show all buildings, trenches, tanks, test facilities, and the extent of visible surface contamination due to spillage. Features and facilities in the Massachusetts Fire Fighting Academy (MFFA) training area are presented on Figure 4-3. This figure is a reproduction of a soil sampling location map prepared by TMI in September, 1986 (TMI, 1986).

1992

The final set of aerial photographs examined was taken in March 1992, by Bionetics under contract to the USEPA's EPIC group. These photographs, along with numerous ground control targets and control points used to establish horizontal and vertical control, and supplemental higher-altitude aerial photographs,

were used to produce an updated topographic site map of the Annex. A portion of this map is presented as Figure 4-1.

A site reconnaissance by OHM recorded the presence of Buildings T-401 and T-402, the fire-retardent test facility, the fenced shed, and 3 monitoring wells installed by Dames & Moore. No evidence of the fire fighting training area was noted.

4.1.1.2 Previous Investigations and Results

1980 - USATHAMA

Environmental investigations were initiated at the Annex in 1980 under the IRP in order to address the environmental impact from past land usage. USATHAMA conducted a preliminary site assessment consisting of a detailed records search (USATHAMA, 1980). USATHAMA identified 22 known or suspected locations of waste materials in their preliminary site assessment, one of which was designated Location 4, the POL - Fire Test Facility. The usage period identified was from the 1950s to the present (1980, the reporting date). AOC A9 was identified as an area of concern due to the potential for petroleum, oil, and lubricants (POLs) products and combustion residues to enter and migrate through the subsurface environment. Site photos included in the USATHAMA report show numerous drums and extensive ground staining.

1982 - USEPA

The USEPA's EPIC group, under an IAG between the USEPA and the U.S. Army, subcontracted Bionetics to aerially photograph portions of the Annex and to analyze the photos to identify possible areas of contamination. The USEPA (1982) analyzed color and color-infrared photographs of the Annex taken in May 1981. Twenty-seven anomalous areas, including AOC A9, were identified in this study. Area-specific results are discussed in Section 4.1.1.1 above.

1983 - AEHA

The AEHA conducted a Hydrogeological and Subsurface Investigation for the 11 AOCs identified by USATHAMA (1980). One purpose of this investigation was to evaluate the hydrogeologic setting and ground water quality. No wells were installed in AOC A9 during this investigation, however, monitoring well EHA-3 was installed upgradient of AOC A9 and SA A8 and was used as a background well in subsequent investigations.

1984 - Dames & Moore

As part of an RI begun by Dames & Moore in 1984, one surface soil sample, designated SS3, was collected near a timber-lined burning trench within the fire-fighting training area in the southwest quarter of the area (Figure 4-1). Full investigation results are presented in Dames & Moore (1986). The surface soil sample was analyzed for BNAs, PCB/Pest, and oil and grease.

Three monitoring wells were installed in AOC A9 at the locations shown on Figure 4-1. Monitoring well DM8 is located near the northwest corner of the area, DM9A is located at the northeast corner of the

area, and DM10 is located on the western side of the area. All the wells were installed in a direction estimated to be hydraulically downgradient of suspected contamination sources.

All wells were screened across the top of the unconfined aquifer and none of the wells encountered bedrock or refusal. Total depths ranged from 30 to 35 feet BGS. Based on depth to ground water measurements collected in August, 1984, ground water flow was determined to be northward towards the Assabet River. All wells were sampled for VOCs, BNAs, PCB/Pest, and oil and grease on October 12, 1984.

1986 - TMI

In preparation for a planned source removal action in the fire fighting training area, TMI was contracted to collect surface and shallow subsurface soil samples (TMI, 1986). The purpose of the sampling was to more fully characterize the soil in this area and to provide data for estimating the volume of soil requiring removal.

In September 1986, 31 soil samples were collected from 24 locations in and around the fire fighting training area. At 7 of the 24 surface soil sampling locations, shallow subsurface samples were also collected at depths ranging from 0.5 to 1.0 foot BGS. All samples were analyzed for soil pH and moisture; oil and grease, EP Toxicity metals, PCBs, and VOCs.

1987/88 - Zecco

Quarterly ground water samples were collected by Zecco, Inc. (Zecco) following a source removal action performed in the fire fighting training area. The Zecco samples were collected from the three Dames & Moore monitoring wells in September and December 1987, and in March and June 1988. Samples were analyzed for VOCs, metals, and oil and grease.

4.1.1.3 Nature and Extent of Contamination Determined from Previous Investigations

All chemical results in the following sections are reported with the units used in the original analytical reports.

1984 - Dames & Moore

The results of the laboratory analyses conducted on surface soil sample SS3 indicated the presence of residual contamination created by the burning of POL and possibly plastics. Specifically, this sample contained the PAHs benzo[A]anthracene at 0.3 µg/g, benzo[A]pyrene at 0.4 µg/g, benzo[K]fluoranthene at 0.4 µg/g, and pyrene at 0.1 µg/g. DEHP was detected at 8 µg/g and di-n-butyl phthalate at 0.5 µg/g. Various hydrocarbons were detected at 0.4 µg/g, unknowns at 1.3 µg/g, and 2,2,4,4,7,7-hexamethyloctahydro-1H-indene at 0.4 µg/g. All positive detections for this sample are presented in Table 4-2.

Ground water samples were collected from the three onsite wells by Dames & Moore in October 1984. The chlorinated VOC 1,1,1-TCA was detected in DM8 at a concentration of 300 µg/L, unknown alcohols at 20 µg/L, and oil and grease at 20 µg/L. Unknown VOCs were detected in DM9A at 700 µg/l and in DM10 at 7 µg/L. DEHP and dioxtyl adipate were both detected in DM8 at a concentration of

1,000 µg/L. DEHP was also detected in DM10 at a concentration of 30 µg/L along with unknown phthalates at a concentration of 50 µg/L. Xylene (100 µg/L), ethylbenzene (20 µg/L), and trimethylbenzenes (200 µg/L) were all detected in DM9A. Low concentrations of naphthalene, indan derivatives, and other unknown BNAs were also detected in this well. All positive ground water detections for this sampling event are presented in Table 4-3. Detections of carbon tetrachloride, dimethoxydimethysilane, hexamethylcyclotrisiloxane, and methylene chloride were attributed to laboratory contamination.

1986 - TMI

Oil and grease were detected in 28 of 31 samples at concentrations ranging from 57.8 mg/kg to 111,676 mg/kg. All compounds detected during this sampling event are presented in Table 4-2. The chlorinated VOCs 1,1,1-TCA, 1,1-dichloroethane (1,1-DCA), and methylene chloride were detected. 1,1-DCA was detected in 5 samples at concentrations ranging from 0.16 mg/kg to 8.28 mg/kg while 1,1,1-TCA was detected in 19 samples at concentrations ranging from 0.10 mg/kg to 72 mg/kg. Methylene chloride was detected in all 31 samples at concentrations ranging from 0.02 to 0.23 mg/kg and is considered a laboratory artifact. Toluene was detected in 22 samples at 0.02 to 39.2 mg/kg. Benzene was detected in 9 samples at concentrations ranging from 0.03 mg/kg to 3.45 mg/kg.

Low concentrations of polychlorinated biphenyls were detected in all 31 samples. Total polychlorinated biphenyl concentrations ranged from 0.016 mg/kg to 22.91 mg/kg. Twenty-nine of the samples had concentrations less than 7 mg/kg. Surface soil sample 8, and shallow subsurface soil sample 8 (0.5 feet BGS), had reported total concentrations of 22.91 and 20.157 mg/kg, respectively.

Low concentrations of metals were also reported. Arsenic (0.001 mg/L), lead (0.08 mg/L), and selenium (0.007 mg/L) were all detected once out of 31 samples. Barium and cadmium were both detected twice at a concentrations of 0.09 mg/L for each. Mercury was detected in 7 samples at concentrations ranging from 0.0002 to 0.0011 mg/L.

1987/88 - Zecco

Chlorinated VOCs, including 1,1,1-TCA at a maximum concentration of 346 µg/L, 1,1-DCE at a maximum concentration of 34 µg/L, and carbon tetrachloride at a maximum concentration of 5 µg/L, were detected in all four ground water samples collected from monitoring well DM8. Fuel oil was consistently detected in samples from DM9A, and the more mobile components of petroleum hydrocarbons, toluene, xylene, and ethylbenzene, were also detected. Ground water samples collected from DM10 from December 1987, through June 1988, contained low concentrations of 1,1,1-TCA. Low levels of metals were present in all the samples but were considered unlikely to be the result of site-related activities. All positive detections are presented in Table 4-3. These results, and the OHM ground water sampling results, show that contaminant concentrations in wells DM8 and DM10 decreased significantly following the source removal action, and have continued to decrease through time.

4.1.1.4 Past Site Usage

This section combines information presented in the previous three sections with information obtained through interviews and records searches. Some of the information gathered during this study is inconsistent with regard to dates and reported activities. The summary of past site usage presented in this report

contains all available information that is consistent with reported analytical results, aerial photograph interpretation, and historical site maps.

The earliest documented use of AOC A9 was for agricultural purposes. The 1939 aerial photograph show that this area contained the remnants of a formerly extensive orchard. This is of significance to this study due to the historic use of pesticides, fungicides, and herbicides on orchards. Many of the agricultural chemicals formerly used contained lead, arsenic, copper, cyanide and sulfur in oil-based carriers. Many of these compounds are persistent in the environment.

Sometime during the late 1950s, probably during 1958 or 1959, the area was cleared of all vegetation, levelled, surrounded by an earthen berm, and enclosed by a fence. The area was then used as a testing facility for fire-retardant clothing and equipment by the Natick Testing Laboratories from 1959 through the end of 1982. Subsequent developments included the erection of several buildings, installation of underground storage tanks (USTs), pumping facilities with associated underground piping, the construction of a fire-retardant cloth testing facility, and the construction of several pits and trenches used for fire fighting training. Several other smaller structures described as "cages" and "other test equipment" (TMI, 1986) were also erected (Figure 4-3).

The flame-retardant cloth testing procedure involved dressing a mannequin in the cloth to be evaluated, placing the mannequin in a litter-shaped basket attached to an overhead pulley system, and then passing the mannequin over a flaming pit. The pit was fueled with oil stored in a UST and pumped through nozzles installed in the base of the pit. The shed in former SA P12 housed the pumping unit, and the oil flowed through underground fuel lines.

The MFFA used the southwest quadrant of the site from 1970 through the end of 1984 for fire fighting training exercises. Activities included the use of two fire pits. Supporting facilities included at least one above ground storage tank (AST) and drums. One pit was approximately 20 feet by 20 feet by no more than 2 feet deep with a 1 to 1.5-foot high berm composed of soil and cinder blocks. The bottom of the pit was unlined. During fire fighting training, this pit was filled with approximately 6 inches of water topped off with virgin fuel oil and ignited. When fuel oil costs began to rise, watered-down JP-4 jet fuel was used with MADEP permission. The second pit used for training consisted of two 10 to 15-foot long trenches in the shape of a "T." These trenches were 18 to 24-inches wide, approximately 24-inches deep, unlined, and used for fire suppression/flashback training. Later, the "T" was backfilled and replaced with a "Z" configuration in the same area. The usual practice was for the flammable fluid provider to deliver material 1 to 2 days ahead of the training exercise. Fuel was placed in a tank and into the water-filled pits. The water was obtained from a hydrant near AOC A9.

The extensive ground staining and numerous scattered drums evident in aerial photographs and in site photos included in the USATHAMA (1980) report, indicate that spills and combustion byproducts in the fire-fighting training area contributed to POL contamination of surface soils in this area. Ground water analytical results suggest that this contamination is the most probable source for contaminants detected in monitoring wells installed in the western half of AOC A9.

AOC A9 was also used by the Massachusetts State Police in the early to mid-1970s to burn confiscated fireworks. No records were found regarding what specific methods were used, the volume of material incinerated, or where on the site this activity occurred.

An examination of records stored in the Fort Devens Environmental Management Office (EMO) included a summary of reported activities occurring in AOC A9 prepared by Mr. Paul Josephson on April 3, 1989. This summary indicated that "oil contaminated with low levels of heavy metals, motor oil, cutting oil, hydro oil, transformer oil, fuel oil, [and] lube oil" were discharged at the site. It was also stated that the "area had been used as an incineration site for oils and solvents." No indication of flammable liquid sources, agencies involved, or intended purposes was included. Soil and ground water analytical results (from previous investigations and the OHM investigation) showing the presence of POLs, POL and possibly plastics combustion byproducts, PCBs, and chlorinated solvents, indicate that this summary is probably an accurate record of liquids burned in AOC A9.

4.1.1.5 Previous Remedial Actions

Initial remedial actions were undertaken in AOC A9 by the Natick Research Development & Engineering Center in coordination with Fort Devens and USATHAMA, and with the approval of the Massachusetts Department of Environmental Quality (DEQE). The remedial program was planned in four phases. Phase I required the removal of all aboveground tanks and drums along with all contents. Phase II involved surface and shallow subsurface soil sampling to delineate the soil requiring removal. Phase III was the removal of all contaminated soil. Phase IV required quarterly ground water monitoring. All phases of the original plan appear to have been completed and are discussed below.

The Phase I contract was awarded to Enpro Services, Inc. (Enpro) on June 3, 1986, to remove all aboveground tanks and drums. This contract was completed sometime before August 20, 1986, according to an internal memo from Mr. Steven C. Kirby, Chief, Bldgs & Lnd Mgmt Br, Fac Eng Div, Svcs & Fac Dir, to HQ Fort Devens, AFZD-DEQ, ATTN: Mr. William Nichols dated August 20, 1986. No additional records were found indicating the number of tanks and drums removed, the volume or nature of liquids and/or sludges recovered, or what facility accepted the wastes.

The Phase II contract for soil sampling was awarded to TMI on August 13, 1986, to collect and analyze soil samples. The results of this investigation are discussed in Section 4.1.1.3 above.

The Phase III contract for soil excavation and offsite disposal was awarded on September 25, 1986, to Zecco. Work was begun on November 12, 1986, and completed by January 9, 1987. The reported depth of the excavation was at least 26 feet BGS in one location (the approximate top of ground water). Excavations were backfilled with soils borrowed from an unknown location on the Annex. The backfill material was staged in the POL area prior to use, and was not certified as clean. Waste manifests indicate that between December 29, 1986 and January 9, 1987, 1,123 cubic yards of waste described as oily soil debris was transported to the Consolidated Waste Services facility in Norridgewock, Maine.

The Phase IV contract for quarterly ground water monitoring was also awarded to Zecco. Samples were obtained for analysis in the third and fourth quarters of 1987, and the first and second quarters of 1988. Results are discussed in Section 4.1.1.3.

A UST removal action was performed by ATEC Associates, Inc. (ATEC) in May, 1992 (ATEC, 1992). UST No. 0094 was located in former SA P12. It was installed beneath a concrete pad that served as the foundation for a fenced-in metal shed housing pumping apparatus. This storage tank and pumping apparatus was used to supply fuel oil to the fire testing facility. The shed and fence were removed by OHM to assist in the removal action.

UST No. 0094, a 1,000-gallon tank reportedly used to store JP-4, was excavated and removed on May 14, 1992 (ATEC, 1992). Approximately 10 gallons of JP-4 were removed from the tank. Analysis of the tank sludge resulted in the detection of naphthalene, 2-methylnaphthalene, benzene, ethylbenzene, toluene, xylenes, lead, and zinc. Analysis of post-excavation soil samples from the wall and floor showed TPH-IR concentrations of 23 mg/kg and 273 mg/kg, respectively. For all further proposed actions, former SA P12 will be included in AOC A9.

4.2 TECHNICAL APPROACH AND FIELD WORK PERFORMED

Surface soil, shallow subsurface soil, and soil boring samples were collected during the Phase II SI/RI to further characterize AOC A9 soils and to assess contaminant migration beyond the site boundary. Seven new monitoring wells were installed and sampled to assess ground water quality in AOC A9, the potential impact to domestic water wells along the Assabet River, and to the Assabet River. Table 4-1 contains a summary of area-specific investigative and sampling activities.

4.2.1 Surface Soil Sampling

Four surface soil samples, designated A9SO7B through A9SO10B, were collected during the Phase II SI/RI (Table 4-1). These sampling locations are shown on Figure 4-1.

4.2.1.1 Rationale and Locations

The four surface soil samples were collected from a four-point grid established around drum confirmatory sample location A9CD1 in the northwest corner of the area. The samples collected were submitted for TAL metals analysis in order to assess the lateral extent of lead which was detected at elevated concentrations in drum confirmatory sample A9CD1A.

4.2.1.2 Physical Results

Surface soil samples A9SO7B through A9SO10B were collected on November 15, 1993, and submitted for metals analysis. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

4.2.2 Subsurface Soil Sampling

Four shallow subsurface soil samples, designated A9HA5B through A9HA8B, were collected using hand augers. Subsurface soil samples A9SB10B and A9SB11B were collected using split spoons. All six samples were collected outside of the southwest corner of the area boundary (Figures 4-1 and 4-2).

4.2.2.1 Rationale and Locations

Arsenic was detected in four soil samples collected during the Phase I SI/RI at concentrations ranged from 56 to 70 μg/g. All four samples were taken outside of the area boundary downgradient of the drainage culvert installed in the southwest corner (Figure 4-2). Additional soil sampling was performed during the Phase II SI/RI to confirm the Phase I SI/RI analytical results, to assess the lateral and vertical distribution of arsenic in area soils, and to provide additional data for the FS.

Soil borings A9B10 and A9B11 were sampled from 4 to 6 feet BGS in order to assess the vertical distribution of arsenic. Boring A9SB10 was located at the same location as Phase I sampling location A9HA2, while boring A9SB11 was located as close as possible to Phase I sampling location A9HA3 (Figure 4-2).

Four hand augered soil samples, designated A9HA5B through A9HA8B, were collected from 0.5 to 1.0 foot BGS at the locations shown on Figure 4-2. Samples A9HA5B and A9HA6B were collected near sample Phase I sampling locations A9HA2 and A9HA3 in order to confirm the presence of arsenic in these locations. Samples A9HA7B and A9HA8B were collected downgradient of Phase I sampling location A9HA4 in order to assess whether arsenic was present at elevated concentrations in the gully draining to the northwest.

4.2.2.2 Physical Results - Soil Boring Sampling

Soil boring A9B10 was advanced to 4 feet BGS using hollow-stem augers. At this depth, a split spoon sampler was advanced to 6 feet BGS in order to obtain a soil sample. The soil consisted of a yellow-orange, fine-to-medium grained sand with some silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted. Soil boring sample A9SB10B was collected on 15 November 1993 and submitted for TAL metals analysis.

Soil boring A9B11 was advanced to 4 feet BGS using hollow-stem augers. At this depth, a split spoon sampler was advanced to 6 feet BGS in order to obtain a soil sample. The soil consisted of a light grey, fine-to-medium grained sand with silt and a few pebbles. No PID or radiological readings above background were observed, and no unusual odors or staining were noted. Soil boring sample A9SB11B was collected on 15 November 1993 and submitted for TAL metals analysis.

4.2.2.3 Physical Results - Hand Auger Sampling

All hand auger samples were collected from a depth of 0.5 to 1.0 foot BGS on 15 November 1993. All samples consisted of a light tan, medium-to-coarse grained sand with some silt and a few pebbles. No PID or radiological readings above background were observed, and no unusual odors or staining were noted. All samples were submitted for TAL metals analysis.

4.2.3 Monitoring Well Installations and Soil Sampling

Four monitoring wells (OHM-A9-54, -55, -56, and -57) were installed in AOC A9 during the Phase II SI/RI (Figure 4-1). Two monitoring wells (OHM-A9-53 and -58) were installed north (downgradient) of AOC A9 near the crest of the ridge overlooking the Assabet River. One facility-wide monitoring well, designated OHM-BW-5, was installed northeast of AOC A9 towards the intersection of White Pond Road and Track Road.

4.2.3.1 Rationale and Locations

OHM-A9-54 was installed downgradient of a former UST location (SA P12) to assess potential contamination resulting from a leak in the UST. OHM-A9-55 was installed within the previously excavated and back-filled fire-pit area to assess subsurface soil and ground water conditions at this suspected source area. Monitoring wells OHM-A9-56 and OHM-A9-57 were installed downgradient of the former fire-pit

area in order to confirm the presence and assess the extent of a suspected contaminant plume. Monitoring wells OHM-A9-53 and OHM-A9-58 were installed north, and downgradient of, AOC A9 in order to assess the quality of ground water flowing towards the Assabet River. These two wells are located on the crest of the slope above the Assabet River. Facility-wide monitoring well OHM-BW-5 was installed approximately 300-feet northeast of AOC A9 to assess the cross-gradient ground water quality between AOC A9 and domestic water wells along the Assabet River.

4.2.3.2 Physical Results

All monitoring well borings were continuously sampled with a split-spoon sampler to the top of ground water, and at 5-foot intervals thereafter. Each well was screened across the top of ground water with 10 feet of 4-inch diameter, 10-slot SCH-40 PVC screen, and completed with a blank SCH-40 PVC riser. Boring logs, well completion diagrams, and survey data are presented in Appendix B.

All subsurface soil samples collected from the well borings were submitted for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, and OP Pest. Soil sample A9SB58B was also submitted for explosives analysis. Area-specific sampling and analytical information is presented in Table 4-1. Detailed sample collection information is presented in Appendix A. Aquifer testing was not conducted during the Phase II SI/RI.

Geotechnical samples representative of the screened interval were also obtained from each of the well borings for grain-size analysis. The depths BGS from which these samples were collected are as follows: 25 to 27 feet (OHM-A9-55); 26 to 28 feet (OHM-A9-54); 30 to 32 feet (OHM-A9-53, -56, and -57); 34 to 36 feet (OHM-A9-58); and 35 to 37 feet (OHM-BW-5). All grain-size analysis results are provided in Appendix B.

OHM-A9-53

Installation began and soil sampling occurred on 9 November 1993. The well was completed on November 10, 1993. The top of water was encountered at approximately 33 feet BGS while drilling, and the boring was terminated at 42 feet BGS. The observed lithologic section was composed primarily of grey and tan, fine and fine-to-medium grained sand with silt.

Subsurface soil sample A9SB53B was collected from 32 to 34 feet BGS and consisted of a grey, fine-to-medium grained sand with silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-A9-54

This well was installed and sampled on November 1, 1993. The top of water was encountered at approximately 25 feet BGS while drilling and the boring was terminated at 32 feet BGS. The section was composed primarily of grey, very fine grained, finely laminated silty sand and sandy silt.

Subsurface soil sample A9SB54B was collected from 24 to 26 feet BGS. The sample consisted of a grey, very finely laminated, very fine grained sand with a trace of silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-A9-55

This monitoring well installed and sampled on November 2, 1993. The top of water was encountered at approximately 19 feet BGS while drilling and the boring was terminated at 27 feet BGS. The section was composed primarily of grey, fine-to-medium grained sand with silt. A few fine-to-coarse grained and fine-grained silty horizons were also encountered. Drill cuttings from approximately 23 to 25 feet BGS had a distinctive degraded petroleum hydrocarbon (PHC) odor. Split spoon sample 11 from 25 to 27 feet BGS also had a distinctive PHC odor associated with a fine sand and silt horizon. A sandy silt underlying this sand had no distinctive odor.

In accordance with the established sampling procedures, subsurface soil sample A9SB55B was collected from the top of ground water at 18 to 20 feet BGS. The sample consisted of a grey, fine-to-medium grained sand with a trace of silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-A9-56

This well was installed and sampled on November 3, 1993. The top of water was encountered at approximately 25 feet BGS while drilling, and the boring was terminated at 33 feet BGS. The section was composed primarily of light grey, finely laminated fine grained sand with silt, and light grey, very silty to silty very fine grained sand.

Subsurface soil sample A9SB56B was collected from 24 to 26 feet BGS. The sample consisted of a light grey, fine-to-medium grained sand with a trace of silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-A9-57

This well was installed and sampled on November 4, 1993. The top of water was encountered at approximately 25 feet BGS while drilling, and the boring was terminated at 33 feet BGS. The section was composed primarily of grey, fine and fine-to-medium grained sand with silt.

Subsurface soil sample A9SB57B was collected from 24 to 26 feet BGS. The sample consisted of a light olive-grey, fine grained sand with silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-A9-58

This well was installed and sampled on November 8, 1993. The top of water was encountered at approximately 30 feet BGS while drilling, and the boring was terminated at 38 feet BGS. The section was composed primarily of grey, interbedded layers of fine grained sand with silt, fine-to-medium and medium grained sand with silt, and dark grey silt.

Subsurface soil sample A9SB58B was collected from 30 to 32 feet BGS. The sample consisted of a grey, medium grained sand with a trace of fine sand. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

OHM-BW-5

Monitoring well installation was begun on November 10, 1993. Sampling and well completion occurred the following day. The top of water was encountered at approximately 31 feet BGS while drilling, and the boring was terminated at 38 feet BGS. The section was composed primarily of grey, finely laminated, fine grained sand with silt, and thin, light tan, silt layers.

Subsurface soil sample FWSB5B was collected from 30 to 32 feet BGS. The sample consisted of a grey, fine grained sand with silt. No PID or radiological readings above background were observed, and no unusual odors or staining were noted.

4.2.4 Ground Water Sampling

Ten ground water samples were collected during the Phase II SI/RI of AOC A9. The seven new monitoring wells were sampled, along with existing monitoring wells OHM-A9-47, DM8, and DM9A. All ground water samples were submitted for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, and OP Pest.

4.2.4.1 Rationale and Locations

Monitoring wells DM8, DM9A, and OHM-A9-47 were re-sampled as part of the Phase II SI/RI to verify and assess the presence of compounds detected during the Phase I sampling rounds. Petroleum-related volatile and semivolatile organic compounds were previously detected in ground water from OHM-A9-47. Chlorinated solvents were detected in monitoring wells DM8 and DM9A during the Phase I SI/RI. The pesticide endrin aldehyde was detected in DM8 during the June 1992 sampling round only. Ground water was also collected from all seven of the newly installed monitoring wells to further asses the nature and extent of ground water contamination in and around the area.

4.2.4.2 Physical Results

The following sections discuss the ground water sampling physical results on a well-by-well basis.

DM8

Approximately five well volumes were purged from this well prior to sampling on December 7, 1993. No odors or PID readings above background concentrations were observed.

DM9A

More than five well volumes were removed from DM9A before sampling on December 7, 1993. PID readings above background were noted while purging. As a result, the purge water was collected in a labeled drum which was later moved to the MFFA drum staging area.

OHM-A9-47

Due to the poor recharge rate of this well, purging prior to sampling was in accordance with USAEC specifications addressing slow recharge wells. These specifications allow less than the preferred 3 to 5 well

volumes to be removed prior to ground water sampling. OHM-A9-47 was pumped dry twice and allowed to recover prior to sampling on December 6, 1993. No odors or PID readings above background concentrations were observed.

OHM-A9-53

Due to slow recharge rates, this well was pumped dry four times prior to sampling on December 3, 1993. An odor was noted during sampling as the sample jars were being filled, and PID readings of 2 to 4 ppm were observed when the tip of the PID probe was held inside the well casing. No elevated PID readings had previously been observed during well installation, soil sampling, development, or purging of this well.

OHM-A9-54

More than five well volumes were removed from this well prior to sampling on December 6, 1993. A faint petroleum odor was noted during purging, and PID readings ranging from 2 to 11 ppm were measured. As a result, the drum containing the purge water was covered, labeled, and later moved to the MFFA drum staging area.

OHM-A9-55

Approximately five well volumes were removed from OHM-A9-55 prior to sampling on December 6, 1993. No odors or PID readings above background concentrations were noted.

OHM-A9-56

More than five well volumes were removed from this well prior to sampling on December 2, 1993. Since the temperature blank in the shipping cooler containing samples for PCB/Pest and OP Pest analysis was reportedly received at the laboratory at a temperature of 8°C, these samples were rejected by the USAEC QA/QC chemist. As a result, this well was re-sampled on December 9, 1993, for these two parameters only. Approximately four well volumes were removed prior to resampling. No odors or PID readings above background were observed during either sampling event.

OHM-A9-57

More than five well volumes were purged from this well prior to sampling on December 2, 1993. PCB/Pest and OP Pest samples from this well were also rejected by the USAEC QA/QC chemist as they were shipped in the cooler which arrived at the laboratory at a temperature above 4°C. This well was also re-sampled on December 9, 1993. Approximately four well volumes were removed prior to resampling for PCB/Pest and OP Pest. No odors or PID readings above background were noted during either sampling event.

OHM-A9-58

More than five well volumes were removed from this well prior to sampling on December 3, 1993. No odors or PID readings above background concentrations were noted.

OHM-BW-5

Approximately three well volumes were removed from this well before sampling on November 11, 1993. No odors or PID readings above background concentrations were observed.

4.2.5 Hydrogeological Assessment

Hydrogeologic and subsurface lithologic conditions at AOC A9 were investigated through the installation of 13 monitoring wells, including OHM-BW-5, and 9 soil borings (Figure 4-1). Aquifer characteristics were investigated through the collection of four rounds of water level elevations, the interpretation of slug test data collected at 7 locations, and the interpretation of 33 grain-size analyses (Appendix B). The data obtained during the OHM investigation has been used to refine the hydrogeologic characterization of the area developed during a previous investigation conducted by Dames & Moore (1986). One water-bearing zone, the overburden, was investigated.

The overburden is the primary water-bearing unit and has been described as an unconfined, water-bearing zone consisting of glacial outwash plain sediments overlying glacial till deposited during the Pleistocene epoch (Hansen, 1956). Boring and slug test results from AOC A9 indicate that the overburden zone varies in thickness from 61 to 76 feet, shows significant lithologic variation both laterally and vertically, and has a wide range of hydraulic conductivities. As in AOC A7, the overburden has been subdivided into upper and lower aquifer units based on lithologic and hydrogeologic characteristics.

Glacial outwash was encountered from ground surface to 74 feet BGS and varied in observed thickness from 54 to 74 feet. This unit consists primarily of unconsolidated fine and very fine-grained sand and silty sand with minor amounts of medium-to-coarse sand and gravel overlying a finer-grained unit of silt and sandy silt with clay. Boring logs suggest that stratigraphically, the glacial outwash consists predominantly of fine-grained sediments interbedded with occasional coarser, areally restricted lenses of medium-to-coarse sand with some gravel and cobbles. Based on the lithologic, grain-size, and hydraulic conductivity data, the upper fine-sand unit of the glacial outwash has been designated the upper aquifer. The silt and sandy silt unit with clay has been designated a member of the lower aquifer.

Glacial till was encountered between 54 and 74 feet BGS, and varied in observed thickness from 2 feet to 7 feet. The till samples recovered consisted primarily of dense, silty fine-to-coarse grained sand with some gravel, cobbles, and weathered rock fragments. The glacial till has also been designated a member of the lower aquifer.

Bedrock cores recovered during this investigation have been classified as belonging to the Carboniferous-aged Gospel Hill gneiss (Hansen, 1956). Bedrock in this region has been characterized as dense, hard, lacking primary openings, and containing water mainly in openings along joints and to a lesser extent in openings along cleavage planes and irregular fractures (Perlmutter, 1962). Due to low yields, bedrock formations in this area are a minor source of water (Perlmutter, 1962; Pollock, et. al., 1969). Flow conditions in the bedrock aquifer were not investigated in AOC A9.

Geologic cross-sections have been constructed for AOC A9 using data obtained during the subsurface investigation. The locations of all cross-sections are presented on Figure 4-4, and the cross-sections are presented as Figures 4-5 and 4-6.

4.2.5.1 Hydraulic Conductivities

Slug tests were performed on 7 monitoring wells in AOC A9 to assess the hydraulic conductivity of the overburden. Test data were evaluated using the Bouwer and Rice (1976) method for unconfined aquifers. A summary of the OHM and E&E slug test results is presented in Appendix B, while all original OHM slug test data, graphical analyses, and calculations for each slug test are contained in Appendix A of the Final Report, Site/Remedial Investigation (OHM, 1994).

Five slug tests were performed on wells screened in the upper aquifer unit. The hydraulic conductivities were 0.007 ft/min at DM8, 0.002 ft/min at DM9A, 0.004 ft/min at DM10, 0.0007 at OHM-A9-47, and 0.002 ft/min at OHM-A9-48. The lower hydraulic conductivity at OHM-A9-47 was expected due to the large fraction of silt and clay encountered during drilling at that location. Using these values, the geometric mean hydraulic conductivity of the upper aquifer unit is calculated to be 0.002393 ft/min. Significant figures were not considered until obtaining a final calculation result. This procedure was followed so that maximum values for all calculations would be obtained.

Two slug tests were performed on wells screened in the lower aquifer unit, or glacial till. The hydraulic conductivities were 0.02 ft/min for OHM-A9-16 and 0.0002 ft/min for OHM-A9-17. The higher hydraulic conductivity value for OHM-A9-16 is due to a lens containing gravel, cobbles, and weathered rock fragments within the screened interval and is not considered representative of the lower aquifer unit. The hydraulic conductivity of the lower aquifer unit has been established at 0.0002 ft/min based on slug test results from OHM-A9-17.

4.2.5.2 Ground Water Flow

Depth to ground water, along with surface water elevation measurements, were collected on June 15 and October 23, 1992, January 8, 1993, and April 27, 1994, to determine ground water flow directions and gradients in AOC A9. Depth to water measurements and calculated top of ground water elevations for all gaging events are contained in Appendix B. Upper aquifer ground water maps for all four gaging events are presented as Figures 4-7 through 4-10 of this report. The lower aquifer ground water, top of till, and top of bedrock map is presented as Figure 4-11. All four gaging events consistently show that the direction of ground water flow is northward towards the Assabet River in both the upper and lower aquifers.

Horizontal hydraulic gradients in the overburden were determined from piezometric surface maps constructed from the data collected during the four gaging events described above. The hydraulic gradients for the upper aquifer were found to be vary between 0.0192 and 0.0357. The hydraulic gradients for the lower aquifer varied between 0.0170 and 0.0214. The maximum observed hydraulic gradients for the two aquifers were determined using the ground water maps for the April 27, 1994, gaging event. These hydraulic gradients were used in all the discharge calculations.

Vertical ground water gradients have been calculated by comparing observed ground water elevation differences (the pressure head differential) to well screen elevation differences (the elevation head differential) for monitoring well couplets OHM-A9-17 and DM8, and OHM-A9-18 and DM9A. Monitoring well OHM-A9-17 is screened within the lower aquifer unit from 162.18 feet to 152.18 feet AMSL, while DM8 is screened across the top of the saturated zone from 186.09 feet to 176.34 feet AMSL. The maximum observed difference in ground water elevations between these two wells was observed on

January 1, 1993. Monitoring well OHM-A9-18 is screened within the lower aquifer unit from 158.94 feet to 148.94 feet AMSL, while DM9A is screened across the top of the saturated zone from 188.26 feet to 178.76 feet AMSL. The maximum observed difference in ground water elevations between these two wells was also observed on January 1, 1993.

Because the observed ground water elevations represent the average of all the potentials across the saturated screened interval, the midpoints of the saturated intervals were used to represent the elevation heads. The midpoint elevations of the saturated screened intervals were 157.18 feet and 179.16 feet for monitoring well couplet OHM-A9-17/DM-8, respectively, and 153.94 feet and 181.11 feet in monitoring well couplet OHM-A9-18/DM-9A, respectively. Dividing the pressure head differentials by the elevation head differentials yields vertical gradients of 0.13 and 0.05, respectively. This is of interest since the vertical hydraulic gradient at observation point OHM-A9-17/DM-8 exceeds the horizontal hydraulic gradient by an order of magnitude. All vertical gradient calculation variables and results are presented in Table 3-2.

The observed vertical hydraulic gradients represent an upward component to ground water flow within the unconfined aquifer. This suggests that any contaminants that might be present in the lower aquifer could be transported in dissolved phase to the upper aquifer in sufficient concentrations to be detected in ground water analyses.

Average flow velocities (V) for each overburden aquifer unit have been calculated based on the geometric mean hydraulic conductivity (K) of each unit and average hydraulic gradients (I). A storage coefficient value of 0.20, calculated using the results of a pump test performed on the unconfined aquifer in the southern portion of the installation (Perlmutter, 1962), was substituted for effective porosity (n_e).

Lower Aquifer Unit

$V = Ki/n_e = (0.0002 \text{ ft/min})(0.01943)/0.20 = 0.00002 \text{ ft/min}$

Upper Aquifer Unit

$V = Ki/n_e = (0.002393 \text{ ft/min})(0.02341)/0.20 = 0.00028 \text{ ft/min}$

4.2.5.3 Ground Water - Surface Water Relationship

The climate, regional drainage patterns, general site configuration, ground water flow directions, and horizontal and vertical ground water gradients indicate that AOC A9 overlies a zone of ground water discharge to the Assabet River. In order to assess the environmental impact from contaminated ground water discharging into the Assabet River, discharge volumes have been estimated.

4.2.5.4 Ground Water Discharge to Surface Water

Ground water discharge volumes have been estimated for the upper and lower aquifer units. This section describes the methods used to estimate the ground water discharge and summarizes the results. Discharge estimate results for each aquifer unit, total discharge volumes, and values for all variables used in the calculations are presented in Table 4-4.

The method used was to calculate a ground water flow volume per unit time for 1 square foot of aquifer area, then to multiply this volume by the entire saturated cross-sectional area of each aquifer unit contributing to ground water flow. This method allows for quick recalculation of total flow volumes under varying aquifer conditions. The equation used to calculate the unit ground water flow is Q = Kai, where Q = the discharge volume, K = the hydraulic conductivity, A = the cross-sectional area, and I = the hydraulic gradient. This equation combines transmissivity with Darcy's law and is discussed in Heath (1989).

Saturated down-gradient cross-sectional areas for each aquifer unit were determined using strike-oriented cross-section A-A' (Figure 4-5) and ground water gaging data from April 27, 1994. Since the highest water levels observed in AOC A9 were during this gaging event, these data were used so that maximum observed saturated aquifer thicknesses would be input into the discharge calculations, thereby maximizing ground water discharge volumes. Cross-sectional area estimates input into the discharge calculations for the entire site, the chlorinated VOC plume, and the xylene plume are presented in Table 4-5. The hydraulic gradient (I) used in the discharge calculations for the upper aquifer unit was 0.0357 and for the lower aquifer unit was 0.0214. These values were also determined using the ground water maps constructed using the April 27, 1994, gaging data (Figures 4-10 and 4-11). The hydraulic conductivities (K) used for the upper and lower aquifer units were 0.002393 ft/min and 0.0002 ft/min, respectively.

Total ground water discharge from AOC A9 to the Assabet River is estimated to be 12,267 gallons/day (8.519 gal/min). Ground water discharge from the chlorinated VOC plume is estimated to be 4,345 gallons/day (3.017 gal/min), while the discharge from the xylene plume is estimated to be 5,902 gallons/day (4.098 gal/min).

4.3 NATURE AND EXTENT OF CONTAMINATION

Analytical results for all surface soil, hand auger, boring, and ground water samples collected by OHM during the remedial investigation of AOC A9 are discussed in the following sections. All sample locations are shown on Figure 4-1.

4.3.1 Surface Soil Sampling Results

OHM has collected one confirmatory drum and ten surface soil samples (depths 0 to 6 inches) from AOC A9. Most of these samples were submitted for analysis of TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. Explosives were not detected in any of these samples. A list of all detected compounds is provided in Appendix D, Table D-23. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 4-6. Analytes detected in surface soil at concentrations above ESAT soil criteria are summarized in Table 4-7.

Acetone, methylene chloride, and alpha-pinene were the only VOCs identified in these surface soil samples. Alpha-pinene is a naturally occurring compound and its detection is not considered to be site-related. Methylene chloride was detected in 4 of 7 samples analyzed. All methylene chloride detections are below both maximum background and MCP S-1/GW-1 values and, as methylene chloride is a common laboratory contaminant, the chemical is not considered to be site-related. Acetone, another common laboratory contaminant, was detected at one sample location, A9CD1, at a concentration below the MCP

S-1/GW-1 soil standard. Seven unknown VOCs were also detected in these surface soil samples at concentrations ranging from 0.01 to 0.09 μg/g (Appendix D, Table D-50).

The BNAs DEHP and di-n-butyl phthalate were detected in AOC A9 surface soils (Appendix D, Table D-23). DEHP was detected at one sample location, A9CD1, at a concentration of 0.58 μg/g which is well below the MCP S-1/GW soil standard of 100 μg/g. Di-n-butyl phthalate was detected at 4 of 7 sample locations. No MCP standard was found for this compound. Although di-n-butyl phthalate was detected in one sample (A9SO3) at a concentration above the background 95 percent UCL value, it does not exceed the maximum background concentration. Since phthalate esters are plasticizers and constituents of sample gloves, they may have been introduced during sampling and therefore, may not be site-related. Four unknown BNAs were detected at concentrations ranging from 6 to 105 μg/g (Appendix D, Table D-50).

The only pesticides detected were ppDDE (1 of 7 samples) and ppDDT (2 of 7 samples) (Appendix D, Table D-23). None of these concentrations exceed background 95 percent UCL levels, MCP S-1/GW-1 standards, or ESAT soil criteria.

As discussed in Section 4.1.1.3, samples collected by TMI prior to the Zecco excavation contained PCBs. However, PCBs were not detected in any of OHM's surface soil samples. It is assumed that most of the TMI samples containing PCBs were located within the area later excavated by Zecco with the possible exceptions of samples 1, 5, 18, 19, 20, 21, 23, and 24. Although these eight sample locations may not have been included as part of the Zecco excavation area, none of the PCB concentrations exceed the MCP S-1/GW-1 soil standard of 2 μg/g. However, the maximum total PCB concentration detected in these eight samples was 1.58 μg/g in sample 18 which slightly exceeds the ESAT soil value of 1 μg/g.

The metals detected in these surface soil samples are listed in Appendix D, Table D-23. Lead, arsenic, beryllium, and thallium were the only metals detected at concentrations above MCP S-1/GW-1 soil standards. Lead was detected at confirmatory drum sample location A9CD1 at a concentration of 450 μg/g which exceeds both the MCP S-1/GW-1 standard of 300 μg/g (Table 4-6) and the ecological screening value of 200 μg/g (Table 4-7). Four additional samples (A9SO7B through A9SO10B) were collected in November 1993 from around this confirmatory drum sample location to determine the lateral extent of this lead contamination. The maximum concentration of lead detected in these four samples was 270 μg/g, which is below the MCP S-1/GW-1 standard but above the ecological screening level. Lead concentrations detected in the other three samples were considerably lower (ranging from 26 to 35 μg/g) which suggests that the elevated lead concentrations are not wide-spread (the four additional samples were collected 10 feet away from A7CD1).

Arsenic exceeds the MCP S-1/GW-1 soil standard at one sample location, A9SO1 (Table 4-6). The concentration of arsenic at this sample location was 46 μg/g. Arsenic concentrations also exceed the ESAT soil value of 4.8 μg/g at 10 of 11 sample locations (Table 4-7). However, concentrations of 7 of 10 of these ESAT exceedences are below the maximum background level (17 μg/g).

Beryllium exceeds the MCP S-1/GW-1 soil standard of 0.4 μg/g at sample locations A9SO7 and A9SO10. The beryllium concentration at both of these locations was 0.547 μg/g. This concentration falls within the range of values detected in background soil samples (0.28 to 0.64 μg/g) and is below the ESAT soil criteria of potential ecological concern (0.55 μg/g based on expected Eastern U.S. background levels). The concentrations being comparable to background soil levels, the consistency of the values, and the lack

of any obvious source suggests that these surface soil detections may be indicative of background beryllium concentrations.

Thallium was detected at one sample location, A9SO7. The concentration detected at this location, 304 μg/g, exceeds the MCP S-1/GW-1 soil standard of 8 μg/g (Table 4-6). The detection of thallium appears to be confined to a very small area as this element was not detected at any of the four adjacent sample locations (Figure 4-1).

All other metals listed in Table 4-6 were detected at concentrations below maximum background values except for barium, calcium, magnesium, sodium, and potassium. There are no MCP soil standards for any of these metals. The single detection of barium at a concentration above maximum background (75.8 μg/g) is not a concern since this level is below the 290 μg/g ESAT screening level. The remaining metals detected are naturally occurring essential elements.

4.3.2 Subsurface Soil Sampling Results

OHM has collected hand auger and boring samples as part of the site investigation of AOC A9. Four hand auger samples were collected in October 1992 downstream of the drainage culvert at the southwest corner of AOC A9 (A9HA1 - A9HA4; Figure 4-2). Four additional hand auger samples and two boring samples (A9B10 and A9B11) were collected from this area in November 1993 to further assess the vertical and lateral extent of arsenic which was found at elevated levels in the 1992 samples. The four hand auger samples collected in October 1992 were submitted for TCL VOC, TCL BNA, PCB/Pest, explosives, and TAL metals analysis. Explosives were not detected in any of these samples. The four hand auger and two boring samples collected in November 1993 were analyzed for TAL metals only. Table D-24 in Appendix D contains a complete list of all compounds detected in the hand auger samples. Boring sample positive detections are included in Appendix D, Table D-25. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 4-8 (hand auger samples) and Table 4-9 (boring samples). Compounds detected at concentrations above ESAT soil criteria in the hand auger samples are summarized in Table 4-10. Since the two boring samples were collected from depths of 4 feet, results from these samples were not compared to ESAT soil values.

OHM has collected 36 boring samples in addition to the two mentioned above. These 36 samples were collected from 22 boring locations (Figure 4-1). Most of these boring samples were submitted for TCL VOC, TCL BNA, PCB/Pest, explosives, TOC, and TAL metals analysis. Explosives were not detected in any of these samples. Boring samples from the seven monitoring wells installed in 1993 were also analyzed for OP Pest but none were detected. All compounds detected in boring samples are listed in Appendix D, Table D-25. Table 4-9 lists compounds detected in these samples at concentrations above background soil 95 percent UCL and/or MCP S-1/GW-1 soil values.

Results of the eight hand auger and two boring samples collected near the drainage culvert at the southwest corner of AOC A9 are discussed separately from the remaining soil boring data as the southwest corner samples focused on a specific contaminant (arsenic). The eight hand auger samples were collected from a depth of 0.5 feet. The two boring samples from the southwest corner, A9B10 and A9B11, were taken from a depth of 4 feet. Sample depths of the remaining 36 boring samples varied and are listed in Appendix D, Table D-25.

Alpha-pinene was the only VOC identified in the hand auger samples. Since this is a naturally occurring compound, the detection of alpha-pinene in the sample collected from A9HA4 is probably not site-related. Two unknown VOCs were also detected at a concentration of 0.01 μg/g (Appendix D, Table D-50).

None of the six BNAs detected in the hand auger samples exceed soil screening level concentrations. Di-n-butyl phthalate was detected in 2 of 4 samples at concentrations below those detected in background soil. Concentrations of all five PAHs detected in these samples (Appendix D, Table D-24) are below MCP S-1/GW-1 soil standards and ESAT soil criteria (Tables 4-7 and 4-10). Twelve unknown BNAs were also present in these samples at concentrations ranging from 1 to 20 μg/g (Appendix D, Table D-50).

The only PCB/Pest detected in these soil samples was ppDDT at 3 of 4 sample locations. ppDDT concentrations in all three samples are below background 95 percent UCL, MCP S-1/GW-1, and ESAT soil criteria.

The metals detected in these eight hand auger samples are listed in Appendix D, Table D-24. Based on these analytical results, arsenic was the only metal identified as a potential COC because concentrations in all eight hand auger samples exceed ESAT soil values. However, arsenic concentrations at three of these locations are below background (background arsenic levels also exceed ESAT screening values). Arsenic was detected at 5 of 8 sample locations at concentrations above MCP S-1/GW-1 soil standards. The highest arsenic concentration (140 μg/g) was detected in the sample collected closest to Patrol Road, upgradient of the drainage culvert (A9HA5). Based on the data collected, it appears as though these elevated arsenic concentrations are limited to the upper end of this drainage culvert, near Patrol Road, as the two samples (A9HA7 and A9HA8) collected from the culvert downgradient of location A9HA4 contained arsenic at background levels. The data also indicate that the elevated arsenic concentrations are restricted to the upper soil layers as arsenic was detected in both borings (collected from depths of 4 feet) at concentrations below 5 μg/g. Beryllium was detected at A9HA5 and A9HA6 at concentrations slightly above background (maximum 0.692 μg/g). These concentrations also exceed MCP SW-1/GW-1 and ESAT soil values. The remaining metals detected in the two boring samples and the hand auger samples (Tables 4-8 and 4-9) were detected at concentrations within the range found in background soils or are essential elements.

The VOCs detected in the other 36 boring samples are listed in Appendix D, Table D-25. Acetone and methylene chloride were detected in some of these samples at concentrations above background 95 percent UCL values (Table 4-9). However, none of these concentrations exceed either maximum background or MCP S-1/GW-1 standards. Also, since both VOCs are common laboratory contaminants, the detection of these compounds may not be site-related. Although the other VOCs listed in Appendix D, Table D-25 were all detected at concentrations below MCP S-1/GW-1 standards (except for 1,3- and 1,4-dimethylcyclohexane which do not have MCP standards), the detection of VOCs at some of these boring locations correlates well with either known past uses of the property or with ground water results. For example, low levels of 1,1,1-TCA were detected at A9B2 and the boring sample from monitoring well OHM-A9-55. A9B2 was completed at the western end of the Zecco removal area, adjacent to monitoring well OHM-A9-55. Although only low levels of 1,1,1-TCA were detected in these soil samples, 1,1,1-TCA was detected in ground water collected from OHM-A9-55 at concentrations above its MCL. Low levels of POL-related constituents were detected at boring locations A9B7 and A9B8 where clothing was burned. Some of the VOCs detected at low concentrations in boring samples from OHM-A9-53 (ethylbenzene), OHM-A9-54 (ethylbenzene and toluene), and OHM-A9-55 (trichloroethane) were detected in ground water

samples from these wells at concentrations above their respective MCLs (Section 4.3.3). A total of 79 unknown VOCs were also detected at concentrations ranging from 0.006 to 1 μg/g (Appendix D, Table D-50).

The BNAs detected in these boring samples are listed in Appendix D, Table D-25. Of the 11 BNAs detected, only concentrations of 2-methylnaphthalene exceed MCP S-1/GW-1 soil standards at sample locations A9B2 (10 μg/g) and OHM-A9-55 (2.2 μg/g). No MCP standards were available for 2,6-dinitrotoluene, di-n-octyl phthalate, or dibenzofuran. The explosive 2,6-dinitrotoluene was detected in the semivolatile organic analysis (BNA) at 1.1 μg/g (A9B2), but its presence was not confirmed by the more specific explosives analysis. Di-n-octyl phthalate was detected at OHM-A9-18 at 0.5 μg/g. Dibenzofuran was detected at two boring locations; A9B2 (1.4 μg/g) and OHM-A9-55 (0.27 μg/g). Ninety unknown BNAs were also present in these samples at concentrations ranging from 0.08 to 200 μg/g (Appendix D, Table D-50).

The pesticides beta endosulfan, heptachlor epoxide, ppDDD, and ppDDE were detected in boring samples. Although concentrations of beta endosulfan, heptachlor epoxide, and ppDDD were detected above background (Table 4-9), none exceed MCP S-1/GW-1 soil standards.

The metals detected in these boring samples are listed in Appendix D, Table D-25. Arsenic, which has been identified as a potential COC in some samples collected near the drainage culvert at the southwest corner of AOC A9, was not detected at elevated levels in any of these boring samples (maximum concentration detected was 17 μg/g). Although some of the metals detected exceed background 95 percent UCL values (Table 4-9), all were detected either at concentrations below maximum background, below MCP S-1/GW-1 standards, or are naturally occurring essential elements such as calcium and potassium.

4.3.3 Ground Water Sampling Results

OHM has collected a total of 25 ground water samples from 15 monitoring well locations in AOC A9 (Figure 4-1). Most of these samples were submitted for TCL VOC, TCL BNA, PCB/Pest, phosphate, explosives, and TAL metals analysis. The ten ground water samples collected in December 1993 were also analyzed for OP Pest but none were detected. A list of all detected compounds is provided in Appendix D, Table D-26. Compounds which exceed ground water criteria are listed in Table 4-11. Analytes detected in AOC A9 ground water were also compared to surface water criteria as a preliminary evaluation of what impact ground water discharge from this area may have on the Assabet River. Compounds detected at concentrations above these criteria are listed in Table 4-12.

Chlorinated and POL-related VOCs were detected in ground water samples collected from AOC A9. VOCs were not detected in monitoring wells OHM-A9-49, DM10, and OHM-A9-17. No samples could be collected from OHM-A9-18 due to the high silt content. The detection of chlorinated VOCs was primarily limited to the monitoring wells installed within and downgradient of the area excavated by Zecco. Of these monitoring wells, only the three located closest to the southwest end of this excavated area (OHM-A9-55, OHM-A9-47, and OHM-A9-56) contained chlorinated VOCs at concentrations above MCLs. In general, POL-related VOCs were detected in monitoring wells OHM-A9-53, DM9A, and OHM-A9-54. A total of 84 unknown VOCs were also detected in these ground water samples at concentrations ranging from 3 to 4,000 μg/L (Appendix D, Table D-50).

OHM-A9-55 was installed at the southwestern end of the fire-pit remediation area to assess subsurface soil and ground water conditions. 1,1,1-TCA (900 μg/L) and 1,1-dichloroethylene (1,1-DCE) (20 μg/L) were detected at concentrations above MCLs in samples from this well. The only other VOC detected in this well was total xylenes at a concentration (100 μg/L) below the MCP GW-1 standard of 10,000 μg/L.

1,1,1-TCA (maximum 500 μg/L) and 1,1-DCE (maximum 17 μg/L) were also detected at concentrations above MCLs in samples collected downgradient of the fire-pit remediation area at monitoring well location OHM-A9-47. Methylene chloride (100 μg/L) and trichloroethylene (4.6 μg/L) were also detected in 1 of 3 samples collected from this well at concentrations above MCLs. No drinking water standards were available for ethylmethyl benzene which was detected at a concentration of 190 μg/L in the June 1992 sample collected from this well. Methylene chloride and ethylmethyl benzene were not detected in either of the two subsequent sampling events in November 1992 and December 1993.

OHM-A9-56, located downgradient of OHM-A9-47, also contained 1,1,1-TCA (maximum 2,000 μg/L) and 1,1-DCE (maximum 70 μg/L) at concentrations above MCLs. Xylenes were the only other VOCs detected in this well and their concentration, 100 μg/L, was equivalent to the concentration detected in OHM-A9-55.

1,1,1-TCA was detected at concentrations below the MCL standard in the three wells located the farthest downgradient of the fire-pit remediation area (DM8, OHM-A9-57, and OHM-A9-58). 1,1,1-TCA concentrations in these well ranged from 18 μg/L (OHM-A9-57) to 46 μg/L (OHM-A9-58). No other VOCs were detected in these three wells. VOCs were not detected in OHM-A9-17 which was installed on top of bedrock, adjacent to DM8, to characterize ground water quality within the deep aquifer.

Methylene chloride was detected in the June 1992 samples collected from OHM-A9-48 and OHM-A9-16 at concentrations above its MCL standard. Both these samples were analyzed as part of lot VCL. Lot VCL consisted of twelve ground water, one rinsate, and four trip blank samples. Of these 16 samples, positive detections of methylene chloride were reported for 12 samples including the rinsate and all 4 trip blanks (Table 4-13). Except for the sample from OHM-A9-47, all detections were within the same range, 7.3 to 9.5 μg/L. These results suggest that the detection of methylene chloride in samples from these two wells was laboratory-related. Methylene chloride was not detected in the November 1992 samples collected from these wells. No other VOCs were detected in either well.

POL-related VOCs were primarily detected at monitoring well locations OHM-A9-53, DM9A, and OHM-A9-54. OHM-A9-54 was installed downgradient of a former UST location (SA P12 on Figure 4-1) to assess potential contamination resulting from a reported leak in the UST. Acetone, ethylbenzene, toluene, and xylenes were the VOCs detected. Only ethylbenzene (2,000 μg/L) and toluene (2,000 μg/L) exceed MCLs at this location.

The four VOCs (acetone, ethylbenzene, toluene, and xylenes) detected in OHM-A9-54 were also detected in DM9A. DM9A is located downgradient of OHM-A9-54. Concentrations of all VOCs detected in DM9A are below MCLs.

Ethylbenzene, toluene, and xylenes were also detected in OHM-A9-53. OHM-A9-53 was installed downgradient of the former clothing test area near the crest of a ridge above the Assabet River. The concentration of ethylbenzene (1,000 μg/L) exceeds its MCL standard of 700 μg/L at this location.

BNAs were detected in several wells and are listed in Appendix D, Table D-26. Fifty-nine unknown BNAs were detected at concentrations ranging from 2 to 800 μg/g. Bis(2-ethylhexyl) phthalate was detected in 1 of 26 samples submitted for TCL BNA analysis. This single detection occurred at DM10 and the concentration detected, 40 μg/L, exceeds the drinking water standard of 6 μg/L. Bis(2-ethylhexyl) phthalate was not detected in the second sample collected from this well in November 1992. No other compounds of any type were detected in this well at concentrations above drinking water standards.

Several POL-related BNAs, primarily substituted benzenes and PAHs, were detected in DM9A. Substituted benzene concentrations ranged from 21 μg/L (1,2,3,4-tetramethylbenzene) to 150 μg/L (1-ethyl-2-methylbenzene). 1-Methylnaphthalene was detected in 1 of 3 samples collected from this well at 14 μg/L. There are no drinking water standards for these compounds. The PAHs 2-methylnaphthalene (maximum 27 μg/L) and naphthalene (maximum 83 μg/L) were detected in all three samples collected from this well at concentrations above MCP GW-1 standards (no MCLs were available for these compounds). The detection of POL-related BNAs is consistent with the VOC data which indicated the presence of low concentrations of petroleum constituents in this well.

2-Methylnaphthalene and naphthalene were also detected in monitoring wells OHM-A9-53, OHM-A9-54, and OHM-A9-55 at concentrations above MCP GW-1 standards. As discussed above, POL-related VOCs were also present in all three of these wells.

The insect repellent N,N-diethyl-3-methylbenzamide (DEET) was detected in the TCL BNA analysis in 4 of 8 samples collected from AOC A9 in June 1992. This compound was not detected in any wells during subsequent sampling rounds when samplers were not wearing the compound as an insect repellent. Therefore, the detection of DEET in AOC A9 ground water is not considered to be site-related.

Confirmed detections of explosives were only found at one monitoring well location, DM9A. 3-Nitrotoluene was detected at a concentration of 1.34 μg/L in the June 1992 sample. 1,3,5-Trinitrobenzene (20.8 μg/L) and 2,4,6,-trinitrotoluene (15.4 μg/L) were detected in the November 1992 sample. There are no drinking water standards for these compounds. Other explosives were reported as unconfirmed analytes in ground water from DM9A, DM10, and OHM-A9-47. In an unconfirmed analysis, a compound tentatively identified on a primary gas chromatographic column does not behave like that compound on the second column run which is required for positive identification. Therefore, these results do not meet criteria for positive identification of the reported compounds and these compounds should be considered as undetected. Unconfirmed results for explosives are included because they suggest the presence of unidentifiable compounds with some properties consistent with the reported compounds.

The detection of PCB/Pest compounds in AOC A9 ground water was limited to monitoring wells DM8, OHM-A9-47, and OHM-A9-49. Endrin aldehyde was detected in 1 of 3 samples collected from DM8 at a concentration of 0.176 μg/L. The presence of this compound in ground water at this location was not confirmed by either of the two samples collected from this well during subsequent sampling rounds (November 1992 and December 1993). No other pesticides were detected in this well. There are no drinking water standards for this compound. The PCB Arochlor 1254 was detected in the November 1992 sample collected from OHM-A9-47. This compound was not detected in the prior (June 1992) or subsequent (December 1993) samples from this well. The concentration of PCB detected, 0.104 μg/L, does not exceed the drinking water standard of 0.5 μg/L. Three pesticides were detected at trace

concentrations in OHM-A9-49. These pesticides were heptachlor epoxide at 0.046 μg/L, alpha-chlordane at 0.029 μg/L, and beta-endosulfan at 0.021 μg/L. Concentrations of these pesticides do not exceed their respective MCLs. The presence of these pesticides in ground water at this location could not be confirmed by additional sampling due to insufficient water in the well. The detection of pesticides in this well is not attributed to AOC A9 as this well is located upgradient of the site.

Metals detected in AOC A9 ground water are listed in Appendix D, Table D-26. Lead was detected in one well, OHM-A9-54, at a concentration above the drinking water standard. The concentration of lead detected in this well was 41 μg/L. This sample was collected during the final sampling round (December 1993). Therefore, an additional sample to confirm the presence of lead in ground water at this location has not been collected. The presence of lead, a constituent of gasoline as tetraethyl lead, is not unexpected based on the detection of POL compounds in this well. No other metals were detected at concentrations above MCLs. Aluminum, iron, and manganese were detected in several wells at concentrations above SMCLs, which are based on aesthetics (Table 4-11). As previously mentioned, elevated concentrations of manganese are typical of the entire region (Perlmutter, 1962; Pollock et al., 1969).

It should be noted that one well, OHM-BW-5, was specifically installed to assess the ground water quality between AOC A9 and the domestic water wells along the Assabet River. There were no positive detections of VOCs, BNAs, or PCB/Pest in the ground water sample collected from this well. The only metals detected in this sample are naturally occurring and, except for manganese which exceeds its SMCL, do not exceed any drinking water standards. Manganese detected at a concentration of 117 μg/L is not considered to be a COC.

Concentrations of compounds detected in the 15 wells in AOC A9 were compared to surface water criteria as a preliminary screening tool to determine if ground water discharge from AOC A9 could adversely affect the water quality of the Assabet River. Compounds which exceed surface water criteria are listed in Table 4-12. This table presents a direct comparison between concentrations detected in ground water and the corresponding surface water criteria. It does not take into account the many factors which will affect the concentrations of compounds actually reaching the Assabet such as dilution, degradation, diffusion, advection, and distance between the source and the river. The significance of the exceedences is discussed as part of the ecological assessment.

4.4 CONTAMINANT FATE AND TRANSPORT

Chemicals of concern for AOC A9 consist primarily of chlorinated alkanes and alkenes (referred to as the chlorinated volatile organics), monocyclic aromatic compounds, and arsenic. The general chemical and physical properties of these chemical groups and mechanisms for their migration are discussed below.

4.4.1 Monocyclic Aromatic Compounds

Monocyclic aromatic compounds [benzene, ethylbenzene, toluene, and xylene (collectively referred to as BTEX)] have high vapor pressures (ranging from 75 mm Hg at 25 °C for benzene to 10 mm Hg for xylene) and relatively low water solubilities (1,800 mg/liter for benzene; 160 mg/liter for xylene). Based on these characteristics, the primary fate of these compounds in surface soils or in surface water is expected to be volatilization to the atmosphere (USEPA, 1985). Photooxidation in the troposphere is the dominant atmospheric fate of these compounds. In subsurface soils, the chemicals are subject to biodegradation, with

the time required for degradation to occur dependent on soil characteristics. The chemicals have fairly low octanol-water partition coefficients and are considered to be rather mobile in the subsurface environment. They are less dense than water and, if large quantities infiltrate to ground water, will tend to float on the surface of the aquifer.

4.4.2 Chlorinated Volatile Organic Compounds

The chlorinated VOCs tend to be rather volatile and behave similarly in shallow soils to the BTEX constituents (USEPA, 1985). Although the halogenated VOCs can be degraded by soil bacteria, the chemicals are substantially less biodegradable than BTEX. The chemicals have fairly low octanol-water partition coefficients and are considered to be rather mobile in the subsurface environment. They are more dense than water and, if large quantities migrate to ground water, will tend to sink through the aquifer and migrate along subsurface lithologic gradients. The migration direction may not be in the same direction as the ground water flow.

Although chlorinated VOCs have been detected in site soil and ground water, the presence of a dense, non-aqueous phase liquid (DNAPL) plume in the lower aquifer is not considered likely for two reasons. The first is that while solvents were reportedly burned at this site, the primary flammable liquids used were PHCs. This suggests that the volume of solvents used was small. This conclusion is supported by analytical data from the TMI soil sampling report and the various ground water sampling events. If chlorinated solvents were discharged at this site in sufficient volumes to result in a DNAPL plume, it is likely that much higher contaminant concentrations would have been detected in site soil and ground water. The second reason is the observed lateral and vertical distribution of chlorinated VOCs. These compounds have only been detected in the shallow aquifer immediately downgradient of the source area (Figure 4-12). Deep aquifer monitoring well OHM-A9-17, also downgradient of the source area and adjacent to shallow well DM8, has had no VOC detections in two rounds of sampling. The ground water flow direction in the lower aquifer is the same as for the shallow aquifer and, if a sufficient volume of DNAPLs had been introduced into the aquifer to create a DNAPL plume, it is likely that DNAPL contamination would have been detected in OHM-A9-17 also.

The absence of ground water analytical data from OHM-A9-18 represents a data gap with regard to chlorinated VOCs. This well is located downgradient, with respect to the tops of till and bedrock (Figure 4-11), to the suspected chlorinated VOC source area in the southwest quadrant of AOC A9. Redevelopment, or more likely, replacement of this well would be required to assess whether or not a DNAPL plume is present. The replacement well could be placed structurally down dip from the suspected source area in close proximity to an existing shallow well free of chlorinated VOCs. This would form a well couplet allowing sampling and evaluation of both the upper and lower aquifers. It would also provide another location for measuring vertical gradients in the aquifer.

4.4.3 Arsenic

Inorganic arsenic can be present in the environment in the +5, +3, 0, or -3 oxidation states but is generally present as either arsenate (As V) or arsenite (As III). The chemical speciation is important in determining arsenic's mobility and distribution. The behavior of arsenic is also dependent on the medium in which it is present and the chemical properties of both the element and the medium.

In soils, arsenic can undergo oxidation, reduction, methylation, adsorption or desorption depending on conditions. Arsenic is generally present as arsenate in vadose zone soils, while arsenite is more likely to be present in saturated or nonoxidized soils. Biological activity can cause either oxidation or reduction depending on the microrganisms involved and can also produce methylation or the formation of arsine gas (AsH_3). The fate of arsenic in soils is also highly dependent on soil type and the cations present. In general, clays and the presence of organic matter, aluminum hydroxide, or ferric oxides lead to increased arsenic adsorption to soils and decreased mobility.

4.4.4 AOC A9 - Summary

As noted above, the behavior of the chemicals present in AOC A9 depends on both the chemicals and the local environment. Chemicals have been in place at AOC A9 for many years and their behavior will be influenced by the environmental weathering that has occurred over that time. For example, some of the chlorinated volatile compounds detected in the subsurface appear to be degradation products of other chlorinated compounds. Arsenic can be mobile in the environment but the arsenic detected in AOC A9 has apparently been present for quite some time (possibly prior to military annexation of the area) and is likely to be tightly bound. The soil in the area generally consist of fairly sandy soil (and some fill) at the surface, grading to much finer materials with depth. Water and chemicals will move fairly readily through the surface material, but the characteristics of the finer soil will serve to limit the flow of water and, consequently, the flow of associated contaminants.

4.5 BASELINE RISK ASSESSMENT SUMMARIES

4.5.1 Human Health

A BRA for the Annex was finalized in January 1994. This risk assessment evaluated the current and potential future health risks to individuals who may use AOC A9. The BRA was developed based on the data collected by OHM during the Phase I SI/RI at the Annex. An addendum to the human health risk assessment was prepared to evaluate data collected during the Phase II SI/RI to determine whether or not findings from this investigation modify the risk estimates reported in January 1994. The Addendum is included as Appendix C to this report. Results of the BRA, the addendum, and an overall evaluation of the potential for health risks at AOC A9 are summarized below.

4.6 PREVIOUS RISK ASSESSMENT RESULTS

Contaminants detected in AOC A9 during the Phase I SI/RI include:

- Elevated levels of several metals, organochlorine pesticides, PAHs, several other BNAs, and VOCs in soil. Other VOCs were detected in soil gas but not in soil samples.

- Ground water contained sodium, explosives, pesticides, insect repellant (probably introduced during sampling), chlorinated solvents and petroleum-related volatile and semivolatile organic compounds.

Risks estimated in the January 1994 report for AOC A9 under current use and future use scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.03	0.1
Cancer Risk	2×10^{-6}	7×10^{-6}

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.2	0.6
Cancer Risk	3×10^{-5}	1×10^{-4}

Ground Water Use

	Average	Maximum
Hazard Index	1	10
Cancer Risk	3×10^{-5}	2×10^{-4}

AOC 9 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and consuming water from a private well on the site is:

Total Systemic and Cancer Risk Residential Use Scenario

	Average	Maximum
Hazard Index	1	10
Cancer Risk	6×10^{-5}	2×10^{-4}

Lead

For exposure to lead, risks are evaluated by comparing blood lead levels estimated using USEPA's Uptake/Biokinetic Model with a USEPA blood lead action level of 10 μg/dl. Lead levels reported for AOC A9 are:

Soil: average conc. = 81 mg/kg; max conc. = 450 mg/kg
Ground Water: average conc. = 3 μg/L; max conc. = 10 μg/L

Based on the UBK model, lead does not pose a health risk in AOC A9.

Discussion

Actual risks are likely to be substantially lower than indicated by this estimate. Much of the elevated risk is associated with sporadic detections of single compounds and frequent repeated contact with these hotspots is unlikely.

The chemical posing the greatest risk at AOC A9 is arsenic, which was detected in a single ground water sample at a concentration (4 μg/L) well below its MCL standard of 50 μg/L. Several other compounds which contribute to risks are also present in only a single sample. Residual petroleum hydrocarbons and halogenated VOCs (primarily 1,1,1-trichloroethane) are present in subsurface soil and ground water at this site. Arsenic was also responsible for the risks posed by site soil, with a single hotspot initially responsible for the elevated risks. Subsequent sampling has identified elevated arsenic levels in a ditch on the southwest side of the site.

4.7 CURRENT FINDINGS

Results of the Phase II SI/RI conducted by OHM in late 1993 at AOC A9 are described in detail in Section 4.3 and are summarized in Tables 4-6 through 4-12 of this report. Chemicals detected at concentrations that were significantly elevated, or that were of interest because of their relationship to results of the Phase I sampling, include arsenic (soil), beryllium (soil), lead (ground water), 1,1-dichloroethylene (1,1-DCE; ground water), 1,1,1-trichloroethane (1,1,1-TCA; ground water), ethylbenzene (ground water), toluene (ground water), and xylene (ground water).

Arsenic was detected at elevated concentrations in the drainage ditch on the southwestern side of AOC A9, confirming previous findings for this area. The maximum concentration detected (140 mg/kg) was slightly higher than observed in the previous sampling event. Beryllium was detected in soil at a maximum concentration of 0.69 mg/kg, slightly above the previous maximum concentration of 0.34 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values are probably indicative of background beryllium concentrations.

Lead was detected in a single ground water sample at a concentration of 41 μg/liter, higher than the maximum of 9.5 μg/liter reported in the Phase I SI/RI. However, lead was detected less frequently in this sampling round.

Volatile organics, including the halogenated compounds 1,1-DCE and 1,1,1-TCA, and the petroleum-derived monocyclic aromatics ethylbenzene, toluene, and xylene, were detected at concentrations that were generally a factor of 10 higher than detected in the Phase I SI/RI. 1,1-DCE was detected in 3 of 9 samples at a maximum concentration of 70 μg/liter. 1,1,1-TCA was detected in 6 of 9 samples (and in 3 of 9 was present at over 500 μg/liter) at a maximum concentration of 2,000 μg/liter. Ethylbenzene and toluene were both present in 3 of 9 samples at maximum concentrations of 2,000 μg/liter. Xylene was present in 4 of 9 samples, with the two highest concentrations being 8,000 and 4,000 μg/liter.

4.8 RISK CHARACTERIZATION

Several volatile compounds were detected in ground water at levels well above concentrations reported in the January 1994 SI/RI report (OHM, 1994). The presence of these higher levels warrants additional quantitative evaluation of potential risks associated with these chemicals. Consequently, risks

were estimated under the future residential use scenario described in the January 1994 risk assessment, namely the use of the water for domestic purposes. It should be stressed that such use is unlikely at AOC A9 as MADEP has ruled that water in the area does not meet state criteria for a domestic water source. However, the use was evaluated for consistency with the previous risk assessment.

Estimated cancer risks (maximum of 1×10^{-3}) are somewhat higher than reported in the BRA, primarily as a result of the higher 1,1-DCE concentrations. Noncancer risks are in the same range as the previous risk assessment (HI=30 as compared with the previous value of HI=20). However, as noted above, the ground water in AOC A9 is considered inadequate for domestic use and consequently, it is unlikely that exposure would occur via this pathway. The presence of low levels of solvents and petroleum-derived compounds in ground water confirms previous conclusions that site ground water and associated subsurface soil showed evidence that the previous clean up was somewhat incomplete. Considering that natural attenuation, dilution, and probably degradation are likely to reduce concentrations of these constituents and that ground water is unlikely to be used, further action may or may not be warranted.

Arsenic was present at elevated concentrations in soil in the southwest corner of this area. However, use of the site for residential purposes is probably unlikely to occur. If it did occur, the removal, or burial under a layer of topsoils, would almost certainly be required to preclude contact with this material.

4.8.1 Ecological

4.8.8.1 Ecological Risk Assessment

A basewide ERA was finalized in January 1994. A supplemental ERA was prepared to evaluate data collected during the Phase II SI/RI at the Annex. This supplemental ERA complements the basewide assessment by focusing more closely on the three RI areas, AOCs A4, A7, and A9. The supplemental ERA is included as Appendix C to this report. Results of the assessment specific to AOC A9 are summarized below.

Ecological concerns in AOC A9 include the presence of arsenic at elevated levels in the southwest corner of the area, an additional soil hotspot in the northwest corner, and the potential for chemicals to migrate to the Assabet River. As in AOC A7, past human use of the site has influenced local habitat. Evidence from aerial photographs indicates that the area was used as an orchard prior to military use and that during military ownership further clearing was done. Arsenic has been detected at slightly elevated levels in the southwest corner of the site, quite possibly as a result of prior agricultural use. An evaluation of the potential for ecological harm associated with the arsenic suggests that the levels are a cause for concern for wildlife that might use the specific area containing high arsenic on a frequent basis. Lead and thallium levels associated with a confirmatory drum sample in the northwestern edge of the site are also of potential concern for animals with limited ranges. However, organisms using the area less frequently (for example, most predators) would not be at risk. The assessment was quite conservative (i.e., designed to ensure ecological protection) and it is possible that even animals using the site frequently may not be adversely impacted.

Elevated levels of several VOCs and lead were detected in site ground water. Of the chemicals detected, only lead and ethylbenzene were present in groundwater at levels exceeding AWQC. Based on

the toxicity, concentration, and environmental behavior of these chemicals, no effect is expected on the Assabet River.

4.9 SUMMARY AND CONCLUSIONS

Prior to the federal government's acquisition of this site in the early 1940s, AOC A9 had been used for agricultural purposes. Now inactive, this area was reportedly used between 1959 and 1984 for product testing, flame-retardant clothing and equipment testing, fire fighting training, and destruction of confiscated fireworks.

This section provides a brief summary of the nature and extent of contamination detected during the Phase I and Phase II SI/RI in AOC A9. Conclusions as to the significance of the compounds detected and recommended future actions are also provided.

4.9.1 Contamination Assessment

4.9.1.1 Soils

During the Phase I and Phase II SI/RI, a total of 11 surface soil and 46 subsurface soil samples were collected. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. The Phase II boring samples were also analyzed for OP Pest but none were detected.

Compounds detected in AOC A9 soils at concentrations above screening criteria were primarily metals. Arsenic was detected at elevated levels in several of the hand auger samples (depths 0.5 feet BGS) collected within and adjacent to the drainage culvert at the southwest corner of AOC A9. The highest arsenic concentration, 140 μg/g, was detected in the sample collected closest to Patrol Road, upgradient of the drainage culvert (A9HA5). Based on the data collected, it appears as though these elevated arsenic concentrations are limited to the upper end of the drainage culvert, near Patrol Road, as the two samples (A9HA7 and A9HA8) collected downgradient of location A9HA4 contained arsenic at background levels. The data also indicated that the elevated arsenic concentrations are restricted to the upper soil layers, as arsenic was detected in both borings (depth 4 feet) at concentrations below 5 μg/g. Arsenic also exceeded MCP S-1/GW-1 soil standards and ESAT criteria at A9SO1 (46 μg/g).

Lead was detected at confirmatory drum sample location A9CD1 at a concentration (450 μg/g) above screening criteria. Four additional samples (A9SO7B through A9SO10B) were collected during the Phase II SI/RI from around A9CD1 (10-foot grid) to determine the lateral extent of this lead contamination. The maximum lead concentration in these four samples was 270 μg/g (A9SO10), which is below the MCP S-1/GW-1 soil standard but above the ESAT value (200 μg/g). Lead concentrations at the other three locations were considerably lower (26 to 35 μg/g) which suggests that the elevated lead concentrations are not wide-spread.

Thallium was detected at A9SO7 at a concentration (304 μg/g) above screening levels. The detection of thallium appears to be confined to a very small area as this element was not detected at any of the four adjacent sample locations (Figure 4-1).

A soil gas survey conducted in this area in 1991 suggests that the southwest corner of A9 contains residual 1,1,1-TCA and other chlorinated solvents. Although VOCs were not detected in any soil sample

at concentrations above screening criteria, the detection of VOCs at low concentrations in some of the boring samples correlates well with either known past uses of the property or with ground water data. For example, low levels of 1,1,1-TCA were detected at A9B2 and in the boring sample from OHM-A9-55. A9B2 was completed at the western end of the fire-pit remediation area and adjacent to monitoring well OHM-A9-55. Although only low levels of 1,1,1-TCA were detected in these soil samples, 1,1,1-TCA was detected in ground water collected from OHM-A9-55 at concentrations above MCLs. Low levels of POL-related VOCs were detected at borings A7B7 and A7B8 which were completed within the area where clothing was burned. Some of the VOCs detected at low concentrations in boring samples from OHM-A9-53 (ethylbenzene), OHM-A9-54 (ethylbenzene and toluene), and OHM-A9-55 (trichloroethane) were detected in ground water samples from these wells at concentrations above MCLs.

4.9.1.2 Ground Water

During the Phase I SI/RI, six shallow monitoring wells and two bedrock monitoring wells were sampled. In the Phase II SI/RI, seven additional existing shallow monitoring wells were installed and sampled, and three shallow wells were re-sampled. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, phosphate, explosives and TAL metals. The ten samples collected during the Phase II SI/RI were also analyzed for OP Pest but none were detected. Ground water data indicate that VOCs, BNAs, and lead are present at concentrations above screening levels.

Chlorinated and POL-related VOCs were detected in AOC A9 ground water at concentrations above MCLs. The detection of chlorinated VOCs was limited to the monitoring wells installed within and downgradient of the fire-pit remediation area excavated by Zecco. Of these monitoring wells, only the three located closest to the southwest end of this area (OHM-A9-47, OHM-A9-55, and OHM-A9-56) contained chlorinated VOCs at concentrations above MCLs. 1,1,1-TCA (maximum 2,000 μg/L), methylene chloride (maximum 100 μg/L), 1,1-DCE (maximum (70 μg/L), and trichloroethylene (maximum 7.4 μg/L) were detected in at least one of these wells at concentrations above MCLs.

POL-related VOCs were detected in monitoring wells OHM-A9-53, OHM-A9-54, and DM9A. OHM-A9-54 and DM9A are located downgradient of the former UST location (SA P12 on Figure 4-1). Ethylbenzene (2,000 μg/L) and toluene (2,000 μg/L) concentrations exceeded MCLs at OHM-A9-54. VOC concentrations at DM9A did not exceed screening criteria. OHM-A9-53 was installed downgradient of the former clothing test area near the crest of a ridge above the Assabet River. Ethylbenzene was detected in this well at a concentration, 1,000 μg/L) above the MCL.

The BNAs 2-methylnaphthalene (maximum 81 μg/L) and naphthalene (maximum 400 μg/L) were detected in samples from DM9A, OHM-A9-53, OHM-A9-54, and OHM-A9-55 at concentrations above the MCP GW-1 standard (there are no MCLs for these compounds).

The explosives 3-nitrotoluene (1.34 μg/L), 1,3,5-trinitrobenzene (20.8 μg/L), and 2,4,6-trinitrotoluene (15.4 μg/L) were reported as confirmed analytes in samples collected from DM9A. There are no drinking water standards for these compounds. There were no other confirmed detections of explosives in any of the other ground water samples.

Lead was detected in the sample from OHM-A9-54 at a concentration of 41 μg/L which exceeds its MCL of 15 μg/L. The presence of lead, a constituent of gasoline as tetraethyl lead, is not unexpected

based on the detection of POL compounds in this well. No other metals were detected at concentrations above MCLs.

One monitoring well, OHM-BW-5, was installed during the Phase II SI/RI to monitor the ground water quality between AOC A9 and the domestic water wells along the Assabet River. No potential contaminants were detected in the sample from this well. There were no positive detections of VOCs, BNAs, or PCB/Pest, and the only metals detected are naturally occurring. No other metals were detected at concentrations above screening criteria

4.9.2 Site Summary

Concerns in AOC A9 include the presence of arsenic at elevated levels in surface soils in the southwest corner of the area, an additional soil hotspot in the northwest corner, and the presence of two separate ground water plumes. Arsenic has been detected at slightly elevated levels in the southwest corner of the site, quite possibly as a result of past agricultural use. Elevated levels of lead and thallium were detected in the northwestern edge of the site and appeared to be associated with a drum. Surrounding samples did not contain elevated levels of these metals, indicating that they are not widespread in this area (i.e., that they exist at hotspots).

Chemicals that are present in ground water include the petroleum-related compounds toluene, ethylbenzene, and xylene in one plume (referred to as the xylene plume, as xylene is present in the greatest concentration), and the chlorinated VOCs 1,1,1-TCA, 1,1-DCE, and TCE in the other. The concentrations of chlorinated VOCs in ground water decreased substantially at downgradient locations. The highest concentrations of chemicals in the xylene plume were found in well OHM-A9-54 where xylene was detected at 8,000 μg/L, and ethylbenzene and toluene at 2,000 μg/L. Lead was also detected at an elevated concentration (41 μg/L) in a sample from this well. Monitoring well OHM-A9-53, downgradient of OHM-A9-54 and closest to the river, also contained petroleum-related compounds. Ethylbenzene was detected in this well at 1,000 μg/L, xylene at 4,000 μg/L, and toluene at 400 μg/L. Lead was not detected in this well, suggesting that attenuation of this compound occurs within the site boundary.

4.9.3 Conclusions

Under the exposure scenarios considered in the human health risk assessment prepared for the site, current use poses an average cancer risk of 2×10^{-6} and a maximum cancer risk of 7×10^{-6}, slightly above the USEPA risk goal of 10^{-6} but within the risk range of 10^{-4} to 10^{-6} commonly used by USEPA in making regulatory decisions. The noncancer health hazard was below the hazard index goal of 1. Risks associated with the unlikely future use scenario of residential use of the site poses an average cancer risk of 6×10^{-5} and a maximum cancer risk of 2×10^{-4}, above the USEPA risk goal of 10^{-6} and for the maximum estimate, above the USEPA risk range of 10^{-4} to 10^{-6}. The hazard index for the residential use scenario was above the target level of 1. As noted in the risk assessment, much of the risks estimated for the site are based on regular contact with hotspots and the use of site groundwater as a drinking water supply, both unlikely occurrences. Consequently, actual risks are likely to be lower, and quite probably substantially lower, than those estimated in the human health risk assessment. Furthermore, any action or future use of the site that leads to lower exposure will also lead to lower risks. For example, deed restrictions to prevent construction of a residential dwelling on the site, or incorporation of the land into the nearby Great Meadows National Wildlife Refuge would lead to health risks that are probably below the USEPA goal level (10^{-6} risk) and at most, would be at the low end of the USEPA risk range.

Two exposure pathways were considered for ecological receptors in AOC A9: terrestrial organisms could be exposed to metals in soils, and aquatic organisms could be exposed to chemicals that migrate in ground water to the Assabet River. A screening-level evaluation of the potential for ecological harm associated with the metals in soil suggests that regular use of the areas containing high metal levels might be a cause for concern. However, organisms using the area less frequently (for example, most predators) would not be at risk and, because of the conservative nature of the assessment, it is possible that even animals using the site frequently may not be adversely impacted. If water from the site is transporting chemicals into the Assabet River, it is possible that adverse effects might be occurring to benthic organisms living at the point of ground water release into the river. The huge dilution provided by the river water should serve to limit the extent of any effect elsewhere in the river (i.e., on the lotic community). Birds and mammals feeding on aquatic organisms should also not be affected because of the anticipated very large dilution. Based on a consideration of site conditions, past use of the area, and the results of the screening level evaluation, it appears unlikely that AOC A9 poses a significant ecological risk.

In the USEPA Directive (OSWER 9355.0-30; April 22, 1991) on the Guidance on the Use of Risk Assessment in Remedy Selection, USEPA notes that action is generally not warranted at a site if health risks are below a cancer risk level of 10^{-4} and a noncancer hazard index of 1, and if a site does not pose ecological risks. However, USEPA notes that exceptions to this rule are possible based on the discretion of the risk manager. At AOC A9, the presence of ethylbenzene and toluene at levels exceeding their MCLs may warrant further action. The remainder of the site is unlikely to pose significant health or ecological risks, particularly under anticipated future use options, and may not warrant risk-based remediation.

At the present time, limited removal actions are proposed for the southwest corner of AOC A9 where elevated levels of arsenic have been detected in surface and shallow subsurface soil samples, and in the northwest corner of AOC A9 where elevated levels of lead and thallium were detected in surface soil samples. This proposed alternative includes the option of placing the excavated soils under the RCRA-C cap proposed for AOC A7.

The ground water OU for AOC A9 has been separated from the soil OU. Ground water alternatives will be addressed after additional work is completed to more fully assess the aquifer characteristics and to assess whether a DNAPL plume composed of chlorinated VOCs exists in AOC A9. Aquifer characteristics will most probably be addressed with a pump test. The question regarding whether or not DNAPLs are present beneath AOC A9 will most probably be addressed by the installation and sampling of a monitoring well located northeast of OHM-A9-55 and screened across the top of till.

5.0 SITE INVESTIGATIONS OF STUDY AREAS

The primary goal of the supplementary Phase II SI/RI was to provide additional chemical data regarding site soil, sediment, ground water, and surface water quality to support the remedy selection process and no further action decisions. The following sections describe the investigative activities performed in each SA, sampling locations, physical results, and analytical results. Area-specific conclusions and recommendations are based on a re-evaluation of all available Phase I and Phase II SI/RI data and observations. The locations of all SAs are shown on Figure 1-1. A list of all samples collected and analytical parameters requested for each area is presented in Table 5-1.

5.1 STUDY AREA A3/P5: GENERAL DUMP/DRUM STORAGE AREA

SA A3, General Dump, was used from at least 1943 through 1986 as a borrow pit and as a dumping and burial ground. It was also reported that a small swampy area to the west was used for general refuse dumping during the 1970s. SA P5 was established after discarded empty drums were discovered in this area.

SA A3 is located approximately 1,000 feet northwest of the East Gate along Patrol Road (Figure 1-1). Sampling locations and survey areas within SA A3 are shown on Figure 5-1.

5.1.1 Area-Specific Background Information

Bedrock in this area has been identified as the Pre-Cambrian(?)-aged Marlboro Formation by Hansen (1956). It is encountered at shallow depths and outcrops in the immediate vicinity. The surficial geology of this area is composed primarily of glacial outwash plain with a small area of ground moraine in the north by Patrol Road.

The northeast portion is an inactive gravel pit. Ground surface slopes from north to south. The southern end of the pit is a steep embankment approximately 8 feet high. The area around the gravel pit is forested and slopes more gently in the same direction. The western perimeter of the area is forested and has numerous small mounds and depressions. Deteriorated drums, construction debris, and other refuse were found in this area scattered on the surface and in discrete piles. A small pit, approximately 4 feet wide by 6 feet long by 2 feet deep, with a wire mesh cover, was also discovered to the sout..west. The extreme southwestern portions of SA A3 are cut by numerous deep trenches and inlets.

SA P5, Drum Storage Area, described in the Fort Devens memo (May 8, 1990) as being a drum storage area, has been included in the SA A3 investigation due to its proximity. The area is located in the forest approximately 150 feet southwest of the gravel pit embankment. Empty drums were found lying on their sides in this area during an OHM site reconnaissance. The ground surface at this location slopes from north to south towards the wetland situated between SA A3/P5 and AOC A4.

The area-specific background information is organized into several sections. These include past site usage, previous environmental investigations, the nature and extent of contamination, and past remedial actions. Background information has been obtained from aerial photographs, maps, reports, correspondence, memorandums, records reviews, and interviews. Each section is arranged in chronological order.

5.1.1.1 Historical Aerial Photographs and Site Maps

Six sets of aerial photographs (USEPA, 1982) taken between 1943 and 1992 (Table 2-2), and one set of low oblique, color infrared photographs taken in 1981, have been examined. These photographs were used in conjunction with three historical site maps prepared by OHM (1992: Figures 3-2, 3-3, and 3-4) in order to assess past site usage, physical changes, and developments that have occurred in SA A3/P5. The following discussion presents the results of this preliminary examination.

1943

The extreme northeastern end of SA A3 appeared to be the site of a newly opened, oval-shaped sand and gravel pit (Figure 2-2). The access road to the pit began at Patrol Road in the northwestern corner of SA A3, and extended to southeast into the pit. The southwestern two-thirds of SA A3, including SA P5, was a cleared field. The field terminated at the edge of a wooded area extending diagonally across SA A3. This wooded area appeared to be a reforested borrow pit. The extreme southwestern end of SA A3 was heavily wooded with one small cleared area on the northwest side.

A cranberry bog was adjacent to SA A3 on the northwest. To the southeast, the northeastern half of the area was bordered by an orchard, and the southwestern half by a wooded lowland.

1952

Few changes had occurred between 1943 and 1952 (Figure 2-3). The borrow pit in the northeast end of SA A3 had been expanded slightly to the south, and revegetation of the cleared field had begun. The small cleared area in the southwestern part of A3 appeared to be covered with small trees.

1963

The northeastern third of SA A3 appeared to be largely void of vegetation, and the borrow pit had been expanded to the northeast and south (Figure 2-4). A new access connected the excavation pit with Patrol Road on the northeast. The two access roads and Patrol Road defined a triangular area in the northeast end of SA A3. This triangular area is still present. The central third of the area, the cleared field, contained what appeared to be cleared, sandy areas on the southeast, and woodland on the northwest. The southwestern third of the area appeared to have been nearly cleared of trees. A few trees were present while the rest of the area appeared to be covered with low growth.

A low dam was present extending straight from the southwestern end of SA A3, across to the north side of the higher ground adjacent to Puffer Pond. The wooded lowland abutting SA A3 on the southeast appeared to be devoid of trees. It is assumed that the deforestation is the result of rising water behind the dam drowning the trees. However, it is possible that the dam was not constructed prior to 1952, and was visible due to the deforestation.

1978

Few changes appear to have occurred between 1963 and 1978 (Figure 2-5). The central portion of SA A3 was more heavily wooded, while the southwestern third appeared to be largely devoid of trees.

1981

A low oblique, color infrared photo of the northeast end of SA A3 was taken on May 18, 1981 and is presented in the USEPA report (USEPA, 1982) as Photo F. SA A3 was designated Natick Laboratory Sudbury Annex Site 16, the Dump. The area was described as containing debris piles in three different locations. Dark ground stains with drums adjacent to them were also noted.

The ground stains were located in the triangular area adjacent to the northeast access road. Two of the debris piles were also located next to this access road, while the third was located in a small area at the western edge of the excavation pit (Phase II Test Pit Location A). The excavation pit was almost completely revegetated at this time.

1986

The borrow pit area had been extended to the southwest and east, and debris was visible in a small area on the western edge of the pit. The central area of the pit had been cleared of all vegetation. The triangular area in the northeast was partially vegetated with shrubs and trees. Mounded areas were present in the southern part of this small area. Two dirt tracks extended southwest from the excavation pit into the central area. The lower two-thirds of the area were heavily forested.

1992

The final set of aerial photographs examined was taken in March 1992 by Bionetics under contract to the USEPA's EPIC group. These photographs, along with numerous ground control targets and control points used to establish horizontal and vertical control, and supplemental higher altitude aerial photographs, were used to produce an updated topographic site map of the Annex.

The excavation pit had been extended to the south and southeast (Figure 2-6). The southern part of the triangular area was devoid of trees and appeared to be sparsely covered with scrub grass and small bushes. The debris present on the western edge of the excavation pit in the 1986 photos was no longer evident. The eastern, central, and southwestern portions of SA A3 were now heavily wooded.

5.1.1.2 Previous Investigations and Results

1980 - USATHAMA

Environmental investigations were initiated at the Annex in 1980 under the IRP in order to address possible environmental impacts from past land usage. USATHAMA conducted a preliminary site assessment consisting of a detailed records search (USATHAMA, 1980).

USATHAMA identified 22 known or potential hazardous waste sites in their preliminary site assessment, one of which was designated Location 14, Old Gravel Pit/Burial Site/Dump (General Refuse). This area is mislocated on Figure 6 in the USATHAMA (1980) report. The usage period identified was from 1957 to 1979. SA A3 (Location 14) was identified as an area of concern due its documented used as a trash and refuse dumping and burial ground. It was also reported that "...a swampy area between Puffer Pond and the East Gate, not far from the old cranberry bogs..." was also used as a general refuse dumping ground from the early 1970's to the present (1980, the reporting date).

1982 - EPA

The USEPA's EPIC group, under an interagency agreement between the USEPA and the U.S. Army, subcontracted Bionetics to aerially photograph portions of the Annex and to analyze the photos to identify possible areas of contamination. The USEPA (1982) analyzed color and color-infrared photographs of the Annex taken in May 1981. Twenty-seven anomalous areas, including the northeast end of SA A3, were identified in this study. Area-specific results are discussed in Section 3.1.1.1 above.

1983 - AEHA

The AEHA conducted a Hydrogeological and Subsurface Investigation for the AOCs identified by USATHAMA (1980). The purpose of this investigation included evaluating the hydrogeologic setting and ground water quality.

Shallow monitoring well EHA6 was installed by AEHA in 1983 adjacent to the original SA A3 access road (Figure 5-1). This location is northeast of the old gravel pit, and is in what was assumed to be a downgradient position from a suspected waste burial area. The boring was completed at refusal at 10 feet BGS, and encountered sand and gravel with traces of silt and cobbles. No information is available on well development.

1984 - Dames & Moore

SA A3 was investigated as part of an RI begun by Dames & Moore in 1984. Although no samples were collected in SA A3, one surface water/sediment sample (SW/SED 15) was collected from the southwest end of the wetland between SA A3/P5 and AOC A4 (Figures 2-2 through 2-6). The location was near the mouth of the stream draining into Puffer Pond and is close to OHM's A4SD3/SW3 sampling location.

5.1.1.3 Nature and Extent of Contamination Determined from Previous Investigations

1983 - AEHA

One ground water sample was collected from EHA6 by AEHA in 1983. Ground water was measured at an elevation of 188.7 feet AMSL prior to sample collection in May 1983. The sample was analyzed for constituents on the Primary Drinking Water Standards list and for organic priority pollutants. NO_2+NO_3 as N were reported at 0.28 μg/L. No other compounds on the Primary Drinking Water Standards List or organic priority pollutants were detected.

1984 - Dames & Moore

In August 1984, during the Dames & Moore investigation, EHA6 was found to be dry. Dames & Moore assumed the local ground water flow direction to be northwest towards Taylor Brook. This assumption was apparently based on the local topography and drainage patterns.

Surface water/sediment sample 15 (SW/SED 15) was collected on November 8, 1985, for analysis of BNAs, RDX, and tetryl. The surface water sample showed no positive detections. Due to laboratory

control problems, the sediment sample was analyzed for RDX and tetryl only. RDX was detected at a concentration of 3 μg/g.

5.1.2 Technical Approach and Field Work Performed

The SI consisted of a geophysical survey, excavation and sampling of five test pits, four surface soil samples, and three surface water/sediment samples. All samples collected, media types, and analytical parameters are presented in Table 5-1.

5.1.2.1 Geophysical Survey

During meetings attended by representatives from MADEP, USEPA, USAEC, and OHM, concern was raised that the gravel pit portion of SA A3 could contain buried drums, since this portion of the SA was not investigated during previous geophysical surveys. In addition, even though bedrock has been encountered at shallow depths in this area, there still appeared to be enough overburden soil in the pit area to provide coverage. In response to these concerns, OHM implemented a Phase II SI/RI geophysical investigation.

The geophysical survey was conducted in SA A3 using magnetics. The portion of the area identified for the study included the former gravel pit and adjacent cleared areas as shown on Figure 5-2. The following discussions present the theory, field procedures, and results of the study.

Magnetic Theory

The magnetics study was conducted to assess the presence of metal below ground surface. The instrument used was a GEM GSM-19 proton precession gradiometer/magnetometer. This instrument is capable of reading the earth's magnetic field intensity and variations in the earth's magnetic field at a given point. These variations occur when a secondary magnetic field interfaces with the earth's magnetic field. Secondary magnetic fields are caused by magnetic objects (e.g., drums and fences) or objects which produce electromagnetic fields (e.g., overhead power lines or underground electrical conduits). These variations are detected by recording the earth's magnetic field simultaneously between two vertically separated instrument sensors. The difference in the readings between the sensors, divided by their separation distance, yields the magnetic gradient. The gradient would typically be zero for a location on the earth's surface not influenced by secondary magnetic or electromagnetic fields. Magnetic gradient readings other than zero constitute magnetic anomalies. These readings can either be positive or negative depending on the orientation and polarity of the magnetic object. For all practical purposes, there is no significant difference between positive or negative gradient values. The magnitude and lateral extent of the anomalies are significant since they are functions of the relative size and depth of the magnetic object.

Field Procedures

The first part of the magnetics study was to identify the portion of the area in which the survey was to be conducted. Once this was done, coordinate baselines were established from which a grid coordinate system could be developed. The baselines were orientated perpendicular to each other using a hand compass and the triangulation measurement method. From these two baselines (Line 0, Position 100) pin flags were used to identify grid points at 50-foot intervals throughout the geophysical SA. The pin flags

were labeled with appropriate position and line numbers so that the survey crew would be able to identify their position within the SA. The established grid system is shown on Figure 5-3.

The next activity was to actually conduct the magnetics study. The study started at Line 0, Position 100 and proceeded along Line 0 until its end. Then the next line (Line 10) was traversed. The procedures were as follows:

- The instrument operator initialized the magnetometer with the correct time, date, line, position spacing, starting line, and position coordinates
- Gradient and total field readings were obtained at the grid point
- The instrument operator continued the data collection process at each grid point along the line until the line was complete
- The next line was then traversed in the opposite direction until its completion.

The geophysics study continued in this manner until the entire geophysical SA shown on Figure 5-3 was traversed and readings obtained at each grid node. Once the magnetics survey was completed, the magnetometer was taken back to the field trailer where the data were downloaded to a portable computer. The gradient data were then processed and a preliminary gradient contour map produced. This map was used to identify magnetic anomalies for further investigation by the geophysical survey crew.

Magnetic anomalies identified on the preliminary gradient map were investigated in order to assess the cause of the anomalous readings. A scanning magnetometer (Schonstedt GA-72 CV) was used to scan the area in and around the mapped anomalies to assess the location of the anomaly source. The Schonstedt GA-72 CV is very similar to the scanning magnetometer used in the Phase I geophysical study conducted in 1992. It has limited detection range (0 to 8 feet), however, it is able to locate magnetic objects more accurately than the GEM GSM-19 used for the initial area-wide geophysical survey described above. The field procedures used for this additional geophysical investigation were as follows:

- Locate in the field an anomalous magnetic area previously identified on the gradient map
- Scan the area using the GA-72 CV to determine whether the magnetic anomaly is caused by surface or subsurface metal
- If the anomaly is caused by subsurface metal, determine the approximate depth and, if possible, uncover the metal using a shovel
- If it is determined the anomalous location warrants additional investigation, mark this location by placing a numbered pin flag at the proposed test pit location.

These procedures were followed until all anomalous areas were scanned with the GA-72 CV.

Results

The data obtained during the geophysical study were processed in the field and anomalous areas identified. The anomalies are shown on Figure 5-3, the final magnetic iso-gradient map. These areas were further investigated using the scanning magnetometer.

There were four anomalous areas caused by surface metal:

- Line 50, Position 90 - Several metal fence posts were found lying on the ground covered by weeds and grass
- Line 110, Positions 140 and 300 - Several small pieces of scrap metal were lying on the ground surface
- Line 290, Position 170 - A partially exposed metal plate (8-inch wide, 0.25-inch thick, and several feet long) was protruding out of the ground surface.

Magnetic anomalies caused by the presence of subsurface metal were also identified. Five anomalous areas were designated as potential test pit locations and are identified on Figure 5-3 as anomalies A through E. Location E is where the partially exposed metal plate was noted. This area was selected for test pitting because it was not clear whether the metal plate was the sole cause of the anomaly, or if additional subsurface metal was also present.

While selecting test pit locations, it became apparent that the cleared area between Patrol Road and the gravel pit was laden with subsurface metal debris. This area appears to have been filled in at some time in the past since there is a 1-to-2 foot elevation drop just inside the tree line north of the cleared area. This abrupt change in elevation appears to have been the result of grading the area after material was dumped.

Summary

Five proposed test pit locations designated A through E were selected based on the magnetic geophysical survey results. These locations are presented on Figures 5-1 through 5-3. Figure 5-4 is a three-dimensional illustration of the magnetic iso-gradient map, and is included to more graphically depict the relative gradient intensities across the SA.

5.1.2.2 Test Pits

Five test pits designated A3TPA through A3TPE were excavated in November 1994 at geophysical anomalies A through E (Figure 5-3). Test pit locations are shown on Figure 5-1, and a list of samples collected, sampling media, and analytical parameters is presented in Table 5-1. All test pit samples were submitted for analysis of TCL BNAs, TAL metals, PCB/Pest, and OP Pest. Samples collected from test pit A3TPD were also analyzed for explosives. Test pit classification logs are contained in Appendix B. No staining, unusual odors, or PID or radiological readings above background, were noted during sample collection.

Test pit A3TPA was located west of the gravel pit area at the edge of the tree line (Figure 5-2 and Figure 5-3, anomaly A). The area around the pit location has apparently been flattened and graded with

a slight rise in elevation towards the west. The test pit was completed at 6 feet BGS with grab soil samples A3TPA1, A3TPA2, and A3TPA3 collected from 2, 4, and 6 feet BGS, respectively (Table 5-1). During excavation, it became apparent that the area has been used as dumping ground for domestic trash and demolition debris, that the refuse had been covered over with soil, and the area graded. A wide variety of material was recovered such as sheet aluminum, electric cable and conduit, wooden paneling, empty food cans, toys, portions of a 55-gallon drum, fluorescent light fixtures, bathroom fixtures, automobile parts, rags, and empty paint cans.

Test pit A3TPB was excavated to investigate geophysical anomaly B (Figure 5-3). The pit was completed at 6 feet BGS with grab soil sample A3TPB1 collected from 2 feet BGS (Table 5-1). Anomaly B was apparently caused by the presence of a buried washing machine as the only other items noted during excavation were nonmetallic wood fragments and a tree trunk.

Test pits A3TPC through A3TPE were excavated to investigate geophysical anomalies C through E, respectively (Figure 5-3). All three test pits are located in the cleared area north of the gravel pit (Figure 5-2).

Test pit A3TPC was completed at a depth of 6 feet BGS with grab soil samples A3TPC1, A3TPC2, and A3TPC3 collected from 2, 4, and 6 feet BGS, respectively (Table 5-1). During excavation of this test pit large metal pipes, plastic, neoprene hose, one drum, and auto parts were uncovered. Many wood and timber fragments were present between 4 and 6 feet BGS.

Test pit A3TPD was completed at a depth of 6 feet BGS with grab soil samples A3TPD1, A3TPD2, and A3TPD3 collected from 2, 4, and 6 feet BGS, respectively (Table 5-1). This pit was extended to length of 20 feet in order to investigate the full extent of anomaly D (Figure 5-3). During excavation of this test pit, pieces of chain link fence, burnt wood, sheet metal, household trash, crushed 55-gallon drums, and pieces of 55-gallon drums were recovered.

During a subsequent site inspection of test pit location A3TPD location, 4 rounds of .30-06 blank ammunition in a stripper clip were recovered from the ground surface. These blanks were delivered to the Annex security personnel for pick-up by the Ft. Devens military police. Due to the presence of this unexpended ordnance, the laboratory was contacted and instructed to add explosives to the analyte list for all samples collected from test pit A3TPD.

Test pit A3TPE was completed at a depth of 6 feet BGS with grab soil samples A3TPE1, A3TPE2, and A3TPE3 collected from 2, 4, and 6 feet BGS, respectively (Table 5-1). Excavation uncovered a replaceable steel cutting blade for a plow, a cast iron sink, aluminum tubing, wood and tree fragments, and a brown plastic bag.

5.1.2.3 Surface Soil Sampling

Four surface soil samples designated P5SO1B through P5SO4B were collected from a four-point grid established around drum confirmatory sample location P5CD3 (Figure 5-1). The samples were submitted for TAL metals analysis (Table 5-1) in order to assess the lateral extent of chromium and lead, two metals present at elevated concentrations in surface soil sample P5CD3A. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

5.1.2.4 Surface Water/Sediment Sampling

Three surface water samples designated P5SW2B through P5SW4B, and three sediment samples designated P5SD2B through P5SD4B, were collected from two locations downgradient (P5SW/SD2 and P5SW/SD3) and one location upgradient (P5SW/SD4) of sample location P5SD1 (Figure 5-1). All samples were submitted for TAL metals analysis (Table 5-1) in order to assess the lateral extent of beryllium and selenium, two metals detected at elevated concentrations in sediment sample P5SD1A. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

5.1.3 Nature and Extent of Contamination

This section summarizes the analytical results for all surface soil, test pit, subsurface soil, ground water, surface water, and sediment samples collected by OHM during the SI of SA A3/P5. All sample locations are shown on Figure 5-1.

5.1.3.1 Surface Soil Sampling Results

OHM has collected 12 surface soil samples (depths 0 to 6 inches) from this area. These samples, except for the four collected in October 1993, were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. No explosives were detected. The four samples collected in 1993 were analyzed for metals only. A list of all detected compounds is provided in Appendix D, Table D-27. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 5-2. Analytes detected at concentrations above ESAT soil criteria are summarized in Table 5-3.

Acetone (1 of 8 samples analyzed for VOCs) and methylene chloride (3 of 8 samples) were detected at concentrations below both background soil levels and MCP S-1/GW-1 soil standards. Seven unknown VOCs were also detected in these samples at concentrations ranging from 0.01 to 0.03 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate was detected at 5 of 8 sample locations (maximum 3 μg/g). This compound is a common laboratory contaminant and was detected in 10 of the 12 background soil samples collected by OHM. The concentrations detected in these samples do not exceed the background soil 95 percent UCL value for this compound. A total of 18 unknown BNAs were detected at concentrations ranging from 1 to 23 μg/g (Appendix D, Table D-50).

ppDDD, ppDDE, and ppDDT were the only pesticides detected in surface soil samples (maximum 0.17 μg/g). Detected concentrations did not exceed MCP S-1/GW-1 standards or ESAT soil criteria.

The only metal detected at concentrations above MCP S-1/GW-1 soil standards is beryllium (5 of 12 samples; maximum 0.55 μg/g) (Table 5-2). However, these concentrations do not exceed the maximum background level or ESAT soil criteria. The concentrations being comparable to background soil levels, the consistency of the values, and the lack of any obvious source indicates that these levels are representative of background beryllium concentrations.

Lead (220 μg/g) slightly exceeds the ESAT value (200 μg/g) at sample location P5CD3. However, as noted in Appendix D, Table D-27, this lead concentration (as well as concentrations of several other

samples) was affected by blank contamination (affected samples are flagged with a "B). Lead concentrations were considerably lower in the four additional samples collected from around P5CD3 in October 1993. Each of these four samples was collected approximately 10 feet away from this former drum location (four-point grid) to determine the extent of this elevated lead level. Lead concentrations in these samples ranged from 41 to 85 μg/g which suggests either that the initial lead concentration detected (220 μg/g) was actually lower than the concentration reported due to blank contamination, or that elevated lead levels are not widespread. All other metals were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements.

5.1.3.2 Test Pit Sampling Results

OHM has collected 13 samples from five test pit locations as part of the site investigation of SA A3/P5. These samples were analyzed for TCL BNAs, PCB/Pest, OP Pest, and TAL metals. No OP Pest were detected. As stated in Section 5.1.2.2, only the three samples collected from A3TPD were analyzed for explosives but none were detected. All compounds detected in these test pit samples are listed in Appendix D, Table D-28. Analytes which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-4.

DEHP (1 of 13 samples; 0.25 μg/g), fluoranthene (4 of 13 samples; maximum 0.6 μg/g), and phenanthrene (3 of 13 samples; maximum 0.28 μg/g) were detected at concentrations well below MCP S-1/GW-1 soil standards. A total of 58 unknown BNAs were also detected in these samples at concentrations ranging from 0.07 to 1 μg/g (Appendix D, Table D-50).

The five pesticides detected in these samples are listed in Appendix D, Table D-28. ppDDD was detected at concentrations ranging from 0.0335 to 0.0538 μg/g, exceeding the 95 percent UCL screening value of 0.019 μg/g in test pits B, C, D, and E. ppDDE and ppDDT were also detected at concentrations exceeding their respective 95 percent UCL screening value in test pits C and E. All positive detections for these compounds were below the MCP S-1/GW-1 screening level of 2 μg/g (Table 5-4). The PCB Aroclor 1254 was detected in one sample (A3TPC2) at a concentration of 2.3 μg/g slightly exceeding MCP S-1/GW-1 soil standard of 2 μg/g. The detection of this PCB may be due to the presence of auto parts which were uncovered during the excavation of this test pit.

Beryllium was the only metal detected at concentrations above the MCP S-1/GW-1 soil standard of 0.4 μg/g (Table 5-4). All positive detections (11 of 13 samples) exceeded the 95 percent UCL screening level of 0.298 μg/g, while 9 of these detections, ranging from 0.41 to 0.568 μg/g, exceeded the MCP standard. However, none of the positive detections exceed the maximum observed background concentration of 0.638 μg/g. Arsenic was detected at a concentration of 9.9 μg/g in test pit sample A3TPE1. This concentration exceeds the 95 percent UCL screening level of 8.951 μg/g, but does not exceed the maximum background (17 μg/g) or MCP S-1/GW-1 (30 μg/g) soil criteria.

5.1.3.3 Subsurface Soil Sampling Results

Subsurface soil samples were collected by OHM from four boring locations. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, organic carbon, and TAL metals. No explosives were detected. Compounds detected in these samples are listed in Appendix D, Table D-29. Analytes detected at concentrations above background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-5.

Acetone was detected in 2 of 4 samples at concentrations below both maximum background and MCP S-1/GW-1 soil standards (Appendix D, Table D-29). Four unknown VOCs were also detected in these samples at concentrations ranging from 0.01 to 0.1 μg/g (Appendix D, Table D-50).

The BNAs DEHP (2 of 4 samples), di-n-butyl phthalate (3 of 4 samples), and sulfur (1 of 4 samples) were detected (Appendix D, Table D-29). DEHP concentrations are below the MCP S-1/GW-1 soil standard. Di-n-butyl phthalate detections do not exceed the maximum background concentration for this compound. Sulfur was detected at a concentration of 2.2 μg/g. There is no MCP S-1/GW-1 soil standard for this compound. A total of 13 unknown BNAs were also detected at concentrations ranging from 1 to 67 μg/g (Appendix D, Table D-50).

ppDDT was detected in 1 of 4 samples at a concentration (0.0096 μg/g) below the background soil 95 percent UCL value. No other PCB/Pest were detected.

The metals detected in these samples are listed in Appendix D, Table D-29. Although all beryllium concentrations are below maximum background, the concentration detected at OHM-A3-1 (0.47 μg/g) slightly exceeds the MCP S-1/GW-1 soil standard. All other metals were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements (i.e., potassium).

5.1.3.4 Ground Water Sampling Results

A total of seven ground water samples, including one field duplicate, were collected from three monitoring wells as part of the site investigation of SA A3/P5. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. Explosives were not detected. All detected compounds are listed in Appendix D, Table D-30. Analytes which exceed ground water criteria are summarized in Table 5-6.

Methylene chloride was detected in the June 1992 sample collected from EHA6 at a concentration (7.1 μg/L) slightly above its MCL of 5 μg/L (Table 5-6). This VOC is a common laboratory contaminant and its detection in this ground water sample may not reflect actual ground water conditions. The possibility that this positive detection is laboratory-related is supported by the fact that methylene chloride was not detected in the subsequent sample collected from this well in October 1992. Two unknown VOCs were also detected in these samples at concentrations ranging from 3 to 11 μg/L.

One unknown BNA was detected in samples from all three wells at concentrations ranging from 14 to 17 μg/L. No other BNAs were detected (Appendix D, Table D-50).

The pesticide beta-endosulfan was detected in 1 of 6 samples at a concentration of 0.09 μg/L. There is no MCL available for this compound. However, the detected concentration is below the MCP GW-1 standard of 0.4 μg/L. Heptachlor epoxide was detected in 1 of 6 samples at a concentration (0.009 μg/L) below its MCL (0.2 μg/L). No other pesticides were detected.

None of the metals detected in these ground water samples exceed MCLs. Manganese was detected in 4 of 6 samples at concentrations above SMCLs, which are based on aesthetics. High manganese concentrations are characteristic of ground water in the region (Perlmutter, 1962; Pollock et al., 1969).

5.1.3.5 Surface Water and Sediment Sampling Results

Since the five surface water/sediment samples collected from SA A3/P5 were taken from the same wetland area as most of the samples in AOC A4, the results from both SI/RI areas were grouped together and discussed in Section 2.3.5. All detected compounds are listed in Appendix D, Tables D-7 and D-8. Analytes which exceed surface water and sediment criteria are summarized in Tables 2-8 and 2-9, respectively.

5.1.4 Conclusions and Recommendations

SA A3/P5 has been used for a variety of purposes. Originally cleared for agricultural purposes, it was used as a gravel pit after being acquired by the federal government in the early 1940s. The excavation pit was later used for surface dumping and burial of solid wastes. Solid waste was also dumped in several locations in the surrounding wooded area.

VOCs, BNAs, pesticides, and metals, except for lead, were not detected or were only detected at concentrations below screening levels in surface soil samples collected in SA A3/P5. Lead was detected at a concentration of 220 μg/g in sample P5CD3, exceeding the maximum background concentration of 110 μg/g, and slightly exceeding the ESAT surface soil value of 200 μg/g. This detection, twice the maximum background value, may represent a site-related contaminant, but is at a concentration below both the MCP S-1/GW-1 and EPA (1994B) surface soil values of 300 μg/g and 400 μg/g, respectively. Lead levels were not elevated in the four surface soil samples collected around this location.

A geophysical survey conducted during the Phase II SI/RI identified two well-defined areas containing anomalies. Five test pits were excavated and sampled to investigate these anomalies. General refuse, demolition debris, crushed drums, and a small amount of ammunition were observed.

Metals, along with VOC, BNA, chlorinated pesticide, and OP Pest compounds, were not detected or were only detected in subsurface soils at concentrations below screening levels. The PCB Aroclor 1254 was detected in test pit sample A3TPC2 at a concentration of 2.3 μg/g, slightly exceeding the MCP S-1/GW-1 standard of 2.0 μg/g. Sulfur, for which no screening level exists, was detected in one sample at a concentration of 2.2 μg/g.

Methylene chloride was detected in monitoring well EHA6 in June 1992. This compound was not detected in this well during the October 1992, sampling event and its single detection is regarded as a laboratory artifact. No BNAs, pesticides, metals, or other VOCs were detected at concentrations above primary screening values. Although manganese was detected in 4 of 7 ground water samples at concentrations above SMCL values, the observed concentrations are interpreted to represent natural background levels in this area.

In conclusion, while surface dumps and buried or widespread solid wastes have been discovered in SA A3/P5, no significant surface soil, subsurface soil, or ground water contamination has been detected in SA A3/P5. However, the presence of crushed drums, drum fragments, and unexpended ordnance in the gravel pit area raises the possibility that undiscovered sources of contamination (hotspots) may exist.

The geophysical survey has identified two well defined areas where buried solid waste was discovered. Therefore, a limited solid waste removal action in these two areas, followed by post-

excavation confirmatory soil sampling, is recommended. If the solid waste is removed, and the confirmatory samples do not indicate the presence of contaminants at elevated levels, the uncertainty regarding possible undiscovered sources of contamination would be decreased significantly. If contamination is detected or suspected based on newly discovered contamination sources or post-excavation analytical results, a supplemental site investigation (SSI) could be proposed at that time to address these concerns.

5.2 STUDY AREA P4: BUNKER DRUM AREA

SA P4 contained four upright 55-gallon drums secured with a nylon harness, one of them labeled "Poison," and is located between Bunkers 347 and 349 (Figure 1-1).

5.2.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P4SO1B through P4SO4B, were collected from a four-point grid established around Phase I drum confirmatory sample location P4CD1 (Figure 5-5). Samples were submitted for TCL BNAs, PCB/Pest, OP Pest, and TAL metals (Table 5-1) in order to assess the lateral extent of arsenic and pesticides. Since the temperature blank in the shipping cooler containing these samples was reportedly received by the laboratory at a temperature of 8°C, the samples submitted for organic analyses were rejected by the USAEC chemist. As a result, surface soil samples P4SO1C through P4SO4C were collected on November 15, 1993 from the original sample locations. These samples were analyzed for TCL BNAs, PCB/Pest, and OP Pest. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

Surface water/sediment samples P4SW/SD1A were collected from a drainage ditch downgradient of sampling location P4CD14. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals.

5.2.2 Nature and Extent of Contamination

Analytical results for all surface soil, surface water, and sediment samples collected by OHM during the site investigation of SA P4 are summarized in this section. Sample locations are shown on Figure 5-5.

5.2.2.1 Surface Soil Sampling Results

Surface soil samples were collected from six locations during the site investigation of SA P4. These samples were analyzed for TCL VOCs (samples P4CD1A and P4CD2A only), TCL BNAs, PCB/Pest, and TAL metals. The four samples collected in 1993 were also analyzed for OP Pest, but none were present. Compounds detected in these surface soil samples are listed in Appendix D, Table D-31. Analytes which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are presented in Table 5-7. Compounds detected at concentrations above ESAT soil criteria are summarized in Table 5-8.

Only the two confirmatory drum samples were analyzed for TCL VOCs. Methylene chloride was detected in the sample collected from P4CD2 at a concentration of 0.012 μg/g. Based on surface soil data, methylene chloride is not considered to be a potential COC because its detected concentration is below both the maximum background level and the MCP S-1/GW-1 soil standard (Table 5-7). One unknown VOC was also detected in both samples at a concentration of 0.01 μg/g (Appendix D, Table D-50).

The detection of BNAs was primarily limited to sample location P4SO4 where 13 PAHs were detected at concentrations ranging from 0.46 to 3.5 μg/g (Appendix D, Table D-31). Of these 13 PAHs, concentrations of six exceed MCP S-1/GW-1 soil standards (Table 5-7). Two of these six PAHs, benzo(a)anthracene and benzo(a)pyrene, also exceed ESAT soil criteria (Table 5-8). One of the anthropogenic sources of PAHs in the environment is emissions from motor vehicles due to the incomplete combustion of organic matter. Since the only sample from SA P4 containing PAHs was collected adjacent to the dirt roadway (Figure 5-5), the source of these PAHs may be from exhaust emissions and run-off from the road.

Di-n-butyl phthalate, which is a common laboratory contaminant, was detected in the sample collected from P4CD2 at a concentration (0.59 μg/g) below the background soil 95 percent UCL level of 3.28 μg/g. Mesityl oxide (4.6 μg/g) was the only other BNA detected at P4CD2. There is no MCP S-1/GW-1 soil standard for this compound. A total of 76 unknown BNAs were also detected in these samples at concentrations ranging from 0.07 to 100 μg/g (Appendix D, Table D-50).

Six pesticides were detected in these soil samples (Appendix D, Table D-31). Although concentrations at some of these sample locations exceed background soil 95 percent UCL and maximum background values (Table 5-7), none of the pesticides were detected at concentrations above MCP S-1/GW-1 soil standards or ESAT soil criteria.

Arsenic was detected at an elevated level (200 μg/g) in confirmatory drum sample P4CD1A. Four additional samples were collected from around P4CD1 in October 1993. Each of these four samples was collected approximately 10 feet away from this former drum location (four-point grid) to determine the lateral extent of arsenic. High arsenic concentrations were found in two of the four samples; P4S03 (130 μg/g) and P4SO4 (210 μg/g). These three elevated arsenic concentrations exceed the MCP S-1/GW-1 soil standard of 30 μg/g. Although arsenic levels at P4CD2 (16 μg/g), P4SO1 (7.1 μg/g), and P4S02 (7.2 μg/g) did not exceed maximum background, they exceed ESAT soil criteria (Table 5-8). The remaining metals listed in Table 5-7 are not considered to be potential COCs because they were either detected at concentrations below maximum background levels, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements.

5.2.2.2 Surface Water and Sediment Sampling Results

One surface water and one sediment sample were collected from SA P4 in April 1992. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, TOC (sediment only), and TAL metals. PCB/Pest and explosives were not detected. The compounds detected in these samples are listed in Appendix D, Tables D-32 and D-33. Analytes detected at concentrations above screening criteria are summarized in Tables 5-9 and 5-10. Surface water sampling data will be discussed first, followed by the sediment sampling results.

VOCs were not detected in the surface water sample. One unknown BNA was detected at a concentration of 15 μg/L (Appendix D, Table D-50). The six metals detected in this sample are listed in Appendix D, Table D-32. Aluminum (293 μg/L) and lead (2 μg/L) were detected at concentrations above ESAT surface water criteria., however, concentrations of both metals are below maximum background levels (Table 5-9). Arsenic was detected at a concentration of 13.2 μg/L which is below the aquatic chronic AWQC, but above the human health AWQC. No other metals were detected in this surface water sample at concentrations above screening levels.

A trace level of acetone (0.03 μg/g) was detected in the sediment sample (Appendix D, Table D-33). There is no ESAT sediment criteria value available for this compound. One unknown VOC was also detected in this sample at a concentration of 0.08 μg/g (Appendix D, Table D-50). No other VOCs were detected.

There are no sediment criteria values for the two BNAs detected in this sediment sample. Di-n-butyl phthalate, which is a common laboratory contaminant, was detected at a concentration of 1 μg/g, and sulfur was detected at a concentration of 10 μg/g.

The metals detected in this sediment sample are listed in Appendix D, Table D-33. Arsenic was detected at a concentration (9.4 μg/g) slightly above the ESAT sediment value (6 μg/g). The concentration of cadmium detected in this sample is approximately equivalent to the 0.6 μg/g ESAT screening level. Although concentrations of chromium, copper, lead, nickel, and zinc exceed maximum background levels, they are below ESAT sediment criteria. There are no ESAT sediment values for aluminum, calcium, iron, and manganese which were detected at concentrations above maximum background. Since these metals are all naturally occurring, the concentrations at which they were detected are probably representative of background levels since the background data was based on only two samples.

5.2.3 Conclusions and Recommendations

Four upright 55-gallon drums secured with a nylon harness were discovered north of the road between Bunkers 347 and 349 (Figure 5-5). One drum was also discovered south of the road in this same area. Two surface soil confirmatory drum samples (Phase I), four surface soil samples (Phase II), and one surface water/sediment sample (Phase I) were collected and analyzed for VOCs (confirmatory drum samples and surface water/sediment only), BNAs, PCB/Pest, and metals to assess whether contaminants were present at elevated levels at this site.

No VOCs detected in surface soil samples exceeded screening levels. Six BNAs (PAHs) were detected, primarily at sampling location P4SO4, at concentrations exceeding MCP S-1/GW-1 standards, and two of these PAHs exceeded ESAT soil standards. As this sampling location is adjacent to the access road, these contaminants are thought to be the result of vehicle exhaust emissions and run-off from the road. Six pesticides were detected at concentrations exceeding background levels, however, none exceeded MCP S-1/GW-1 or ESAT soil criteria. Arsenic was detected in confirmatory drum sample P4CD1A (200 μg/g), and in confirmatory surface soil samples P4SO3B (130 μg/g) and P4SO4B (210 μg/g), in exceedence of screening criteria.

Surface water/sediment samples P4SD/SW1A were collected from a drainage ditch downgradient from sampling location P4CD1 (Figure 5-5) and analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. Aluminum and lead were detected in surface water at concentrations exceeding ESAT values, but below background levels. Arsenic was detected in exceedence of background levels and the human health (consumption of organisms only) AWQC values, but below freshwater aquatic chronic AWQC values. No VOCs or BNAs were detected in sediments at concentrations exceeding screening criteria. Arsenic, at 9.4 μg/g, exceeded both background and the ESAT sediment criteria. However, the arsenic detection is essentially equivalent to surface soil arsenic concentrations and, considering that surface water concentrations are below AWQC levels, it is unlikely that arsenic would adversely affect organisms in this area. The slight exceedences of surface water/sediment criteria at this location do not appear to warrant further action.

Due to the presence of arsenic and PAHs in surface soils, a limited removal action around sample location P4CD1, followed by post-excavation confirmatory soil sampling, is recommended.

5.3 STUDY AREA P7: PATROL ROAD WASTE AREA

Based on interviews with Natick Laboratories employees, this area has been previously identified as a possible miscellaneous waste chemical disposal area.

5.3.1 Technical Approach and Field Work Performed

Three ground water samples designated P7GW28C, P7GW30C, and P7GW31C were collected from monitoring wells OHM-P7-28, OHM-P7-30, and OHM-P7-31, respectively (Figure 5-6). The samples were analyzed for TCL VOCs (Table 5-1) in order to confirm the presence of toluene, an organic compound detected in one ground water sample collected from monitoring well OHM-P7-31 on October 26, 1992. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

5.3.2 Nature and Extent of Contamination

This section summarizes the analytical results for all test pit, subsurface soil, and ground water samples collected by OHM during the site investigation of SA P7. Sample locations are shown on Figure 5-6.

5.3.2.1 Test Pit Sampling Results

OHM has collected six soil samples from two test pit locations. The two composite samples, P7TPA1 and P7TPB1, were submitted for TCL VOC, TCL BNA, PCB/Pest, chlorinated herbicides, explosives, and TAL metals analysis. The remaining four samples were collected as grab samples and were submitted for TCL VOC analysis only. No VOCs, PCB/Pest, herbicides, or explosives were detected. Table D-34 in Appendix D lists all compounds detected in these test pit samples. Analytes which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-11.

The only BNA identified in these test pit samples was di-n-butyl phthalate (maximum 0.42 μg/g) at concentrations below the background 95 percent UCL value (3.8 μg/g). Di-n-butyl phthalate is a common laboratory contaminant and was detected in 10 of the 12 background soil samples collected by OHM. Therefore, the detection of this compound at these low concentrations may not be site-related. Since the concentrations detected do not exceed background levels, this compound is not considered to be a potential COC. Two unknown BNAs were also detected in these samples at concentrations ranging from 1.1 to 1.9 μg/g (Appendix D, Table D-50).

None of the metals detected in these test pit samples exceed MCP S-1/GW-1 soil standards (Table 5-11). Although cadmium concentrations do not exceed MCP S-1/GW-1 standards, it is believed that the levels in these samples were actually lower than the concentrations reported. Cadmium concentrations above background levels were found in all soil samples from the first six analytical lots. Consequently, the first six lots, including the SA P7 test pit samples, were rerun outside of holding times. Metals other than cadmium were found at concentrations similar to the initial runs, suggesting that the

holding time exceedence had little effect on concentrations detected. However, cadmium concentrations decreased by factors of five to ten, indicating that analytical problems were present in the initial runs. It appears as though there was an inaccurate interelement correction related to interference effects of iron on cadmium. The second results could not be substituted for the initial results because USAEC policy does not allow substitution of data obtained outside of holding times. Consequently, the initial results are used in this report. Potassium is listed in Table 5-1 because its detected concentrations exceed the background soil 95 percent UCL value for this compound. However, both detections are below the maximum background concentration.

5.3.2.2 Subsurface Soil Sampling Results

The four boring samples, including one field duplicate, collected during the installation of the three monitoring wells in SA P7 were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, TOC, and TAL metals. PCB/Pest, herbicides, and explosives were not detected. A list of all detected compounds is provided in Appendix D, Table D-35. Analytes which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-12.

Acetone was detected at 1 of 3 sample locations at a concentration of 0.023 μg/g which is below background soil 95 percent UCL and MCP S-1/GW-1 levels. Two unknown VOCs were also detected in these samples at concentrations ranging from 0.01 to 0.04 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate, a common laboratory contaminant, was detected in all four samples at concentrations ranging from 0.32 to 0.69 μg/g. These concentrations do not exceed the background soil 95 percent UCL value of 3.8 μg/g. Eight unknown BNAs were also detected at concentrations ranging from 1 to 7 μg/g (Appendix D, Table D-50).

None of the metals detected in these samples is considered to be a potential contaminant of concern. All of the metals listed in Appendix D, Table D-35 were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or, in the case of potassium, is a naturally occurring essential element (Table 5-12).

5.3.2.3 Ground Water Sampling Results

OHM has collected nine ground water samples from the three monitoring wells in SA P7. Except for the samples collected in December 1993, all samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Herbicides and explosives were not detected. The three samples collected in December 1993 were submitted for VOC analysis only. A list of all detected compounds is provided in Appendix D, Table D-36. Compounds which exceed ground water criteria are summarized in Table 5-13.

Toluene was detected in 1 of 9 ground water samples at a concentration of 2.6 μg/L, well below its MCL of 1,000 μg/L. This compound was detected in the October 1992 sample collected from OHM-P7-31. Toluene was not detected in the prior sample collected from this well in June 1992. These three monitoring wells were sampled for a third time in December 1993 for the sole purpose of determining whether toluene was present in SA P7 ground water. Toluene was not detected in any of these additional samples thus confirming that the single, low-level detection of this compound was not site-related. Three

unknown VOCs were also detected in these samples at concentrations ranging from 3 to 11 μg/L (Appendix D, Table D-50).

One unknown BNA was detected in the June 1992 samples from all three wells at concentrations ranging from 12 to 13 μg/L (Appendix D, Table D-50). The frequency of detection, the consistency of the values, and the fact that this unknown compound was not detected in any of the samples collected during the subsequent sampling round (October 1992), suggests that the presence of this compound may have been laboratory-related. No other BNAs were detected.

The pesticide ppDDT was detected in 1 of 6 samples submitted for PCB/Pest analysis. Since there is no MCL for this compound, the concentration detected was compared to the MCP GW-1 standard. ppDDT was detected at a concentration of 0.05 μg/L in the June 1992 sample collected from OHM-P7-28, which is below the MCP GW-1 standard of 0.3 μg/L. ppDDT was not detected in the October 1992 sample collected from this well. No other PCB/Pest were detected.

The six metals detected in these ground water samples are listed in Appendix D, Table D-36. No metals were detected at concentrations above MCLs. Aluminum and manganese concentrations exceed SMCLs, which are based on aesthetics, in all six samples submitted for metals analysis (Table 5-13). As previously noted, high manganese concentrations are characteristic of ground water in the region (Perlmutter, 1962; Pollock et al., 1969).

5.3.3 Conclusions and Recommendations

SA P7 was identified as a possible waste chemical disposal area. To investigate this possibility, soil gas and geophysical surveys were conducted, along with the excavation of two test pits, and the installation and sampling of three monitoring wells.

Test pit and boring samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, chlorinated herbicides, explosives, and TAL metals. Boring samples were also analyzed for total organic carbon. Although some metals were found at concentrations exceeding background criteria in the test pit samples, no compounds were detected at concentrations exceeding MCP S-1/GW-1 soil screening criteria. None of the compounds detected in the boring samples are considered potential contaminants of concern.

Three ground water samples have been collected from each monitoring well. No VOCs, BNAs, PCB/Pest, chlorinated herbicides, or explosives were detected at concentrations exceeding ground water screening criteria. No metals were detected at concentrations exceeding MCLs, however, aluminum and manganese were detected at concentrations exceeding SMCLs.

No physical evidence has been found indicating that chemical waste disposal has occurred in this area. In addition, no potential contaminants of concern have been detected in soil or ground water samples. Consequently, no further action is recommended for this site.

5.4 STUDY AREA P17: BUILDING T206 CLOTH BURIAL AREA

SA P17 has been investigated to assess possible contamination resulting from debris burial occurring during the 1960s and 1970s, and from a 55-gallon drum located on the western edge of the area.

5.4.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P17SO1B through P17SO4B, were collected from a four-point grid established around Phase I drum confirmatory sample location P17CD1 (Figure 5-7). All Phase II samples were submitted for TAL metals, PCB/Pest and OP Pest analyses (Table 5-1) in order to assess the lateral extent of arsenic, ppDDT, and ppDDT-related compounds previously detected in drum confirmatory sample P17CD1A. Since the temperature blank in the shipping cooler containing these samples was reportedly received by the laboratory at a temperature of 8°C, the samples submitted for organic analyses were rejected by the USAEC chemist. As a result, surface soil samples P17SO1C through P17SO4C were collected on November 15, 1993 from the original sample locations. These samples were analyzed for PCB/Pest and OP Pest. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

5.4.2 Nature and Extent of Contamination

Analytical results for all surface soil, test pit, and ground water samples collected in conjunction with OHM's SI in SA P17 are described in this section. Sample locations are shown on Figure 5-7.

5.4.2.1 Surface Soil Sampling Results

Surface soil samples (depths 0 to 6 inches) were collected from a total of five locations in SA P17. The confirmatory drum sample and the field duplicate collected in May 1992 were analyzed for VOCs, BNAs, PCB/Pest, herbicides, explosives, phosphate, thiodiglycol, and metals. Herbicides, explosives, phosphate, and thiodiglycol were not detected. The soil samples collected in October 1993 from a four-point grid around confirmatory drum sample P17CD1 were submitted for PCB/Pest, OP Pest, and metals analysis only. No OP Pest were present. All detected compounds are listed in Appendix D, Table D-37. Analytes which exceed background 95 percent UCL values and/or MCP S-1/GW-1 soil standards are presented in Table 5-14. Compounds detected at concentrations above ESAT soil criteria are summarized in Table 5-15.

Methylene chloride was detected in sample P17CD1A at 0.009 μg/g. This VOC was not present in the duplicate sample and the detected concentration does not exceed the maximum background level or the MCP S-1/GW-1 soil standard (Table 5-14). One unknown VOC was also detected in the field sample at a concentration of 0.01 μg/g (Appendix D, Table D-50). This unknown compound was not present in the field duplicate.

Four unknown BNAs were detected in the surface soil samples at concentrations ranging from 2 to 24 μg/g (Appendix D, Table D-50). No other BNAs were detected.

A positive detection of beta-benzenehexachloride was reported in the duplicate sample collected from P17CD1 but was not detected in the field sample. The concentration present in this duplicate sample, 0.01 μg/g, which exceeds the maximum background value of 0.004 μg/g. There is no MCP S-1/GW-1 standard or ESAT soil value for this pesticide. ppDDD, ppDDE, and ppDDT were detected at all five sample locations. The concentrations detected ranged from 0.06 to 1.1 μg/g which are below MCP S-1/GW-1 soil standards. However, ppDDE concentrations slightly exceeded the ESAT soil criteria of 0.5 μg/g at 3 of 5 sample locations (Table 5-15). No other PCB/Pest were detected.

Arsenic was the only metal detected at elevated concentrations. Arsenic was present at a concentration of 220 μg/g in the sample collected from P17CD1 and at 210 μg/g in the associated field duplicate. The samples collected from a four-point grid around P17CD1 to determine the lateral extent of the elevated arsenic levels also contained high arsenic concentrations (240 to 260 μg/g). These arsenic concentrations exceed maximum background, MCP S-1/GW-1 standards, and ESAT soil criteria.

Beryllium concentrations of 0.44 to 0.58 slightly exceed the MCP S-1/GW-1 soil standard of 0.4 μg/g in 4 of 6 samples, and slightly exceeds the ESAT soil value at one sample location (Tables 5-14 and 5-15). However, all concentrations are below the maximum background soil level of 0.638 μg/g. Therefore, the beryllium concentrations detected in these samples are considered to be representative of background levels. The remaining metals listed in Table 5-14 were detected at concentrations below maximum background.

5.4.2.2 Test Pit Sampling Results

OHM has collected 30 soil samples from 10 test pit locations in SA P17. Most of these samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, herbicides, explosives, phosphate, thiodiglycol, and TAL metals. Herbicides, explosives, and thiodiglycol were not detected. Compounds detected in these test pit samples are listed in Appendix D, Table D-38. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-16.

Methylene chloride, which is a common laboratory contaminant, was detected in 11 of 30 samples at concentrations below maximum background levels and MCP S-1/GW-1 soil standards. Four unknown VOCs were also detected in these samples at concentrations ranging from 0.005 to 0.01 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate was present in all 12 samples submitted for BNA analysis. However, this compound is a common laboratory contaminant and positive detections of this compound were reported for 10 of the 12 background samples collected by OHM. All concentrations detected in these test pit samples are below the maximum background concentration of 9 μg/g. Therefore, di-n-butyl phthalate is not considered to be a potential COC. Toluene was detected in the semivolatiles analysis (P17TPH3) at a concentration of 3.5 μg/g. The presence of toluene was not confirmed by the VOC analysis, which suggests that this analyte may be a laboratory contaminant. This reported concentration does not exceed the MCP S-1/GW-1 soil standard of 90 μg/g. Nine unknown BNAs were also detected at concentrations ranging from 1 to 46 μg/g (Appendix D, Table D-50).

Heptachlor epoxide (2 of 12 samples), ppDDE (2 of 12 samples), and ppDDT (3 of 12 samples) were the only pesticides detected in these samples. All reported concentrations for these compounds are below MCP S-1/GW-1 soil standards (Table 5-16).

Phosphate was detected in 1 of 12 samples submitted for analysis at a concentration of 1.64 μg/g which is below the background soil 95 percent UCL value (6 μg/g). There is no MCP S-1/GW-1 soil standard for this compound.

The metals detected in these samples are listed in Appendix D, Table D-38. All metals were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements (Table 5-16).

5.4.2.3 Ground Water Sampling Results

OHM has collected three ground water samples from boundary well OHM-BW-3, located at the south-southeastern edge of SA P17. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, cyanide (October 1991 sample only), explosives, and TAL metals. The two 1992 samples were also analyzed for phosphate and herbicides. Cyanide, herbicides, and explosives were not detected. Table D-39 in Appendix D lists all positive detections. Compounds which exceed ground water criteria are summarized in Table 5-17.

Chloromethane (14.2 μg/L) and methylene chloride (11.8 μg/L) were detected in the October 1991 sample. These VOCs were not present in either of the two subsequent samples collected from this well. There is no drinking water standard available for chloromethane. Further, since chloromethane was not detected in 2 of 3 samples, this VOC is not considered a COC in SA P17 groundwater. The methylene chloride concentration exceeds the MCL of 5 μg/L. This positive detection sample was one of ten samples analyzed as part of lot VGM. Methylene chloride was detected in all ten samples in this lot at similar concentrations (Table 3-12). Since lot VGM also contained two trip blanks and one rinsate blank, the methylene chloride detection is considered to be a laboratory artifact. No other VOCs were detected in these ground water samples.

The insect repellent N,N-diethyl-3-methylbenzamide (DEET) was detected in the BNA analysis in the June 1992 sample. This compound was also detected in ground water samples collected from other SAs during the June 1992 sampling round. DEET was not detected in this well during the other two sampling rounds when sampling personnel were not wearing the compound as an insect repellent. Therefore, the detection of DEET in SA P17 ground water is not considered to be site-related. Two unknown BNAs were also detected in the June 1992 sample at concentrations of 15 and 20 μg/L (Appendix D, Table D-50).

There were no confirmed detections of pesticides in these ground water samples. Heptachlor is reported as an unconfirmed analyte in the October 1991 sample and should be considered as undetected.

Phosphate was detected in 2 of 3 samples at a maximum concentration of 14 μg/L. There are no ground water criteria available for this compound.

The nine metals detected in these samples are listed in Appendix D, Table D-39. None of the metals detected exceed ground water criteria.

5.4.3 Conclusions and Recommendations

The site investigation of SA P17 consisted of a geophysical study, excavation of ten test pits with soil sampling, installation of a downgradient boundary well followed by three rounds of ground water sampling, removal of a 55-gallon drum followed by surface soil sampling, and the collection of four soil samples from a 4-point grid established around the confirmatory drum sampling location. Samples were submitted for analysis of TCL VOCs, TCL BNAs, TAL metals, PCB/Pest, chlorinated herbicides, explosives, phosphate, and thiodiglycol.

During the geophysical study, several areas of buried solid debris were located. These areas were investigated through the excavation and sampling of ten test pits. Buried debris was found in test pits P17TPC, P17TPE, P17TPH, and P17TPI. Downgradient ground water quality was assessed by three

rounds of ground water samples from boundary well OHM-BW-3. No potential COCs were detected in subsurface soils or in ground water.

Arsenic was detected during the Phase I SI/RI in confirmatory drum sample P17CD1A at a concentration of 220 μg/g. The four surface soil samples collected from the 4-point grid established around sample location P17CD1 contained arsenic at concentrations ranging from 240 to 260 μg/g. All five arsenic detections exceed screening values. No other potential COCs were detected in SA P17.

Due to elevated arsenic levels detected in surface soil in and around P17CD1, a limited supplementary site investigation is recommended to assess the lateral extent of this contaminant. Once the extent of the contamination is reliably established through the collection and analysis of additional soil samples, appropriate remedial measures should be recommended.

5.5 STUDY AREA P19: CLEARING, TRACKED ROAD

SA P19 is a cleared area with tire tracks and dead trees that has been used as an encampment during troop training exercises. Several soil mounds, trenches, and pits were noted and are believed to be the remains of fighting positions left by military units training in this area. A drum and scrap metal were also found in the forest on the northwest edge of the area.

5.5.1 Technical Approach and Field Work Performed

The drum located on the northwest edge of the area was removed and placed in the staging area at the old MFFA. Confirmatory soil sample P19CD1B was collected for analysis of TCL BNAs, TCL VOCs, TAL metals, PCB/Pest, and OP Pest (Table 5-1). Figure 5-8 shows the sample location. No staining or unusual odors, or PID or radiological readings above background, were noted during sample collection.

5.5.2 Nature and Extent of Contamination

This section summarizes the confirmatory drum sample analytical results. The sample was analyzed for the parameters listed in the previous section. OP Pest were not present. A complete list of all positive detections is provided in Appendix D, Table D-40. Compounds detected at concentrations above background 95 percent UCL values and/or MCP S-1/GW-1 soil standards are presented in Table 5-18. Analytes which exceed ESAT soil criteria are summarized in Table 5-19.

The only VOCs or BNAs detected in this sample were unknowns. One unknown VOC (0.007 μg/g) and 64 unknown BNAs were present in this sample at concentrations ranging from 0.1 to 20 μg/g (Appendix D, Table D-50).

ppDDE (0.08 μg/g) and ppDDT (0.03 μg/g) were the only pesticides detected. Concentrations of these pesticides do not exceed maximum background levels, MCP S-1/GW-1 soil standards, or ESAT soil criteria.

None of the 16 metals detected in this sample is considered to be a potential COC. Beryllium was detected at a concentration (0.48 μg/g) slightly above the MCP S-1/GW-1 soil standard (0.4 μg/g), but below the ESAT soil criteria, and background soil concentrations which ranged from 0.28 to 0.64 μg/g. No other metals were detected at concentrations above MCP S-1/GW-1 soil standards.

Even though arsenic was detected at a concentration (10 μg/g) below maximum background (17 μg/g), it exceeds the ESAT soil value of 4.8 μg/g. Lead was detected at a concentration of 80 μg/g which does not exceed either the MCP S-1/GW-1 soil standard (300 μg/g) or the ESAT soil criteria (200 μg/g).

5.5.3 Conclusions and Recommendations

SA P19 was used as an encampment area during troop training exercises. An enhanced area reconnaissance (EAR) was conducted to identify stressed vegetation, surface debris, or evidence of disposal in and around the SA. Small soil mounds, trenches, clearings, wood debris, scrap metal, corrugated pipe, and two empty drums were found. No evidence of dumping or disposal was discovered, and no indications of contamination were noted.

One confirmatory drum sample (P19CD1B) was collected for analysis of TCL VOCs, TCL BNAs, TAL metals, PCB/Pest, and OP Pest. No VOCs, BNAs, or pesticides were detected in exceedence of screening values. No metals were detected in exceedence of maximum background concentrations. Beryllium, detected at 0.48 μg/g, slightly exceeds the MCP S-1/GW-1 soil standard of 0.4 μg/g. Arsenic was detected at 10 μg/g, exceeding the ESAT value of 4.8 μg/g. However, it should be noted that the background arsenic concentrations for the 95 percent UCL (8.95 μg/g) and maximum background (17 μg/g) both exceed the ESAT ecological soil value.

In summary, no indications of dumping or disposal were found in this area, and no potential COCs were detected in the confirmatory drum sample. Consequently, no further action is recommended for this area.

5.6 STUDY AREA P20: BURNED AREA AND DRUM

This area is a depression excavated into hillside adjacent to Puffer Pond Road and has been determined to be a small borrow pit. Figure 1-1 shows the area location. SA P20 contains a small soil mound, a larger rock and soil pile along the edge of the road, and standing water in the bottom of the depression. Metal was noted protruding from the ground, and a drum was located on the western slope of the area. Surface soil sample P20SO1A was collected on April 20, 1992, from the bottom of the depression, directly down-gradient from the drum location.

5.6.1 Technical Approach and Field Work Performed

The field investigation included a geophysical survey, excavation of two test pits, and the collection of four surface soil samples. Figure 5-9 shows the sample locations.

5.6.1.1 Geophysical Survey

The geophysical investigation was prompted by discussions with the MADEP, USEPA, and USAEC concerning two small, apparently manmade mounds in this area. The possible contents of the mounds were a subject of concern and the target of this investigation.

The geophysical study involved physically scanning each mound with a Schonstedt GA-72 CV magnetic locator to identify buried metal. This was accomplished by sweeping the entire surface area of

each mound with the instrument. Several magnetic anomalies were detected for each mound at locations which had partially exposed metal debris such as bed springs, strips of metal, and small metal pipes. One test pit location was selected for each mound.

5.6.1.2 Test Pits

Two test pits, designated P20TPA and P20TPB, were excavated in November 1993 at the locations shown on Figure 5-9. Test pit classification logs are contained in Appendix B.

Test pit P20TPA was located west of the entrance to SA P20 on a large rock and soil pile. The pit was completed at 6.5-feet below the top of the mound, approximately ground surface elevation. Excavation exposed sheet metal, bed springs, banding iron, broken glass, and porcelain pieces. The mound had apparently been created by piling up debris and rocks once spread on the ground surface. No staining or unusual odors were noted, and no PID or radiological reading above background were recorded during excavation. Due to the lack of potential contamination sources, no soil samples were collected from this test pit.

Test pit P20TPB was located east of the entrance to SA P20 on a low soil and rock mound that had a metal pipe protruding from it. The pit was completed at 6 feet BGS. Excavation revealed a single 1.25-inch diameter pipe 4.5 feet long as the source of the anomaly. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded. Due to the lack of potential contamination sources, no soil samples were collected from this test pit.

5.6.1.3 Surface Soil Sampling

Four surface soil samples designated P20SO2 through P20SO5 were collected from a four-point grid established around Phase I surface soil sample location P20SO1 (Figure 5-9). All Phase II samples were analyzed for TAL metals in order to assess the lateral extent of lead, a metal detected at an elevated concentration in sample P20SO1A. No staining, unusual odors, or elevated radiological reading were noted during sample collection. A PID was not used to screen the samples due to heavy precipitation.

5.6.2 Nature and Extent of Contamination

This section summarizes the analytical results for the six surface soil samples (depths 0 to 6 inches) collected during the SI of SA P20. Sample locations are shown on Figure 5-9. The two samples (P20SO1 and P20CD1) collected in 1992 were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. No explosives were detected. The four samples collected in October 1993 were submitted for TAL metals analysis only. All detected compounds are listed in Appendix D, Table D-41. Compounds detected at concentrations above background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 5-20. Analytes which exceed ESAT soil criteria are summarized in Table 5-21.

Neither of the two VOCs detected in these samples is considered to be a potential COC. Acetone, a common laboratory contaminant, was detected in both samples (maximum 0.06 μg/g) submitted for VOC analysis at concentrations below MCP S-1/GW-1 soil standards. Alpha-pinene was detected at a concentration of 0.12 μg/g at P20CD1. This compound is a naturally occurring terpene and its detection at this confirmatory drum sample location is not likely to be the result of chemical contamination. Six

unknown VOCs were also detected at concentrations ranging from 0.01 to 0.06 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate was detected in both samples at a maximum concentration of 3 μg/g. This compound is a common laboratory contaminant associated with plastics and was detected in 10 of the 12 background samples collected by OHM. In addition, the di-n-butyl phthalate concentrations in these samples do not exceed the background soil 95 percent UCL value. Four unknown BNAs were also detected at concentrations ranging from 2 to 20 μg/g (Appendix D, Table D-50).

ppDDE and ppDDT were detected in these samples at a maximum concentration of 0.04 μg/g. The concentrations of these pesticides are below background soil levels, MCP S-1/GW-1 soil standards, and ESAT soil criteria. No other pesticides were detected.

Lead was detected at an elevated concentration in one of the two samples collected from this area in 1992. This high lead concentration, 780 μg/g, was detected in the sample (P20SO1A) collected from the bottom of the depression, down-gradient of the former drum location. This concentration exceeds both the MCP S-1/GW-1 soil standard (300 μg/g) and the ESAT soil value (200 μg/g) (Tables 5-20 and 5-21). The lead concentration in the sample collected from beneath the empty 55-gallon drum was not elevated (35 μg/g). Four additional samples were collected from around sample point P20SO1 in October 1993 to determine the lateral extent of the elevated lead levels. Lead was only detected in 1 of 4 of these additional samples at a concentration above screening levels. The exceedence was in sample P20SO3 where lead was detected at a concentration of 3,000 μg/g. Concentrations in the remaining three samples ranged from 14 to 110 μg/g.

Beryllium was detected at 1 of 6 sample locations (P20SO3) at a concentration of 0.57 μg/g which is above both the MCP S-1/GW-1 soil standard and the ESAT soil value. However, this concentration does not exceed the maximum background soil level (0.64 μg/g). Therefore, this beryllium concentration is considered to be representative of background levels. Although arsenic was detected at concentrations below background, arsenic levels exceed ESAT criteria at 5 of 6 sample locations (Table 5-21). There are no MCP S-1/GW-1 soil standards for copper and potassium which were detected at concentrations above maximum background levels. The maximum copper concentration detected, 100 μg/g (P20SO3), is equivalent to the ESAT soil value. Potassium is a naturally occurring essential element and its detection at concentrations slightly above background levels is probably due to natural variations in the geology of the area. All other metals were detected at concentrations below maximum background levels.

5.6.3 Conclusions and Recommendations

SA P20 is a small borrow pit excavated into the side of a hill. A drum was discovered on the western side of the pit, and metallic debris was noted protruding from a small mound by the road. The site investigation of SA P20 included an area reconnaissance, a geophysical survey, two test pit excavations, and the collection of six surface soil samples.

Test pit excavations revealed a variety of solid debris such as broken glass and porcelain, bedsprings, banding iron, sheet metal, and metal pipe. Due to the lack of contamination sources, and the absence of visible or detectable signs of contamination in or around these pits, no samples were collected.

Lead was detected at a concentration of 780 μg/g in surface soil sample P20SO1A, exceeding all screening criteria. This sample was collected from near the bottom of the pit, down gradient from the drum discovered on the western slope. Four surface soil samples were collected from a 4-point grid established around this sampling location to assess the lateral extent of lead. One of the four samples, P20SO3, had a lead concentration of 3,000 μg/g. The other three samples did not exceed screening criteria for this metal.

The analytical results show that lead is a COC in this area. A limited supplemental site investigation is recommended to assess the lateral and vertical extent of this metal. Once the extent of this COC is reliably established, appropriate remedial actions should be recommended.

5.7 STUDY AREA P25: TEST CHAMBER BUILDING T463

The test chamber is an abandoned and open bunker-like structure built into the side of a hill. It was originally constructed during operation of the Maynard Ordnance Test Station (MOTS). The building was used by the USAF Cambridge Research Laboratory for air gun experiments and for velocity experiments conducted with a cannon.

5.7.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P25SO2B through P25SO5B, were collected from a four-point grid established around Phase I surface soil sample location P25SO1 (Figure 5-10). The samples were submitted for analysis of TAL metals, PCB/Pest, and OP Pest in order to assess the lateral extent of ppDDT, ppDDE, ppDDD, and TAL metals (Table 5-1) which were detected at elevated levels in soil sample P25SO1A. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded during sampling.

5.7.2 Nature and Extent of Contamination

This section summarizes the analytical results for the seven surface soil samples (depths 0 to 6 inches) collected by OHM during the SI of SA P25. Sample locations are shown on Figure 5-10. The two confirmatory aboveground storage tank (AST) samples (P25CA1A and P25CA2A) were submitted for TPH analysis only. The sample collected from P25SO1 in April 1992 was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals, while the four samples collected in October 1993 were submitted for PCB/Pest, OP Pest, and TAL metals analysis only. No explosives or OP Pest were detected. All detected compounds are listed in Appendix D, Table D-42. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 5-22. Analytes detected at concentrations above ESAT soil criteria are summarized in Table 5-23.

Methylene chloride was detected in the only sample submitted for VOC analysis (P25SO1) at a concentration of 0.01 μg/g which is below both the maximum background level and the MCP S-1/GW-1 standard (Table 5-22). Two unknown VOCs were also detected in this sample at concentrations of 0.01 and 0.06 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate, a common laboratory contaminant, was detected in sample P25SO1 at 0.9 μg/g. One unknown BNA was also present at a concentration of 22 μg/g (Appendix D, Table D-50).

The five pesticides detected in these surface soil samples are listed in Appendix D, Table D-42. ppDDD (2 of 5 samples), ppDDE (3 of 5 samples), and ppDDT (4 of 5 samples) were detected at concentrations below MCP S-1/GW-1 soil standards (Table 5-22). However, the concentration of ppDDE at one sample location (P25SO4) is equivalent to the ESAT soil value (Table 5-23). There is no MCP standard for alpha-chlordane (1 of 5 samples) or endrin aldehyde (2 of 5 samples; maximum 0.06 μg/g) which were detected at concentrations above maximum background.

None of the metals detected in these surface soil samples exceed MCP S-1/GW-1 soil standards (Table 5-22). Although beryllium was detected in 1 of 4 samples at a concentration equivalent to the MCP S-1/GW-1 standard (0.4 μg/g), this concentration is below the maximum background value (0.64 μg/g) and the ESAT soil screening level (0.55 μg/g). Arsenic was detected at concentrations below the background soil 95 percent UCL value at all sample locations. However, arsenic levels exceed ESAT criteria in 3 of 5 samples (Table 5-23). Silver was detected at a concentration of 52.3 μg/g in the April 1992 sample collected from P25SO1. This concentration is below the MCP S-1/GW-1 soil standard of 100 μg/g, but above the ESAT soil value of 10 μg/g. Silver concentrations in the samples collected from a four-point grid around P25SO1 in October 1993 were significantly lower. Silver was detected in 3 of 4 of these samples at concentrations ranging from 1.5 to 8.3 μg/g, which are below ESAT criteria. Each of these four samples was collected approximately 10 feet away from P25SO1. Therefore, these lower silver concentrations indicate that the single high detection represents a hotspot that is confined to a small area. This single exceedence of the ESAT soil criteria is not likely to pose a significant ecological risk due to the low potential for organisms to come in frequent contact with this hotspot. Zinc and copper were detected at concentrations above the maximum background. All other metals were detected at concentrations below maximum background levels or are naturally occurring essential elements.

Petroleum hydrocarbons were detected in the sample collected from beneath the AST (P25CA1A), but not in the sample collected downgradient of this former tank location (P25CA2A). The concentration detected in this sample, 180 μg/g, does not exceed the MCP S-1/GW-1 soil standard of 500 μg/g. Hydrocarbons are not considered a COC at this location.

5.7.3 Conclusions and Recommendations

The test chamber is an abandoned bunker-like structure built into the side of a hill and was used for air gun and velocity experiments. Two abandoned above-ground oil tanks were discovered in a building foundation north of the test chamber. During the Phase I SI/RI, a confirmatory soil sample was collected from beneath each tank location for TPH analysis, and one surface soil sample was collected from outside of the test chamber. The surface soil sample was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. Four surface soil samples were collected during the Phase II SI/RI from a four-point grid established around Phase I location P25SO1 and analyzed for PCB/Pest, OP Pest, and TAL metals.

No compounds were detected in any of these samples in exceedence of the background or MCP S-1/GW-1 screening standards. Some compounds slightly exceed ESAT soil levels. Arsenic was detected in 3 of 5 samples while silver was detected in 1 of 5 samples in exceedence of the ESAT surface soil guideline. The confirmatory soil sampling indicates that the single high detection represents a hotspot confined to a small area, and that it is not likely to pose a significant ecological risk due to the low potential for exposure.

Based on the analytical results and the low potential for ecological impact, no further action is recommended for this area.

5.8 STUDY AREA P35: MAIN GATE GUARD SHACK

SA P35 is located at the main gate of the Annex on Hudson Road (Figure 1-1). During the OHM site reconnaissance conducted in March 1991, a section of the grass behind the building showed visible signs of staining and possible stressed vegetation.

5.8.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P35SO2B through P35SO5B, were collected from a four-point grid established around Phase I surface soil location P35SO1 (Figure 5-11). The samples were submitted for analysis of TAL metals, PCB/Pest, and OP Pest to assess the lateral extent of pesticides, mercury, and lead (Table 5-1). These metals and compounds were detected in Phase I soil sample P35SO1A. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded during sampling.

5.8.2 Nature and Extent of Contamination

Analytical results for all surface soil, ground water, and transformer samples collected by OHM during the SI of SA P35 are summarized in this section. Sample locations are shown on Figure 5-11.

5.8.2.1 Surface Soil Sampling Results

OHM has collected surface soil samples (depths 0 to 6 inches) from five sample locations in SA P35 (Figure 5-11). The soil sample collected in April 1992, and the associated field duplicate, were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. No explosives were detected. The four samples collected in October 1993 were submitted for PCB/Pest, OP Pest, and TAL metals analysis only. OP Pest were not detected. A list of all detected compounds is provided in Appendix D, Table D-43. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-24. Table 5-25 lists the analytes which were detected at concentrations above ESAT soil criteria.

Methylene chloride was detected at 0.009 μg/g at sample location P35SO1. This VOC was not found in the duplicate sample. The concentration detected is below both maximum background and MCP S-1/GW-1 soil values. Two unknown VOCs were also detected at concentrations ranging from 0.01 to 0.12 μg/g (Appendix D, Table D-50).

The concentration of 2-methylnaphthalene (2 μg/g) detected at P35SO1 exceeds the MCP S-1/GW-1 soil standard (0.7 μg/g) (Table 5-24). No other BNAs, including unknowns, were detected.

Several pesticides were detected in these samples (Appendix D, Table D-43). Concentrations of total chlordane (maximum 6.9 μg/g; P35SO2), ppDDD (2.6 μg/g; P35SO2), ppDDE (2.4 μg/g; P35SO4), and ppDDT (3 μg/g; P35SO1) exceed MCP S-1/GW-1 standards. Concentrations of these four pesticides also exceed ESAT criteria at several sample locations (Table 5-25). Endrin and heptachlor epoxide were detected at concentrations below MCP S-1/GW-1 and ESAT soil levels. Endrin aldehyde was detected in

3 of 5 samples at concentrations (0.05 to 0.13 μg/g) above maximum background levels. There are no MCP S-1/GW-1 or ESAT screening values for this compound.

The metals detected in these soil samples are listed in Appendix D, Table D-43. Lead concentrations were elevated (100 to 360 μg/g) at all five sample locations. The maximum concentration detected (360 μg/g at P35SO2) exceeds MCP S-1/GW-1 and ESAT soil criteria (Tables 5-24 and 5-25). Arsenic was detected at concentrations ranging from 4.6 to 32 μg/g. This detection of 32 μg/g at P35SO3 slightly exceeds the MCP S-1/GW-1 soil standard of 30 μg/g. Although the arsenic concentrations at P35SO1, P35SO2, P35SO4 and P35SO5 are below background soil levels, they exceed ESAT criteria (Table 5-25).

Positive detections of beryllium were reported for 1 of 5 samples at a concentration (0.45 μg/g) slightly exceeding the MCP S-1/GW-1 soil standard of 0.4 μg/g. However, this concentration is within the range detected in the background soil samples (maximum 0.64 μg/g) and is below the ESAT value of 0.55 μg/g.

Zinc was detected at concentrations below the MCP S-1/GW-1 soil standard. However, the concentration detected at sample locations P35SO2 and P35SO5 (maximum 453 μg/g) exceed the ESAT ecological screening value of 350 μg/g (Table 5-25).

There are no MCP S-1/GW-1 soil standards for copper and barium. Although these metals were detected at concentrations above maximum background, these concentrations do not exceed their respective ESAT ecological screening levels. All other metals listed in Table 5-24 were either detected at concentrations below maximum background, below MCP S-1/GW-1 soil standards, or are naturally occurring essential elements.

5.8.2.2 Ground Water Sampling Results

Two samples were collected from the guard shack water supply well. These samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, phosphate, and TAL metals. The only organic compounds detected were one unknown VOC at 3 μg/L, and one unknown BNA at 14 μg/L (Appendix D, Table D-50). None of the six metals detected (Appendix D, Table D-44) were found at concentrations exceeding ground water criteria.

5.8.2.3 Transformer Sampling Results

Analytical results for the seven transformer samples collected from the guardhouse electrical utility room are summarized in Appendix D, Table D-45. These samples were analyzed for PCBs only. The only PCB detected was Aroclor 1260 at a concentration of 6.1 μg/g (P35TF1). PCB concentrations below 50 μg/g are considered to be non-hazardous and non-TSCA.

5.8.3 Conclusions and Recommendations

SA P35 surrounds the guard shack at the front gate of the Annex. A former above ground storage tank location was noted during a site reconnaissance of this area, along with stressed vegetation. Five surface soil samples were collected adjacent to the guard shack, and two rounds of ground water samples were collected from an existing shallow water supply well. The well is not used as a potable water supply. Seven transformers installed or stored in the guardshack were sampled and analyzed for PCBs.

Ground water samples were analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, phosphate, and TAL metals. No compounds were detected at levels exceeding screening criteria.

Transformer fluid samples were analyzed for PCBs only. The only PCB detected was Aroclor 1260 in sample P35TF1A at a concentration of 6.1 μg/g. All transformers have been removed from the guard shack and properly disposed of by Fort Devens personnel.

The surface soil sample collected from former AST location P35SO1 was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. The four samples collected in 1993 from a four-point grid established around P35SO1 were analyzed for TAL metals, PCB/Pest, and OP Pest only.

No VOCs were detected at concentrations exceeding surface soil screening criteria. The BNA 2-methylnaphthalene was detected at location P35SO1 at a concentration of 2 μg/g, in exceedence of MCP S-1/GW-1 criteria (0.7 μg/g). The total concentration of the pesticide chlordane at location P35SO2 (6.9 μg/g) exceeded the MCP S-1/GW-1 criteria of 1 μg/g. The pesticides ppDDD (2.6 μg/g), ppDDE (2.4 μg/g), and ppDDT (3 μg/g) were also detected at concentrations slightly exceeding their MCP S-1/GW-1 criteria of 2 μg/g. These four pesticide detections also exceeded ESAT ecological soil criteria.

Lead, arsenic, beryllium, and zinc were all detected at concentrations exceeding one or more soil screening criteria. Four samples exceeded maximum background lead criteria, and one of the lead detections (360 μg/g) exceeded maximum background and the MCP S-1/GW-1 criteria, but does not exceed the EPAs (1994B) soil lead guidance value of 400 μg/g. One arsenic detection (32 μg/g) slightly exceeded the MCP S-1/GW-1 criteria of 30 μg/g and maximum background. Four arsenic detections exceeded ESAT ecological soil criteria. One beryllium detection (0.45 μg/g) slightly exceeds the MCP S-1/GW-1 soil standard of 0.4 μg/g, but does not exceed background or ESAT soil criteria. Zinc was detected at one location at a concentration of 453 μg/g, exceeding the ESAT soil screening value of 350 μg/g, but is well below the MCP S-1/GW-1 value of 2,500 μg/g. Copper and barium were also detected at levels greater than background, but did not exceed the ESAT ecological soil screening criteria. Arsenic, lead, zinc, ppDDT, ppDDD, ppDDE, and chlordane were also detected at one or more sampling locations above ecological screening levels.

Lead, arsenic, ppDDD, ppDDE, ppDDT, and total chlordane exceeded background and MCP S-1/GW-1 screening criteria. The pesticides are the likely result of pest control activities around the guard shack, and not the result of chemical disposal. The elevated lead levels are probably the result of automobile exhaust emissions in the surrounding parking areas, or from paint used on the guard shack. Based on these findings, a limited removal action is recommended for this site.

5.9 STUDY AREA P49: TWO DRUMS NEAR ROAD AND BUNKER 323

SA P49 is located in the central portion of the Annex, west of Bunker 323 and near the base of a hill (Figure 1-1). Two empty 55-gallon drums were discovered at this location during an OHM area reconnaissance conducted in March 1991.

5.9.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P49SO1B through P49SO4B, were collected from a four-point grid established around Phase I sample point P49CD1 (Figure 5-12). All samples were submitted for

analysis of TCL VOCs, PCB/Pest, and OP Pest in order to assess the lateral extent of pesticides and to assess whether solvents were present (Table 5-1). ppDDT, ppDDE, and ppDDD were detected at elevated levels in Phase I soil sample P49CD1A along with a trace of tetrachloroethylene.

Because the laboratory did not unpack the container in which the vials for the TCL VOC analysis were shipped, additional VOC samples, designated P49SO1C through P49SO4C, were collected from the original sample locations on November 15, 1993. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded during sampling.

5.9.2 Nature and Extent of Contamination

This section summarizes the analytical results for the five surface soil samples (depths 0 to 6 inches) collected by OHM during the SA P49 SI. The confirmatory drum sample collected in May 1992 was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. No explosives were detected. The four samples collected in 1993 were submitted for TCL VOC, PCB/Pest, and OP Pest analysis. No OP Pest were present. All detected compounds are listed in Appendix D, Table D-46. Compounds detected at concentrations above background 95 percent UCL values and/or MCP S-1/GW-1 soil standards are listed in Table 5-26. Analytes which exceed ESAT soil criteria are summarized in Table 5-27.

A trace of tetrachloroethylene (0.003 μg/g) was detected in the confirmatory drum sample (P49CD1A) collected in May 1992. This compound was not detected in the samples collected from a four-point grid around this former drum location in October 1993. This tetrachloroethylene concentration is well below the MCP S-1/GW-1 soil standard of 0.5 μg/g and is not considered to be a potential COC. Three unknown VOCs were detected in these samples at concentrations ranging from 0.008 to 0.1 μg/g (Appendix D, Table D-50).

Di-n-butyl phthalate was the only BNA detected in the confirmatory drum sample. This compound is a common laboratory contaminant and was detected in 10 of the 12 background soil samples collected by OHM. The concentration of di-n-butyl phthalate detected in this sample (0.98 μg/g) is below the background soil 95 percent UCL level of 3.8 μg/g. There are no MCP S-1/GW-1 or ESAT soil criteria for this compound. One unknown BNA was also detected at 2 μg/g (Appendix D, Table D-50).

The five pesticides detected in these samples are listed in Appendix D, Table D-46. Although some of these concentrations exceed background soil 95 percent UCL values, most concentrations are below maximum background levels, and all were below both MCP S-1/GW-1 soil standards and ESAT soil screening criteria (Table 5-26).

Only the confirmatory drum sample collected in May 1992 was submitted for TAL metals analysis. No metals were detected at concentrations above screening criteria except for arsenic. The observed arsenic concentration (6.4 μg/g) is below background soil concentrations, but exceeds the ESAT soil criteria of 4.8 μg/g. Since this arsenic detection is representative of background levels, it is not considered to be a potential COC.

5.9.3 Conclusions and Recommendations

Two empty 55-gallon drums were discovered at this location. Phase I confirmatory drum sample P49CD1A was analyzed for TCL VOCs, TCL BNAs, TAL metals, explosives, and PCB/Pest. Four Phase II confirmatory surface soil samples were collected from a four-point grid established around location P49CD1 to assess the lateral extent of pesticides and TCL VOCs.

No VOCs were detected in any of these samples at levels exceeding soil screening criteria. Five pesticides were detected in these soil samples, some of which exceeded background soil criteria. However, all pesticide detections were below both MCP S-1/GW-1 and ESAT ecological soil screening criteria. Arsenic was detected in confirmatory drum sample P49CD1A at a concentration of 6.4 μg/g, slightly exceeding the ESAT criteria of 4.8 μg/g, but below both background and MCP S-1/GW-1 screening criteria.

Based on the low contaminant concentrations detected, no further action is recommended for this site.

5.10 STUDY AREA P51: ONE DRUM NEAR WHITE POND ROAD

SA P51 is located on White Pond Road, approximately 0.25 mile north of SA A5 (Figure 1-1). One drum was discovered along the edge of the road during a site reconnaissance in March 1991.

5.10.1 Technical Approach and Field Work Performed

Four surface soil samples, designated P51SO1B through P51SO4B, were collected from a four-point grid established around Phase I confirmatory drum sample location P51CD1 (Figure 5-13). All samples were analyzed for TAL metals, PCB/Pest, and OP Pest (Table 5-1) to assess the lateral extent of copper, lead, mercury, potassium, ppDDT, ppDDD, ppDDE, and dieldrin. These metals and pesticides were detected in Phase I soil sample P51CD1A. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded during sampling.

5.10.2 Nature and Extent of Contamination

This section summarizes the analytical results for the five surface soil samples (depths 0 to 6 inches) collected by OHM from SA P51. Sample locations are shown in Figure 5-13. The confirmatory drum sample collected in May 1992 was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. BNAs and explosives were not detected. The four samples collected in November 1993 were submitted for PCB/Pest, OP Pest, and TAL metals analysis. No OP Pest were present. The compounds detected in these soil samples are listed in Appendix D, Table D-47. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-28. Analytes detected at concentrations above ESAT criteria are listed in Table 5-29.

One unknown VOC was detected in the sample collected from P51CD1 at a concentration of 0.07 μg/g (Appendix D, Table D-50). No other VOCs were detected in this sample.

The pesticides alpha-chlordane (2 of 5 samples), dieldrin (1 of 5 samples), ppDDD (5 of 5 samples), ppDDE (5 of 5 samples), and ppDDT (5 of 5 samples) were detected (Appendix D, Table D-47). The single detection of dieldrin (0.12 μg/g at P51CD1) exceeds the MCP S-1/GW-1 soil standard of 0.03 μg/g.

There is no ESAT screening value for this compound. Dieldrin was not detected in any of the four Phase II surface soil samples collected around Phase I sample location P51CD1, which suggests that the presence of this pesticide is not widespread. The remaining pesticides were detected at concentrations below MCP S-1/GW-1 soil standards. The ppDDE concentration at P51CD1 is approximately equivalent to the ESAT soil value of 0.5 μg/g. Pesticide concentrations do not exceed ESAT criteria at any sample location.

The 16 metals detected in these samples are listed in Appendix D, Table D-47. Beryllium was detected in 1 of 5 samples at a concentration (0.73 μg/g) slightly above maximum background and above both MCP S-1/GW-1 and ESAT soil criteria (Tables 5-28 and 5-29). However, this detection probably represents natural background variation, and beryllium is not considered a COC in SA P51.

All arsenic detections are below background levels and the MCP S-1/GW-1 criteria. However, the concentration detected at P51SO4 (12 μg/g) exceeds the ESAT soil value of 4.8 μg/g (Table 5-29). Arsenic is not considered to be a potential COC.

There is no MCP S-1/GW-1 soil standard for copper. The maximum concentration detected (26 μg/g) exceeds the maximum background soil level (19.5 μg/g). However, this concentration is well below the ESAT soil screening value of 100 μg/g.

Mercury was detected at a concentration (0.37 μg/g) slightly above maximum background in the sample collected from P51CD1. Mercury was not detected in any of the four samples collected from around this sample point. This mercury concentration does not exceed either the MCP S-1/GW-1 soil standard or the ESAT criteria. The maximum selenium concentration (1.1 μg/g) is below the MCP S-1/GW-1 standard of 300 μg/g, but exceeds the maximum background. The remaining metals listed in Table 5-28 were either detected at concentrations below maximum background or are naturally occurring essential elements.

5.10.3 Conclusions and Recommendations

One drum was discovered at this site during a site reconnaissance conducted in March 1991. Phase I confirmatory soil sample P51CD1A was collected from this location during the Phase I SI/RI and was analyzed for TCL VOCs, TCL BNAs, PCB/Pest, explosives, and TAL metals. During the Phase II SI/RI, additional soil samples were collected from a four-point grid established around P51CD1 to assess the lateral extent of metals and pesticides detected at this location.

Dieldrin was detected in the Phase I sample at a concentration of 0.12 μg/g, which exceeded the MCP S-1/GW-1 soil standard of 0.03 μg/g. There is no ESAT soil value for this compound. Dieldrin was not detected in any of the Phase II samples, which suggests that the presence of this pesticide is not widespread. ppDDT, ppDDD, and ppDDE were detected in all five samples, but at concentrations below screening criteria.

Except for beryllium, all metals were detected at concentrations below maximum background levels, MCP S-1/GW-1 soil standards, and/or ESAT criteria. Beryllium was detected at 0.73 μg/g at P51SO4, which exceeded maximum background, MCL S-1/GW-1, and ESAT soil criteria. However, beryllium was not detected in the other four samples collected from this area. Consequently, the single elevated detection, slightly above the maximum site background level of 0.64 μg/g, does not appear to be an indication of contamination, but probably reflects variability in background beryllium levels. For this reason, beryllium

is not considered a COC in SA P51. Based on field observations and the low concentrations of compounds detected, no further action is recommended for this area.

5.11 STUDY AREA P59: CANS AND METALLIC DEBRIS NORTH OF BUNKER 319

SA P59 was one of the two new SAs that was added to the SOW based on observations made during the Phase II SI/RI. SA P59 is located north of Bunker 319 in a swampy area adjacent to Taylor Brook (Figure 1-1). This location was identified as a potential SA after 5-gallon cans and other metallic debris, some partially buried, were observed scattered over the site. This observation was made during a period of low flow. The cans were empty, rusted, and decomposing.

5.11.1 Technical Approach and Field Work Performed

As a first step, a geophysical study was conducted using a GA-72 CV magnetometer in order to locate partially buried and buried metallic debris. Magnetic anomalies were identified with orange flags to indicate partially exposed debris, and with pink flags to indicate buried debris. Approximately 48 flags were placed in this area with the majority located along the swamp edge.

Five sediment samples were collected in the swamp for analysis of TCL BNAs, TAL metals, PCB/Pest, and OP Pest (Table 5-1). Figure 5-14 shows the sample locations. Sample FWISD21B was collected from directly beneath two rusted and decomposing 5-gallon metal containers. Samples FWISD22B through FWISD25B were collected from shallow holes dug to identify the sources of buried anomalies. Rusted and decomposed pieces of containers similar to those identified on the surface were the apparent source of all but one of the anomalies investigated. The magnetic anomaly at sample location FWISD25 was the result of pieces of unidentifiable rusted and decomposed metallic debris at a depth of 0.5 to 1 foot BGS. No staining or unusual odors were noted, and no PID or radiological readings above background were recorded during sampling.

5.11.2 Nature and Extent of Contamination

Analytical results for the five sediment samples collected by OHM from SA P59 are summarized in this section. All detected compounds are listed in Appendix D, Table D-48. No OP Pest were detected. Compounds which exceed sediment criteria are summarized in Table 5-30.

BNAs, mostly PAHs, were detected in these sediment samples (Appendix D, Table D-48). The detection of these BNAs primarily occurred at sample location FWISD23 where eight PAHs were detected. Benzo(a)anthracene (0.58 μg/g), benzo(a)pyrene (0.78 μg/g), benzo(def)phenanthrene (pyrene) (1.4 μg/g), chrysene (1 μg/g), and phenanthrene (0.4 μg/g) were detected at FWISD23 at concentrations above ESAT sediment criteria (Table 5-30). Benzo(a)pyrene at 0.48 μg/g also exceeds the ESAT value of 0.4 μg/g at FWISD21. No other BNAs were detected at concentrations above ESAT criteria. DEHP, a common laboratory contaminant, was detected at 2 of 5 sample locations at a maximum concentration of 1.4 μg/g. There is no ESAT sediment value for this compound. Ninety-five unknown BNAs were also detected in these sediment samples at concentrations ranging from 0.07 to 10 μg/g (Appendix D, Table D-50).

Lindane was detected at 1 of 5 sample locations (FWISD25) at 0.11 μg/g. This concentration exceeds the ESAT sediment value for total benzene hexachloride of 0.003 μg/g (Table 5-30). Concentrations of ppDDD (5 of 5 samples), ppDDE (5 of 5 samples), and ppDDT (4 of 5 samples) also

exceed ESAT criteria. ppDDT concentrations were highest at sample location FWISD23 (ΣppDDT = 10.5 μg/g). The total ppDDT concentration at this location was ten times greater than the next highest concentration detected (1.5 μg/g, FWISD24).

Lead concentrations were elevated at 4 of 5 sample locations (maximum 120 μg/g). Concentrations at these four locations exceed the ESAT sediment value of 31 μg/g. Arsenic (4 of 5 samples, maximum 36 μg/g), barium (2 of 5 samples, maximum 26.2 μg/g), copper (5 of 5 samples, maximum 187 μg/g), nickel (2 of 5 samples, maximum 45.2 μg/g), and selenium (4 of 5 samples, maximum 1.9 μg/g) concentrations also exceed ESAT sediment values (Table 5-30).

Beryllium was detected at 1 of 5 sample locations at a concentration of 1.5 μg/g. There is no ESAT sediment value for this compound. However, the concentration detected is higher than what was generally detected at the Annex. The elevated iron concentrations at 4 of 5 sample locations are probably due to the fact that the samples were collected from beneath decomposing, rusty, metal containers. Although every effort was made to minimize the number of metal pieces collected with the sample material, it was impossible to avoid the collection of this material altogether. Chromium and zinc were detected at concentrations below ESAT sediment criteria.

5.11.3 Conclusions and Recommendations

SA P59 was established as a SA after 5-gallon cans and other metallic debris were discovered in a swampy area adjacent to Taylor Brook. A geophysical survey located approximately 48 surface and subsurface magnetic anomalies. Five sediment samples were collected for analysis of TCL BNAs, TAL metals, PCB/Pest, and OP Pest.

BNAs were primarily detected at sample location FWISD23, where eight PAHs were detected. Benzo(a)anthracene (0.58 μg/g), benzo(a)pyrene (0.78 μg/g), benzo(def)phenanthrene (pyrene; 1.4 μg/g), chrysene (1 μg/g), and phenanthrene (0.4 μg/g) exceeded ESAT criteria at one or more sample locations. ppDDT concentrations were highest at sample location FSISD23 (∑ppDDT = 10.5 μg/g). The total ppDDT concentration at this location was ten times greater than the next highest concentration detected (1.5 μg/g at FWISD24).

Several metals, including lead (4 of 5 samples, maximum 120 μg/g), arsenic (4 of 5 samples, maximum 36 μg/g), barium (2 of 5 samples, maximum 26.2 μg/g), copper (5 of 5 samples, maximum 187 μg/g), nickel (2 of 5 samples, maximum 45.2 μg/g), and selenium (4 of 5 samples, maximum 1.9 μg/g) exceeded ESAT criteria. Beryllium was detected at 1 of 5 sample locations at 1.53 μg/g. There is no ESAT sediment value for this compound. However, the concentration detected is higher than what was generally detected at the Annex.

In summary, several PAHs, pesticides, and metals were detected in this area at concentrations above ESAT criteria. Since only five of the 48 anomalies identified were investigated as part of the Phase II SI/RI and no subsurface samples have been collected, additional sampling is recommended for this area to confirm the lateral and vertical extent of the compounds detected and to determine the nature of the subsurface anomalies. If exceedences of screening criteria are still minimal, a limited removal of surface debris may be the only remedial action needed at this site.

5.12 STUDY AREA P60: THREE DRUMS WEST OF PATROL ROAD

SA P60 was the second new SA added to the Phase II SI/RI SOW after three drums were discovered near the boundary fence west of Patrol Road. This location is approximately 900 feet west-southwest of SA P30 (Figure 1-1). Two small drums were discovered lying next to each other, and another 55-gallon drum was located nearby. All three drums were empty and there were no signs of staining, stressed vegetation, or unusual odors. Figure 5-15 shows the locations of the drums and sampling points.

5.12.1 Technical Approach and Field Work Performed

A two-point composite surface soil sample designated FWICD1B was collected from beneath the two small drums. Grab surface soil sample FWICD2B was collected from beneath the 55-gallon drum. Both samples were submitted for laboratory analysis of TCL BNAs, TAL metals, PCB/Pest, and OP Pest (Table 5-1). No staining or unusual odors were noted, and no PID or radiological readings above background were recorded, during the sampling event.

5.12.2 Nature and Extent of Contamination

This section summarizes the analytical results for the two confirmatory drum samples collected from this area. All detected compounds are listed in Appendix D, Table D-49. No OP Pest were detected. Compounds which exceed background soil 95 percent UCL values and/or MCP S-1/GW-1 soil standards are summarized in Table 5-31. Analytes detected at concentrations above ESAT soil criteria are listed in Table 5-32.

DEHP was detected at FWICD1 at a concentration of 0.69 μg/g which is well below the MCP S-1/GW-1 standard of 100 μg/g. Forty-eight unknown BNAs were also detected in these samples at concentrations ranging from 0.02 to 2 μg/g (Appendix D, Table D-50).

The pesticides ppDDD, ppDDE, and ppDDT were detected in both of these samples. All concentrations are below both MCP S-1/GW-1 soil standards and ESAT criteria. No other pesticides were detected.

The 16 metals detected in these samples are listed in Appendix D, Table D-49. Arsenic concentrations at both sample locations were elevated. Arsenic was detected in samples FWICD1B and FWICD2B at 260 and 460 μg/g, respectively, which exceed maximum background, MCP S-1/GW-1, and ESAT soil criteria (Tables 5-31 and 5-32). All other metals were detected at concentrations below maximum background levels and/or below MCP S-1/GW-1 soil standards.

5.12.3 Conclusions and Recommendations

SA P60 was established after three drums were discovered near the boundary fence west of Patrol Road. One discrete surface soil sample, and one two-point composite surface soil sample, were collected for analysis of TCL BNAs, TAL metals, PCB/Pest, OP Pest.

Arsenic was detected in the two confirmatory drum samples at concentrations of 260 and 460 μg/g. These detected concentrations are in exceedence of background, MCP S-1/SW-1, and ESAT soil screening criteria. Based on these results, a limited supplementary site investigation to assess the lateral and vertical

extent of arsenic at this site is recommended. Once these extents are reliably established, appropriate remedial actions should be recommended.

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6.0 REFERENCES

ATEC, 1992, Post-Removal Report, Underground Storage Tank Closure, 1,000 Gallon JP-4, UST No. 0094: ATEC File 37.07.91.07451, 03 June 1992.

Bouwer, H. and Rice, R.C., 1976, A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells: Water Resources Research, Vol. 12, p. 423-428.

Brackley, R.A. and Hansen, B.P., 1985, Hydrology and Water Resources of Tributary Basins to the Merrimack River from Salmon Brook to the Concord River, Massachusetts: USGS Hydrologic Investigation Atlas HA-662.

Cooper, H.H., Jr., Bredehoeft, J.D., and Papadopulos, I.S., 1967, Response of a Finite Diameter Well to an Instantaneous Charge of Water: Water Resources Research, Vol. 3, p. 263-269.

Dames & Moore, 1986, Remedial Investigation of Sudbury Annex, Massachusetts: Report No. AMXTH-IR-CR86094, November.

Dames & Moore, 1991, Draft Final Community Relations Plan; December.

E&E, 1994, Draft Phase II Site Investigations Report, Volume I of III, General Annex-Wide Information, Fort Devens Sudbury Training Annex, Massachusetts: Ecology & Environment, Inc., March.

ESAT, 1993, TID No. 01-9305-48, Eco Risk Screening Tables - Soils, Sediments and Surface Waters: Environmental Services Assistance Teams, US EPA - Region I, June.

Fort Devens, 1990, Additional Installation Restoration Program (IRP) Sites for Investigation at Sudbury Training Annex, Sudbury, Massachusetts: Memorandum for Commander, USATHAMA, May.

Hansen, W.R., 1956, Geology and Mineral Resources of the Hudson and Maynard Quadrangles, Massachusetts: USGS Bulletin 1038.

Heath, R.C., 1989, Basic Ground-Water Hydrology: USGS Water-Supply Paper 2220.

Lyman, W.J. et al., eds., 1982, Handbook of Chemical Property Estimation Methods: Environmental Behavior of Organic Compounds: McGraw-Hill Co., New York.

MacKay, D.M., Roberts, P.V., and Cherry, J.A., 1985, Transport of Organic Contaminants in Groundwater: Environmental Science and Technology, Vol. 19, No. 5, p. 384-392.

MADEP, 1993, The Massachusetts Contingency Plan, 310 CMR 40.0000: Massachusetts Department of Environmental Protection, November.

MADEP, 1994, Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Waters: The Commomwealth of Massachusetts Department of Environmental Protection, Office of Research and Standards; Autumn.

OHM Corporation, 1992a, Final Master Environmental Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; January.

OHM Corporation, 1992b, Final Technical Plans for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; April.

OHM Corporation, 1992c, Final Health and Safety Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; April.

OHM Corporation, 1992d, Final Work Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; April.

OHM Corporation, 1992e, Final Field Sampling Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; April.

OHM Corporation, 1992f, Final Quality Assurance Project Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; April.

OHM Corporation, 1993, Final Addendum to the Final Technical Plans for the Phase II Feasibility Study at the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; November.

OHM Corporation, 1994, Final Report, Site/Remedial Investigation, Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts; January.

Perlmutter, N.M., 1962, Ground-Water Geology and Hydrology of the Maynard Area, Massachusetts: USGS Water-Supply Paper 1539-E.

Pollock, S.J., Farrell, D.F., and Caswell, W.W., 1969, Water Resources of the Assabet River Basin, Central Massachusetts: USGS Hydrologic Investigations Atlas HA-312.

PAL, 1985, An Intensive Archeological Survey of the Sudbury Training Annex, Sudbury, Massachusetts: The Public Archaeology Laboratory, Inc., Providence, RI; April.

TMI, 1986, Cover Letter with Analytical Reports on Contract No. DAAK60-86-M-3045, Soil Testing - Fire Test Area; September.

USACE, 17 September 1958, M. C. Memo Army Family Housing No. 58-4, SUBJECT: Field Investigation of Possible Sites for Capehart Housing - Maynard Odnance Depot - 3 Sept 1958 and 12 Sept 1958: New Endland Division Corps of Engineers, Military Branch, Engineering Division.

USAEHA, 1983, Phase 2, Solid Waste Management Consultation No. 32-26-8260-83, Hydrogeologic and Subsurface Investigation, Fort Devens, Massachusetts.

USATHAMA, 1980, Installation Assessment of U.S. Army Natick Research and Development Command, Report No. 170, May.

USEPA, 1982, Installation Assessment NARADCOM Research and Development Laboratory, Massachusetts: TS-PIC-0066, March.

USEPA, 1985, Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites: Prepared by Clement Associates for USEPA, Office of Waste Program Enforcement, Washington, D.C.; September.

USEPA, 1994a, Drinking Water Regulations and Health Advisories: Office of Water, USEPA, Washington, D.C., May.

USEPA, 1994b, Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities: OSWER Directive #9355.4-12, USEPA Office of Solid Waste and Emergency Response, Washington, D.C., August.

USEPA, 1995, Fort Devens Sudbury Training Annex, Area of Contamination A9, Risk Based Soil Cleanup Level for Thallium: Letter from Bob Lim, Remedial Project Manager, Federal Facilities Superfund Section, USEPA Region I, to Ronald Ostrowski, Installation Environmental Officer, Fort Devens, Massachusetts; May 19.

Zecco, Inc., 1987a, Environmental Report, Fire Test Area, Fort Devens-Sudbury Tranining Center, Sudbury, Mass., Report #1. (Results from the 16 September 1987 ground water sampling event in AOC A9).

Zecco, Inc., 1987b, Environmental Report, Fire Test Area, Fort Devens-Sudbury Tranining Center, Sudbury, Mass., Report #2. (Results from the 16 December 1987 ground water sampling event in Area A9).

Zecco, Inc., 1988a, Environmental Report, Fire Test Area, Fort Devens-Sudbury Tranining Center, Sudbury, Mass., Report #3. (Results from the 16 March 1988 ground water sampling event in AOC A9).

Zecco, Inc., 1988b, Environmental Report, Fire Test Area, Fort Devens-Sudbury Tranining Center, Sudbury, Mass., Report #4. (Results from the 29 June 1988 ground water sampling event in AOC A9).

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EXPLANATION OF ABBREVIATIONS AND SYMBOLS USED IN EXCEEDANCE TABLES

*	Not analyzed
@	Actual cadmium concentration may be lower than the concentration reported due to interelement interferences
1	Result was less than the CRL but greater than the COD
2	Ending calibration was not within acceptable limits
7	Low spike recovery was not within control limits
B	Analyte was found in the method blank or QC blank as well as the sample
D	Duplicate analysis (field duplicate)
S	Non-target compound analyzed for and detected (GC/MS methods)
X	Analyte recovery was outside of the certified range but within acceptable limits
Z	Non-target compound analyzed for and detected

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Table 1-1 - SUMMARY OF PHASE II AREA-SPECIFIC ACTIVITIES AND SAMPLING

AREA	Geo-physics	Test Pits/ Trenches	Test Pit Samples	Surface Soil	Hand Auger	Boring Samples	Monitor Wells	Ground-water	SW/ Sed	Tanks
A4		4/2	12	1		1	1	4	4/10	1
A7	x	4/2	15	1	2	10	2	5	1/1	
A9				4	4	8	6	9		
A3	x	5/0	13							
P4				4						
P5				4					3/3	
P7								3		
P17				4						
P19				1						
P20	x	2/0		4						
P25				4						
P35				4						
P49				4						
P51				4						
FW	x			2		1	1	1	0/5	
TOTAL	4 areas	15/4	40	41	6	20	10	22	8/19	1

TABLE 1-2
INTRODUCTION
SOIL, SEDIMENT, AND SURFACE WATER SCREENING CRITERIA

Method	Analyte	Background Soil		MA State S-1/GW-1 Criteria (ugg)	Background Sediment (ugg)	Background Surface Water (ugl)
		95% UCL (ugg)	Maximum Detection (ugg)			
VOC	1,1,1,2-Tetrachloroethane			0.4		
VOC	1,1,1-Trichloroethane			30		
VOC	1,1,2,2-Tetrachloroethane			0.02		
VOC	1,1,2-Trichloroethane			0.3		
VOC	1,1-Dichloroethane			3		
VOC	1,1-Dichloroethene			0.7		
VOC	1,2,4-Trichlorobenzene			100		
VOC	1,2-Dichlorobenzene			100		
VOC	1,2-Dichloroethane			0.05		
VOC	1,2-Dichloroethene, cis-			2		
VOC	1,2-Dichloroethene, trans-			4		
VOC	1,2-Dichloropropane			0.1		
VOC	1,3-Dichlorobenzene			100		
VOC	1,3-Dichloropropene			0.01		
VOC	1,4-Dichlorobenzene			2		
VOC	Acetone	0.026	0.046	3		
VOC	Benzene			10		
VOC	Bromodichloromethane			0.1		
VOC	Bromoform			0.1		
VOC	Bromomethane			10		
VOC	Carbon tetrachloride			1		
VOC	Chlorobenzene			8		
VOC	Chloroform			0.1		
VOC	Dibromochloromethane			0.09		
VOC	Ethylbenzene			80		
VOC	Methyl ethyl ketone			0.3		
VOC	Methyl isobutyl ketone			0.5		
VOC	Methyl tertiary butyl ether			3		
VOC	Methylene chloride	0.008	0.018	0.1		
VOC	Styrene			2		
VOC	Tetrachloroethylene			0.5		
VOC	Toluene			90		
VOC	Trichloroethylene			0.4		
VOC	Vinyl chloride			0.3		
VOC	Xylenes, total			500		
BNA	1,1-Biphenyl			1		
BNA	2,4,5-Trichlorophenol			3		
BNA	2,4,6-Trichlorophenol			3		
BNA	2,4-Dichlorophenol			10		
BNA	2,4-Dimethylphenol			0.7		
BNA	2,4-Dinitrophenol			3		
BNA	2-Chlorophenol			0.7		
BNA	2-Methylnaphthalene			0.7		
BNA	3,3'-Dichlorobenzidine			1		
BNA	4-Chloroaniline			1		
BNA	Acenaphthene			20		
BNA	Acenaphthylene			100		
BNA	Anthracene			1000		
BNA	Benzo(a)anthracene			0.7		
BNA	Benzo(a)pyrene			0.7		
BNA	Benzo(b)fluoranthene			0.7		
BNA	Benzo(ghi)perylene			100		
BNA	Benzo(k)fluoranthene			0.7		
BNA	Benzo[def]phenanthrene			500		

TABLE 1-2
INTRODUCTION
SOIL, SEDIMENT, AND SURFACE WATER SCREENING CRITERIA

Method	Analyte	Background Soil		MA State S-1/GW-1 Criteria (ugg)	Background Sediment (ugg)	Background Surface Water (ugl)
		95% UCL (ugg)	Maximum Detection (ugg)			
BNA	Bis(2-chloroethyl) ether			0.7		
BNA	Bis(2-chloroisopropyl) ether			0.7		
BNA	Bis(2-ethylhexyl) phthalate			100		
BNA	Chrysene			0.7		
BNA	Dibenz(ah)anthracene			0.7		
BNA	Diethyl phthalate			100		
BNA	Dimethyl phthalate			30		
BNA	Di-n-butyl phthalate	3.80	9			
BNA	Ethylene dibromide			0.005		
BNA	Fluoranthene			600		
BNA	Fluorene			400		
BNA	Hexachlorobenzene			0.7		
BNA	Hexachlorobutadiene			3		
BNA	Hexachloroethane			6		
BNA	Indeno[1,2,3-C,D]pyrene			0.7		
BNA	Naphthalene			4		
BNA	Pentachlorophenol			5		
BNA	Phenanthrene			700		
BNA	Phenol			60		
PCB/Pest	Aldrin	0.012	0.004	0.03	0.007	
PCB/Pest	Benzene hexachloride, alpha	0.003	0.005			
PCB/Pest	Benzene hexachloride, beta	0.005	0.004			
PCB/Pest	Benzene hexachloride, delta	0.021	0.01			
PCB/Pest	Chlordane, alpha	0.004	0.004			
PCB/Pest	Chlordane, gamma	0.019	0.005			
PCB/Pest	Chlordane, total	0.023	0.009	1		
PCB/Pest	Dieldrin	0.010	0.023	0.03		
PCB/Pest	Endosulfan sulfate	0.013	0.008		0.001	
PCB/Pest	Endosulfan, alpha	0.005	0.008			
PCB/Pest	Endosulfan, beta	0.007	0.005			
PCB/Pest	Endosulfan, total			0.2		
PCB/Pest	Endrin	0.011	0.008	0.6		
PCB/Pest	Endrin aldehyde	0.026	0.011			
PCB/Pest	Heptachlor	0.009	0.002	0.1		
PCB/Pest	Heptachlor epoxide	0.004	0.006	0.06		
PCB/Pest	Lindane	0.019	0.004	0.1	0.001	
PCB/Pest	Methoxychlor			100		
PCB/Pest	PCBs, total			2		
PCB/Pest	ppDDD	0.019	0.063	2		
PCB/Pest	ppDDE	0.039	0.139	2		
PCB/Pest	ppDDT	0.066	0.23	2		
PO4	Phosphate	6.01	19.5			280
PO4, TOT	Phosphates, total					280
Phos,TOT	Phosphorus, total					280
Explosives	2,4-Dinitrotoluene			0.7		
TPH/IR	Total petroleum hydrocarbons			500	16.6	
Cyanide	Cyanide			100		
Dioxin	2,3,7,8-TCDD (Dioxin)			4E-06		
Metals	Aluminum	10835	18000		5020	400
Metals	Antimony	0.822	0.578	10	0.5	5
Metals	Arsenic	8.95	17	30	2.03	3.15
Metals	Barium	21.6	54.7		23.9	10.4
Metals	Beryllium	0.298	0.638	0.4	0.18	5
Metals	Cadmium	0.563	1.79	30	0.5	5

TABLE 1-2
INTRODUCTION
SOIL, SEDIMENT, AND SURFACE WATER SCREENING CRITERIA

Method	Analyte	Background Soil		MA State S-1/GW-1 Criteria (ugg)	Background Sediment (ugg)	Backgrour Surface Water (ugl)
		95% UCL (ugg)	Maximum Detection (ugg)			
Metals	Calcium	554	1170		562	8520
Metals	Chromium	18.7	62.5	1000	9.66	3.16
Metals	Chromium (III)			1000		
Metals	Chromium (VI)			200		
Metals	Cobalt	3.47	7.3		3.74	4.79
Metals	Copper	9.52	19.5		6.33	10
Metals	Iron	12807	28000		7590	4810
Metals	Lead	51.4	110	300	4.48	10.3
Metals	Magnesium	1794	5060		2140	1890
Metals	Manganese	264	1100		70.5	156
Metals	Mercury	0.101	0.318	10		
Metals	Mercury, methyl			7		
Metals	Nickel	9.32	23.2	300	5.92	10
Metals	Potassium	451	700		1520	2060
Metals	Selenium	0.368	0.571	300	0.2	2
Metals	Silver			100		
Metals	Sodium	123	123			14000
Metals	Thallium			8	0.195	
Metals	Vanadium	27.1	51.2		17	4.72
Metals	Zinc	33.9	85.8	2500	20.8	13.3

TABLE 1-3
INTRODUCTION
ECOLOGICAL SCREENING CRITERIA

Method	Analyte	ESAT Surface Soil (ugg)	ESAT Sediment (ugg)	ESAT Surface Water (ugl)	AWQC Chronic Criteria (ugl)	AWQC Human Health (ugl)
VOC	1,1,2,2-Tetrachloroethane			2400		11
VOC	1,1,2-Trichloroethane			9400		42
VOC	1,1-Dichloroethene					3.2
VOC	1,2-Dichloroethane					99
VOC	1,3-Dichloropropene					1700
VOC	Acrolein					780
VOC	Acrylonitrile					0.66
VOC	Benzene	0.5				71
VOC	Bromodichloromethane					22
VOC	Bromoform					360
VOC	Bromomethane					4000
VOC	Carbon tetrachloride					4.4
VOC	Chlorobenzene	1				21000
VOC	Chloroform					470
VOC	Dibromochloromethane					34
VOC	Ethylbenzene			1600		29000
VOC	Haloethers			122		
VOC	Methylene chloride					1600
VOC	Pentachloroethane			1100		
VOC	Tetrachloroethylene			840		8.85
VOC	Toluene			875		200000
VOC	Trichloroethylene			21900		81
VOC	Vinyl chloride					525
BNA	1,2-Dichlorobenzene					17000
BNA	1,2-Diphenylhydrazine					0.54
BNA	1,3-Dichlorobenzene					2600
BNA	1,4-Dichlorobenzene					2600
BNA	2,4,5-Trichlorophenol			63		
BNA	2,4,6-Trichlorophenol			970		6.5
BNA	2,4-Dichlorophenol					790
BNA	2,4-Dinitrophenol					14000
BNA	2,4-Dinitrotoluene					9.1
BNA	2-Methylnaphthalene		0.065			
BNA	3,3'-Dichlorobenzidine					0.077
BNA	4,6-Dinitro-2-cresol					765
BNA	Acenaphthene		0.15			
BNA	Anthracene	10	0.085			110000
BNA	Benzidine					0.00054
BNA	Benzo(a)anthracene	1	0.23			0.031
BNA	Benzo(a)phenanthrene	1				
BNA	Benzo(a)pyrene	1	0.4			0.031
BNA	Benzo(b)fluoranthene					0.031
BNA	Benzo(k)fluoranthene					0.031
BNA	Benzo[def]phenanthrene	10	0.35			11000
BNA	Bis(2-chloroethyl) ether					1.4
BNA	Bis(2-chloroisopropyl) ether					170000
BNA	Bis(2-ethylhexyl) phthalate			360		5.9

TABLE 1-3
INTRODUCTION
ECOLOGICAL SCREENING CRITERIA

Method	Analyte	ESAT Surface Soil (ugg)	ESAT Sediment (ugg)	ESAT Surface Water (ugl)	AWQC Chronic Criteria (ugl)	AWQC Human Health (ugl)
BNA	Chrysene	5	0.4			0.031
BNA	Di-n-butyl phthalate					12000
BNA	Dibenz(ah)anthracene		0.06			0.031
BNA	Diethyl phthalate					120000
BNA	Dimethyl phthalate					2900000
BNA	Fluoranthene	10	0.6	200		370
BNA	Fluorene		0.035			14000
BNA	Hexachlorobenzene			3.68		0.00077
BNA	Hexachlorobutadiene					50
BNA	Hexachlorocyclopentadiene			5.2		17000
BNA	Hexachloroethane			540		8.9
BNA	Indeno[1,2,3-C,D]pyrene					0.031
BNA	Isophorone					600
BNA	N-Nitrosodimethylamine					8.1
BNA	N-Nitrosodiphenylamine					16
BNA	Naphthalene	5	0.34			
BNA	Nitrobenzene			1350		1900
BNA	Nitrophenol			150		
BNA	Pentachlorophenol			13	13	8.2
BNA	Phenanthrene	5	0.225	6.3		
BNA	Phenol			2560		460000
PCB/Pest	Aldrin		0.002		0	0.00014
PCB/Pest	Benzene hexachloride, alpha					0.013
PCB/Pest	Benzene hexachloride, beta					0.046
PCB/Pest	Benzene hexachloride, total		0.003	5		
PCB/Pest	Chlordane, total	0.5	0.0005		0.0043	0.00059
PCB/Pest	Chlorinated pesticides, total	1				
PCB/Pest	Dieldrin		2E-05		0.0019	0.00014
PCB/Pest	Endosulfan sulfate					2
PCB/Pest	Endosulfan, alpha				0.056	2
PCB/Pest	Endosulfan, beta				0.056	2
PCB/Pest	Endosulfan, total			0.056	0.12	4
PCB/Pest	Endrin	0.5	2E-05	0.0023	0.0023	0.81
PCB/Pest	Endrin aldehyde					0.81
PCB/Pest	Heptachlor	0.5		0.0038	0.0038	0.00021
PCB/Pest	Heptachlor epoxide	0.5		0.0038	0.0038	0.00011
PCB/Pest	Lindane				0.08	0.063
PCB/Pest	Methoxychlor			0.03		
PCB/Pest	PCB 1016				0.014	4.5E-05
PCB/Pest	PCB 1221				0.014	4.5E-05
PCB/Pest	PCB 1232				0.014	4.5E-05
PCB/Pest	PCB 1242				0.014	4.5E-05
PCB/Pest	PCB 1248				0.014	4.5E-05
PCB/Pest	PCB 1254				0.014	4.5E-05
PCB/Pest	PCB 1260				0.014	4.5E-05
PCB/Pest	PCBs, total	1	0.05			
PCB/Pest	ppDDD	0.5	0.002			0.00084

TABLE 1-3
INTRODUCTION
ECOLOGICAL SCREENING CRITERIA

Method	Analyte	ESAT Surface Soil (ugg)	ESAT Sediment (ugg)	ESAT Surface Water (ugl)	AWQC Chronic Criteria (ugl)	AWQC Human Health (ugl)
PCB/Pest	ppDDE	0.5	0.002			0.00059
PCB/Pest	ppDDT	0.5	0.001		0.001	0.00059
PCB/Pest	Toxaphene			0.0002	0.0002	0.00075
OP Pest	Azinphos methyl			0.01		
OP Pest	Chlorpyrifos	0.5				
OP Pest	Malathion			0.1		
OP Pest	Parathion			0.013		
Cyanide	Cyanide	10		5.2	5.2	220000
Dioxin	2,3,7,8-TCDD (Dioxin)					1.4E-08
Metals	Aluminum	33000		87		
Metals	Antimony	8.8	2			4300
Metals	Arsenic	4.8	6		190	0.14
Metals	Arsenic (III)			190		
Metals	Barium	290	20			
Metals	Beryllium	0.55		5.3		
Metals	Cadmium	5	0.6	0.38	0.38	
Metals	Chromium	250	26	11	11	
Metals	Chromium (III)			67	67	
Metals	Chromium (VI)			11	11	
Metals	Cobalt	50				
Metals	Copper	100	16	3.6	3.6	
Metals	Lead	200	31	0.55	0.55	
Metals	Mercury	2	0.15	0.012	0.012	0.15
Metals	Molybdenum	5				
Metals	Nickel	100	16	49	49	4600
Metals	Selenium	2	1	5	5	
Metals	Silver	10	1	0.12	0	
Metals	Thallium			40		6.3
Metals	Vanadium	150				
Metals	Zinc	350	120	33	33	

TABLE 1-4
INTRODUCTION
GROUNDWATER SCREENING CRITERIA

Method	Analyte	EPA MCL (ugl)	EPA SMCL (ugl)	MA State GW-1 Criteria (ugl)
VOC	1,1,1,2-Tetrachloroethane			5
VOC	1,1,1-Trichloroethane	200		200
VOC	1,1,2,2-Tetrachloroethane			2
VOC	1,1,2-Trichloroethane	5		5
VOC	1,1-Dichloroethane			70
VOC	1,1-Dichloroethene	7		7
VOC	1,2,4-Trichlorobenzene	70		70
VOC	1,2-Dichlorobenzene	600		600
VOC	1,2-Dichloroethane	5		5
VOC	1,2-Dichloroethene, cis-	70		70
VOC	1,2-Dichloroethene, trans-	100		100
VOC	1,2-Dichloropropane	5		5
VOC	1,3-Dichlorobenzene	600		600
VOC	1,3-Dichloropropene			0.5
VOC	1,4-Dichlorobenzene	75		5
VOC	Acetone			3000
VOC	Benzene	5		5
VOC	Bromodichloromethane	100		5
VOC	Bromoform	100		5
VOC	Bromomethane			10
VOC	Carbon tetrachloride	5		5
VOC	Chlorobenzene	100		100
VOC	Chloroform	100		5
VOC	Dibromochloromethane	100		5
VOC	Ethylbenzene	700		700
VOC	Methyl ethyl ketone			350
VOC	Methyl isobutyl ketone			350
VOC	Methyl tertiary butyl ether			700
VOC	Methylene chloride	5		5
VOC	Styrene	100		100
VOC	Tetrachloroethylene	5		5
VOC	Toluene	1000		1000
VOC	Trichloroethylene	5		5
VOC	Vinyl chloride	2		2
VOC	Xylenes, total	10000		10000
BNA	1,1-Biphenyl			400
BNA	2,4,5-Trichlorophenol			200
BNA	2,4,6-Trichlorophenol			10
BNA	2,4-Dichlorophenol			10
BNA	2,4-Dimethylphenol			100
BNA	2,4-Dinitrophenol			200

TABLE 1-4
INTRODUCTION
GROUNDWATER SCREENING CRITERIA

Method	Analyte	EPA MCL (ugl)	EPA SMCL (ugl)	MA State GW-1 Criteria (ugl)
BNA	2-Chlorophenol			10
BNA	2-Methylnaphthalene			10
BNA	3,3'-Dichlorobenzidine			80
BNA	4-Chloroaniline			30
BNA	Acenaphthene			20
BNA	Acenaphthylene			300
BNA	Anthracene			600
BNA	Benzo(a)anthracene	0.1		0.2
BNA	Benzo(a)pyrene	0.2		0.2
BNA	Benzo(b)fluoranthene	0.2		0.2
BNA	Benzo(ghi)perylene			0.5
BNA	Benzo(k)fluoranthene	0.2		0.2
BNA	Benzo[def]phenanthrene			80
BNA	Bis(2-chloroethyl) ether			30
BNA	Bis(2-chloroisopropyl) ether			30
BNA	Bis(2-ethylhexyl) phthalate	6		6
BNA	Butylbenzyl phthalate	100		
BNA	Chrysene	0.2		0.2
BNA	Dibenz(ah)anthracene	0.3		0.2
BNA	Diethyl phthalate			6000
BNA	Dimethyl phthalate			50000
BNA	Dioctyl adipate	400		
BNA	Ethylene dibromide	0.05		0.02
BNA	Fluoranthene			100
BNA	Fluorene			300
BNA	Hexachlorobenzene	1		1
BNA	Hexachlorobutadiene			0.6
BNA	Hexachlorocyclopentadiene	50		
BNA	Hexachloroethane			8
BNA	Indeno[1,2,3-C,D]pyrene	0.4		0.2
BNA	Naphthalene			20
BNA	Pentachlorophenol	1		1
BNA	Phenanthrene			300
BNA	Phenol			4000
PCB/Pest	Aldrin			0.5
PCB/Pest	Chlordane, total	2		5
PCB/Pest	Dieldrin			0.1
PCB/Pest	Endosulfan, total			0.4
PCB/Pest	Endrin	2		2
PCB/Pest	Heptachlor	0.4		0.4
PCB/Pest	Heptachlor epoxide	0.2		0.2

TABLE 1-4
INTRODUCTION
GROUNDWATER SCREENING CRITERIA

Method	Analyte	EPA MCL (ugl)	EPA SMCL (ugl)	MA State GW-1 Criteria (ugl)
PCB/Pest	Lindane	0.2		0.2
PCB/Pest	Methoxychlor	40		40
PCB/Pest	PCBs, total	0.5		0.5
PCB/Pest	ppDDD			0.1
PCB/Pest	ppDDE			0.1
PCB/Pest	ppDDT			0.3
PCB/Pest	Toxaphene	3		
Herbicides	2,4-D	70		
Herbicides	245TP (Silvex)	50		
Herbicides	Dalapon	200		
Herbicides	Picloram	500		
Explosives	2,4-Dinitrotoluene			30
TPH/IR	Total petroleum hydrocarbons			1000
Cyanide	Cyanide	200		200
Dioxin	2,3,7,8-TCDD (Dioxin)	3E-05		3E-05
Metals	Aluminum		50	
Metals	Antimony	6		6
Metals	Arsenic	50		50
Metals	Barium	2000		
Metals	Beryllium	4		4
Metals	Cadmium	5		5
Metals	Chromium	100		100
Metals	Chromium (III)			100
Metals	Chromium (VI)			50
Metals	Copper	1300	1000	
Metals	Iron		300	
Metals	Lead	15		15
Metals	Manganese		50	
Metals	Mercury	2		2
Metals	Mercury, methyl			2
Metals	Nickel	100		100
Metals	Selenium	50		50
Metals	Silver		100	40
Metals	Thallium	2		2
Metals	Zinc		5000	2000

TABLE 1-5
INTRODUCTION
MATRIX FOR CHEMICAL RESULTS TABLES

AREA	HIT FILE	FILE TYPE	SITE TYPE	APNDX D TBLS	Combine MCLs SMCLs	Combine GW-1 ORSGs	Combine 95% UCLs MAX BKG	Combine S1/GW1	Combine ESAT	Combine BKGRND SW/SE	Combine AWQC CHRON	Combine AWQC HH-ORG	RCRA
A4	X	CSO	EXCV	X			X	X					
			SURF	X			X	X	X				
			BORE	X			X	X					
		CGW	WELL	X	X	X							
		CSW		X					X	X	X	X	
			TANK	X									
		CSE		X					X	X			
A7	X	CSO	EXCV	X			X	X					
			SURF	X			X	X	X				
			AHOL	X			X	X	X				NA
			DTCH										
			BORE										
			TCLP	X									
		CGW	WELL	X	X	X				X	X	X	
		CSW		X					X	X	X	X	
		CSE		X					X	X			
A9	X	CSO	SURF	X			X	X	X				
			AHOL	X			X	X	X				
			DTCH										
			BORE	X			X	X					
		CGW	WELL	X	X	X			X	X	X	X	
A3/P5	X	CSO	EXCV	X			X	X					
			SURF	X			X	X	X				
			BORE	X			X	X					
		CGW	WELL	X	X	X							
		CSW	WITH	X					X	X	X	X	
		CSE	A4	X					X	X			
P4	X	CSO	SURF	X			X	X	X				
		CSW		X					X	X	X	X	
		CSE		X					X	X			
P7	X	CSO	EXCV	X			X	X					
			BORE	X			X	X					
		CGW	WELL	X	X	X							
P17	X	CSO	SURF	X			X	X	X				
			EXCV	X			X	X					
P19	X	CSO	SURF	X			X	X	X				
P20	X	CSO	SURF	X			X	X	X				
P25	X	CSO	SURF	X			X	X	X				
P35	X	CSO	SURF	X			X	X	X				
		CGW	WELL	X	NA	NA							
		CTF	TRAN	X	< or > 50 ppm: <50 ppm = Non-haz and Non-TSCA								
P49	X	CSO	SURF	X			X	X	X				
P51	X	CSO	SURF	X			X	X	X				
P59	X	CSE		X					X	X			
P60	X	CSO	SURF	X			X	X	X				
AR	X	CSW		X					X	X	X	X	
		CSE		X						X			

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TABLE 2-1 - PHASE II SAMPLING - AREA A4

Site ID	Sample Number	Sampling Media	Analytical Parameters
OHM-A4-50	A4SB50B,C	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest OP Pest, TOC
A4TPD	A4TPD1, A4TPD2 A4TPD3	Subsurface soil (test pit)	Metals, PCB Pest, OP Pest
A4TPE	A4TPE1, A4TPE2 A4TPE3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest TPH
A4TPF	A4TPF1, A4TPF2 A4TPF3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest TPH
A4TPG	A4TPG1, A4TPG2 A4TPG3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest TPH
A4SD4	A4SD4B	Surface sediment	Explosives
A4SD5	A4SD5B1, A4SD5B2 A4SD5B3	Stratified sediment	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives
A4SD6	A4SD6B1, A4SD6B2 A4SD6B3	Stratified sediment	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives, TOC
A4SD7	A4SD7B1, A4SD7B2 A4SD7B3	Stratified sediment	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives, TOC
A4SW4	A4SW4B	Surface water	Explosives
A4SW5	A4SW5B	Surface water	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives
A4SW6	A4SW6B	Surface water	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives
A4SW7	A4SW7B	Surface water	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives
A4SO5	A4SO5B	Surface soil	BNA, VOC, Metals, PCB/Pest, OP Pest, Explosives
A4AT1	A4AT1B	Tank contents	BNA, VOC, Metals, PCB/Pest, OP Pest
DM4	DMGW4C	Groundwater	BNA, Metals, Metals TOT
OHM-A4-4	A4GW4C	Groundwater	BNA, VOC, Metals, Metals TOT, PCB/Pest, OP Pest
OHM-A4-5	A4GW5C	Groundwater	BNA, VOC, Metals, Metals TOT, PCB/Pest, OP Pest
OHM-A4-50	A4GW50A	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest

TABLE 2-2
AREAS A3/P5, A4, A7, AND A9
HISTORICAL AERIAL PHOTOGRAPH INDEX

PHOTO DATE	SERIES AND SCALE	AREA	PHOTOGRAPH OR STEREO PAIR	EPA EPIC NO.	REMARKS
10 APR 39	1:3,500	A7/A9	UNKNOWN	42567	No stereo pair avaliable
06 JUN 43	US16DPU 1:21,369	A7/A9	207-1-253	N/A	First photo in series labeled US16DPU-23:6:43:0819-7135W4234N-210:1:253-6:10000-AYER,MASS.
			208-1-253	N/A	
		A4/A3/P5	208-1-253	N/A	
			209-1-253	N/A	
05 SEP 52	DPO-12K 1:20,000	A7/A9	104	9277	
		A4/A3/P5	105	9278	
29 APR 63	GS VAQZ 1:24,042	A7/A9	1-44	9229	
			1-45	9230	
		A4/A3/P5	1-22	9223	
			1-44	9229	
12 MAY 78	GS WSJS 1:41,326	A7/A9	4-119	9221	No stereo pair available
		A4/A3/P5	4-118	9220	
			4-119	9221	
01 APR 86	480 1:5,418	A7 and A9	10482-2-113	N/A	Photograped by COL-EAST, Inc., North Adams, MA Date taken is approx. 8-mos prior to Zecco excavation in Area A9.
			10482-2-114	N/A	
			10482-2-115	N/A	
	480 1:5,308	A4/A3/P5	10482-4-103	N/A	
			10482-4-104	N/A	
			10482-4-105	N/A	
15 MAR 92	WILD 15/4 UA Nr 13078 153. 1:3,158	A7/A9	9112	N/A	Photographed by Bionetics Corp under subcontract to the EPA's EPIC
			9113	N/A	
	WILD 15/4 UA Nr 13078 153. 1:2,300	A4/A3/P5	9307	N/A	
			9308	N/A	
			9274	N/A	
			9275	N/A	

Table 2-3
Area A4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4CD1 A4CD1A 28-May-92 0 feet	A4CD2 A4CD2A 28-May-92 0 feet	A4SO1 A4SO1A 21-Apr-92 0 feet	A4SO2 A4SO2A 21-Apr-92 0 feet	A4SO3 A4SO3A 21-Apr-92 0 feet	A4SO4 A4SO4A 21-Apr-92 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1				0.016	0.013	0.014
BNAs:									
Chrysene			0.7						
Di-n-butyl phthalate	3.801	9				5 S	6 S	7 S	
PCB/Pesticides:									
ppDDE	0.039	0.139	2	0.214	0.0809				
ppDDT	0.066	0.23	2	0.0861	0.162				
Metals:									
Aluminum	10834.976	18000				11000 B	11000 B	12000 B	
Antimony	0.822	0.578	10		9.43				
Barium	21.603	54.7		27.3	31.7		25.8		25
Beryllium	0.298	0.638	0.4				0.325	0.353	
Cadmium	0.563	1.79	30	7.42					
Calcium	554.016	1170		588	1110				
Chromium	18.666	62.5	1000						19
Cobalt	3.472	7.3					4.8	3.61	
Copper	9.521	19.5			12				
Iron	12806.693	28000							
Lead	51.432	110	300	53 B					
Magnesium	1793.596	5060				1910	2690	2260	3170
Manganese	263.698	1100			270				
Mercury	0.101	0.318	10						
Nickel	9.322	23.2	300				10.5		
Potassium	450.597	700		458	502	548	996	687	1710
Zinc	33.907	85.8	2500	1200					

Table 2-3
Area A4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4SO5 A4SO5B 08-Nov-93 0 feet	A4SO5 DUPSO01C 08-Nov-93 0 feet
VOCs:					
Methylene chloride	0.008	0.018	0.1		
BNAs:					
Chrysene			0.7	0.91	*
Di-n-butyl phthalate	3.801	9			*
PCB/Pesticides:					
ppDDE	0.039	0.139	2	0.225	*
ppDDT	0.066	0.23	2	0.449	*
Metals:					
Aluminum	10834.976	18000			
Antimony	0.822	0.578	10		
Barium	21.603	54.7		100	91.7 D
Beryllium	0.298	0.638	0.4		
Cadmium	0.563	1.79	30	12.1	13.5 D
Calcium	554.016	1170		5890	5470 D
Chromium	18.666	62.5	1000		
Cobalt	3.472	7.3			
Copper	9.521	19.5		42.2	48.2 D
Iron	12806.693	28000		18000	20000 D
Lead	51.432	110	300	520	890 D
Magnesium	1793.596	5060		2060	
Manganese	263.698	1100			
Mercury	0.101	0.318	10	0.552	0.192 D
Nickel	9.322	23.2	300	12.1	10.6 D
Potassium	450.597	700		740	544 D
Zinc	33.907	85.8	2500	2420	2550 D

Table 2-4
Area A4
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A4CD1 A4CD1A 28-May-92 0 feet	A4CD2 A4CD2A 28-May-92 0 feet	A4SO1 A4SO1A 21-Apr-92 0 feet	A4SO3 A4SO3A 21-Apr-92 0 feet	A4SO5 A4SO5B 08-Nov-93 0 feet	A4SO5 DUPSO01C 08-Nov-93 0 feet
Metals:							
Antimony	8.8		9.43				
Arsenic	4.8	6.61		5.44	8.6	6.4	7.4 D
Cadmium	5	7.42				12.1	13.5 D
Lead	200					520	890 D
Zinc	350	1200				2420	2550 D

Table 2-5
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPA A4TPA1 11-Nov-92 0 feet	A4TPB A4TPB1 11-Nov-92 0 feet	A4TPC A4TPC1 11-Nov-92 0 feet	A4TPD A4TPD1 09-Nov-93 0 feet	A4TPD A4TPD2 09-Nov-93 2 feet	A4TPD A4TPD3 09-Nov-93 4 feet
PCB/Pesticides:									
Endosulfan, alpha	0.005	0.008			0.0185				
ppDDE	0.039	0.139	2		0.0455	0.0526			
ppDDT	0.066	0.23	2		0.0836				
Metals:									
Aluminum	10834.976	18000		15000		14000			
Arsenic	8.951	17	30						
Barium	21.603	54.7		31.5	29.3	41.9	22.7	47.3	40
Beryllium	0.298	0.638	0.4	0.407					
Cadmium	0.563	1.79	30	0.96	0.575	3.29			
Calcium	554.016	1170		1700	713	824			657
Chromium	18.666	62.5	1000						
Cobalt	3.472	7.3				4.09			
Copper	9.521	19.5		13.7		28.5			
Iron	12806.693	28000				23000			
Lead	51.432	110	300			570			
Magnesium	1793.596	5060		2270	2550	1810	3210	2460	2200
Nickel	9.322	23.2	300			12.9			
Potassium	450.597	700		784	1220	705	1160	1850	1530
Sodium	122.501	122							
Vanadium	27.081	51.2							
Zinc	33.907	85.8	2500	41		220			

Table 2-5
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPE A4TPE1 09-Nov-93 0 feet	A4TPE A4TPE2 09-Nov-93 2 feet	A4TPE A4TPE3 09-Nov-93 4 feet	A4TPF A4TPF1 09-Nov-93 0 feet	A4TPF A4TPF2 09-Nov-93 2 feet	A4TPF A4TPF3 09-Nov-93 4 feet
PCB/Pesticides:									
Endosulfan, alpha	0.005	0.008							
ppDDE	0.039	0.139	2						
ppDDT	0.066	0.23	2						
Metals:									
Aluminum	10834.976	18000		11000	14000	13000			
Arsenic	8.951	17	30						
Barium	21.603	54.7		46.7	55.3	69.5	36.8	55.4	72.2
Beryllium	0.298	0.638	0.4	0.415	0.639	0.489			
Cadmium	0.563	1.79	30						
Calcium	554.016	1170		1120	568	2790	744		801
Chromium	18.666	62.5	1000	18.7	20.5	43	45.5	31.7 B	25.7 B
Cobalt	3.472	7.3		4.59	7.38	7.76			
Copper	9.521	19.5		11.8	16.8	23.6	18.6	28.7	22.3
Iron	12806.693	28000		14000	17000	20000		13000	14000
Lead	51.432	110	300						
Magnesium	1793.596	5060		3190	3510	6800	2600	3610	3690
Nickel	9.322	23.2	300	10.4	11.8	25.7			16.3
Potassium	450.597	700		2330	2140	2570	2060	2150	3290
Sodium	122.501	122				274			
Vanadium	27.081	51.2			27.4	30.8			29
Zinc	33.907	85.8	2500			36.5			38.8

Table 2-5
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPG A4TPG1 09-Nov-93 0 feet	A4TPG DUPTP01C 09-Nov-93 0 feet	A4TPG A4TPG2 09-Nov-93 2 feet	A4TPG A4TPG3 09-Nov-93 4 feet
PCB/Pesticides:							
Endosulfan, alpha	0.005	0.008			*		
ppDDE	0.039	0.139	2		*		
ppDDT	0.066	0.23	2		*		
Metals:							
Aluminum	10834.976	18000			11000 D	12000	12000
Arsenic	8.951	17	30				40
Barium	21.603	54.7		69.3	70.9 D	74.6	68.3
Beryllium	0.298	0.638	0.4	0.421	0.421 D	0.5	0.639
Cadmium	0.563	1.79	30				
Calcium	554.016	1170		1580	1490 D	1050	1110
Chromium	18.666	62.5	1000			19	19.7
Cobalt	3.472	7.3		6.77	8.36 D	7.33	8.58
Copper	9.521	19.5		13.7	15.6 D	15.2	21.6
Iron	12806.693	28000		14000	16000 D	18000	21000
Lead	51.432	110	300				
Magnesium	1793.596	5060		2950	3300 D	4030	3910
Nickel	9.322	23.2	300	13.7	15 D	21.6	21.4
Potassium	450.597	700		2040	2180 D	2700	2370
Sodium	122.501	122		124			123
Vanadium	27.081	51.2				27.7	28.2
Zinc	33.907	85.8	2500			37.7	38.3

Table 2-6
Area A4
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4B1 A4SB1A 06-May-92 2 feet	A4B2 A4SB2A 06-May-92 2 feet	OHM-A4-4 A4SB4A1 05-May-92 4 feet	OHM-A4-4 A4SB4A2 05-May-92 10 feet	OHM-A4-5 A4SB5A 06-May-92 2 feet	OHM-A4-50 A4SB50B 26-Oct-93 8 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1	0.011	0.014	0.014	0.02	0.032	*
Metals:									
Aluminum	10834.976	18000				16000 B	*		
Arsenic	8.951	17	30			30	*		
Barium	21.603	54.7			25.9	83.7	*		47.8
Beryllium	0.298	0.638	0.4			0.408	*		
Cadmium	0.563	1.79	30			0.994	*		
Calcium	554.016	1170			966		*		1010
Chromium	18.666	62.5	1000			31.4	*		
Cobalt	3.472	7.3			4.09	5.7	*		4.27
Copper	9.521	19.5				22.6	*		
Iron	12806.693	28000				23000 B	*		
Magnesium	1793.596	5060		2190	2220	5370	*	2090	1990
Nickel	9.322	23.2	300			14.4	*		12.6
Potassium	450.597	700		1110	1450	4210	*	1330	1710
Vanadium	27.081	51.2				37.4	*		

Table 2-7
Area A4
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	DM4 DMGW4A 23-Jun-92 Filtered metals	DM4 DMGW4B 28-Oct-92 Filtered metals	DM4 DMGW4C 30-Nov-93 Filtered metals	DM4 DMGW4C 30-Nov-93 Unfiltered metals	DM5 DMGW5A 23-Jun-92 Filtered metals	DM5 DMGW5B 28-Oct-92 Filtered metals
BNAs:									
Bis(2-ethylhexyl) phthalate	6		6		7.8	*	*		
Metals:									
Aluminum		50		349			19800		
Iron		300		2660	2720	2190	37000	387	
Lead	15		15						
Manganese		50		101	72	76.3	225	320	381

Table 2-7
Area A4
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	EHA7 EHAGW7A 23-Jun-92 Filtered metals	EHA7 EHAGW7B 29-Oct-92 Filtered metals	OHM-A4-4 A4GW4A 23-Jun-92 Filtered metals	OHM-A4-4 A4GW4C 02-Dec-93 Filtered metals	OHM-A4-4 A4GW4C 02-Dec-93 Unfiltered metals	OHM-A4-5 A4GW5B 28-Oct-92 Filtered metals
BNAs:									
Bis(2-ethylhexyl) phthalate	6		6						
Metals:									
Aluminum		50						2870	
Iron		300		1950				2810	
Lead	15		15						190
Manganese		50		295	154	227	71.3	121	

Table 2-7
Area A4
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A4-5 A4GW5C 30-Nov-93 Unfiltered metals	OHM-A4-50 A4GW50A 30-Nov-93 Filtered metals
BNAs:					
Bis(2-ethylhexyl) phthalate	6		6		
Metals:					
Aluminum		50		10900	
Iron		300		14000	
Lead	15		15		
Manganese		50		201	983

Table 2-8
Areas A4 and A3/P5
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A3SW1 A3SW1A 24-Apr-92 0.25 feet	A4SW1 A4SW1A 30-Apr-92 0 feet	A4SW2 A4SW2A 01-May-92 0 feet	A4SW3 A4SW3A 30-Apr-92 0 feet	A4SW5 A4SW5B 02-Nov-93 0 feet	A4SW6 A4SW6B 03-Nov-93 0 feet
PCB/Pesticides:										
ppDDT			0.001	0.00059					0.0285 1	
Metals:										
Aluminum	400	87			724	285	820		24400	2030
Arsenic	3.15		190	0.14	9.19	7.38	5.52		21	6.4
Barium	10.4								85.7	47.4
Calcium	8520								16000	27900
Chromium	3.16	11	11						17.3	
Copper	10	3.6	3.6						89.4	
Iron	4810				4970				21000	
Lead	10.3	0.55	0.55		10.5	1.77	3.13	2.3	140	50
Magnesium	1890								2200	2120
Manganese	156									
Potassium	2060									2090
Vanadium	4.72								40.4	20.2
Zinc	13.3	33	33		25	13.4 B	17.9 B	14.8 B	532	713

Table 2-8
Areas A4 and A3/P5
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A4SW7 A4SW7B 03-Nov-93 0 feet	P5SW1 P5SW1A 24-Apr-92 0.25 feet	P5SW2 P5SW2B 01-Nov-93 0 feet	P5SW3 P5SW3B 01-Nov-93 0 feet	P5SW4 P5SW4B 01-Nov-93 0 feet
PCB/Pesticides:									
ppDDT			0.001	0.00059			*	*	*
Metals:									
Aluminum	400	87			1450		2350	174	1570
Arsenic	3.15		190	0.14	27		5.4		7.9
Barium	10.4				41.3		51.4		68.5
Calcium	8520				21000		22900	10200	11800
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Iron	4810				12000		7940		14000
Lead	10.3	0.55	0.55		18	3.76	28		21
Magnesium	1890				2710		2650		
Manganese	156				231				
Potassium	2060						2740		
Vanadium	4.72								
Zinc	13.3	33	33		632 B	23.6	455 B	453 B	474 B

Table 2-9
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	A3SD1 A3SD1A 24-Apr-92 1 foot	A4SD1 A4SD1A 30-Apr-92 2 feet	A4SD2 A4SD2A 01-May-92 0.5 feet	A4SD3 A4SD3A 30-Apr-92 2.5 feet	A4SD5 A4SD5B1 02-Nov-93 0 feet	A4SD5 A4SD5B2 02-Nov-93 1 foot	A4SD5 A4SD5B3 02-Nov-93 2 feet
PCB/Pesticides:									
ppDDD		0.002					0.0231 1		
ppDDE		0.002							
Metals:									
Aluminum	5020		9900 B	10000 B	8500 B	5900 B	5850	6700	
Arsenic	2.03	6	6.27	17	36	6.36		2.4	
Barium	23.9	20		30.9	26.8				
Beryllium	0.18		0.319						
Calcium	562		772 B		1500	943	1950	875	703
Chromium	9.66	26	14.2	13.9	13.4			10.2	
Cobalt	3.74				4.41				
Copper	6.33	16		7.26	9.77				
Iron	7590		8700 B	9900 B	11000 B				
Lead	4.48	31	5.3 B	9.9	15	9.1	18		
Magnesium	2140			2140					
Manganese	70.5			79.2	380				
Nickel	5.92	16	7.36	8.49	6.27				
Selenium	0.2	1					0.65		
Vanadium	17				18.1				
Zinc	20.8	120			38.4				

Table 2-9
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	A4SD6 A4SD6B1 03-Nov-93 0 feet	A4SD6 A4SD6B2 03-Nov-93 1 foot	A4SD6 A4SD6B3 03-Nov-93 2 feet	A4SD7 A4SD7B1 03-Nov-93 0 feet	A4SD7 A4SD7B2 03-Nov-93 1 foot	A4SD7 A4SD7B3 03-Nov-93 2 feet	P5SD1 P5SD1A 24-Apr-92 1.5 feet
PCB/Pesticides:									
ppDDD		0.002							
ppDDE		0.002	0.0983 1						
Metals:									
Aluminum	5020		6350	11200	5470	6350	9570	18400	15000
Arsenic	2.03	6				3.8	4.4	4.9	
Barium	23.9	20		44	28.3	79.5	102	231	
Beryllium	0.18			1.51				6.57	3.38
Calcium	562		24400	8090	1330	25900	28500	20500	8910 B
Chromium	9.66	26		13.8	11			25.4	16.1
Cobalt	3.74								
Copper	6.33	16						29.5	8.13
Iron	7590								
Lead	4.48	31	31	7.1		32		13	13 B
Magnesium	2140						2260	2180	
Manganese	70.5				72.2	84.5	123	91.8	
Nickel	5.92	16						59.1	
Selenium	0.2	1	2.1	1.6		3.2	6.1	3	4.83
Vanadium	17		17.7				25.5	37.5	
Zinc	20.8	120	34.7	21.1	32	40.3			

Table 2-9
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	P5SD2 P5SD2B 01-Nov-93 0.5 feet	P5SD3 P5SD3B 01-Nov-93 0.5 feet	P5SD4 P5SD4B 01-Nov-93 0.5 feet
PCB/Pesticides:					
ppDDD		0.002			
ppDDE		0.002			
Metals:					
Aluminum	5020		8760	6390	17900
Arsenic	2.03	6			
Barium	23.9	20	41.6	51.7	44.1
Beryllium	0.18				
Calcium	562		13600	13000	4220
Chromium	9.66	26			17.4
Cobalt	3.74				
Copper	6.33	16			
Iron	7590				12000
Lead	4.48	31	22	68	33
Magnesium	2140				
Manganese	70.5				
Nickel	5.92	16			
Selenium	0.2	1	2.4	2.3	2
Vanadium	17			21.9	23.9
Zinc	20.8	120	26.9	52.5	35.8

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TABLE 3-1 - PHASE II SAMPLING - AREA A7

Site ID	Sample Number	Sampling Media	Analytical Parameters
A7HA3	A7HA3A	Subsurface soil (hand auger)	TCLP Metals
A7HA4	A7HA4A	Subsurface soil (hand auger)	TCLP Pest
A7B13	A7SB13B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B14	A7SB14B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B15	A7SB15B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B16	A7SB16B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B17	A7SB17B	Subsurface soil (boring)	TCLP Full
A7B18	A7SB18B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B19	A7SB19B	Subsurface soil (boring)	PCB/Pest, OP Pest
A7B20	A7SB20B	Subsurface soil (boring)	PCB/Pest, OP Pest
OHM-A7-51	A7SB51B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest OP Pest, TOC
OHM-A7-52	A7SB52B	Subsurface soil (well)	PCB/Pest, OP Pest, TOC
A7TPQ	A7TPQ1, A7TPQ2 A7TPQ3, A7TPQ4	Subsurface soil (test pit)	PCB/Pest, OP Pest
	A7TPQTC		TCLP Semivol, TCLP Pest
A7TPR	A7TPR1, A7TPR2	Subsurface soil (test pit)	BNA, VOC, Metals, PCB/Pest, OP Pest, Expl, Herb, PO4
	A7TPRTC		TCLP Semivol, TCLP VOC
A7TPS	A7TPS1, A7TPS2 A7TPS3	Subsurface soil (test pit)	Metals, PCB/Pest, OP Pest
	A7TPSTC		TCLP Metals, TCLP Pest
A7TPT	A7TPT1, A7TPT2 A7TPT3	Subsurface soil (test pit)	PCB/Pest, OP Pest
A7TPs	00001, 00002, 00003 00004, 00005, 00006 00007	Air	Asbestos
A7SD3	A7SD3B,C	Surface sediment	BNA, VOC, Metals, PCB/Pest, OP Pest, Expl, Herb, TOC, PO4
A7SW3	A7SW3B	Surface water	BNA, VOC, Metals, PCB/Pest, OP Pest, Expl, Herb, PO4
OHM-A7-45	A7GW45C1,2	Groundwater	PCB/Pest, PCB/Pest DIS, OP Pest
OHM-A7-46	A7GW46C1,2	Groundwater	PCB/Pest, PCB/Pest DIS, OP Pest
OHM-A7-51	A7GW51A1,2	Groundwater	BNA, VOC, PCB/Pest, PCB/Pest DIS OP Pest
OHM-A7-52	A7GW52A1,2	Groundwater	PCB/Pest, PCB/Pest DIS, OP Pest
OHM-A7-8	A7GW8C1	Groundwater	BNA, VOC, PCB/Pest, PCB/Pest DIS OP Pest

TABLE 3-2
AREAS A7 AND A9
VERTICAL GROUNDWATER GRADIENTS

MONITORING WELL COUPLETS	DATE	TOP OF WATER (ft AMSL)	TOP OF SCREEN ELEVATION (ft AMSL)	BASE OF SCREEN ELEVATION (ft AMSL)	MIDPOINT OF SATURATED SCREEN (ft AMSL)	PRESSURE HEAD ELEV DIFFERENTIAL (ft AMSL)	ELEVATION HEAD DIFFERENTIAL (ft AMSL)	VERTICAL GRADIENT AND DIRECTION
OHM-A7-10	06/15/92	177.55	177.64	169.64	173.60	4.09	18.495	0.22
OHM-A7-11		181.64	160.10	150.10	155.10			UPWARD
OHM-A7-10	10/23/92	176.48	177.64	169.64	173.06	5.16	17.96	0.29
OHM-A7-11		181.64	160.10	150.10	155.10			UPWARD
OHM-A7-10	01/08/93	178.94	177.64	169.64	173.64	2.70	18.54	0.15
OHM-A7-11		181.64	160.10	150.10	155.10			UPWARD
OHM-A7-10	04/27/94	178.94	177.64	169.64	173.64	2.70	18.54	0.15
OHM-A7-11		181.64	160.10	150.10	155.10			UPWARD
OHM-A9-17	06/15/92	185.38	162.18	152.18	157.18	2.39	22.49	0.11
DM-8		182.99	186.09	176.34	179.67			UPWARD
OHM-A9-17	10/23/92	184.08	162.18	152.18	157.18	2.22	21.92	0.10
DM-8		181.86	186.09	176.34	179.10			UPWARD
OHM-A9-17	01/08/93	184.85	162.18	152.18	157.18	2.84	22.00	0.13
DM-8		182.01	186.09	176.34	179.18			UPWARD
OHM-A9-17	04/27/94	186.29	162.18	152.18	157.18	2.57	22.85	0.11
DM-8		183.72	186.09	176.34	180.03			UPWARD
OHM-A9-18	06/15/92	185.83	158.94	148.94	153.94	0.78	27.97	0.03
DM-9A		185.05	188.26	178.76	181.91			UPWARD
OHM-A9-18	10/23/92	184.37	158.94	148.94	153.94	0.65	27.30	0.02
DM-9A		183.72	188.26	178.76	181.24			UPWARD
OHM-A9-18	01/08/93	184.92	158.94	148.94	153.94	1.46	27.17	0.05
DM-9A		183.46	188.26	178.76	181.11			UPWARD
OHM-A9-18	04/27/94	186.62	158.94	148.94	153.94	1.42	28.04	0.05
DM-9A		185.20	188.26	178.76	181.98			UPWARD

TABLE 3-3
AREA A7
GROUNDWATER DISCHARGE ESTIMATES

AREA A7 - DISCHARGE ESTIMATES

	AQUIFER UNIT	X-SECTION AREA (sq ft)	FLOW VOLUME (1) (cu ft/min/sq ft)	FLOW VOLUME (2) (gal/min)	TOTAL FLOW (gal/min)	FLOW VOLUME (3) (gal/day)	TOTAL FLOW (gal/day)
ENTIRE AREA	UPPER	2072	4.04E-04	6.284	7.099	9,049	10,223
	LOWER	10900	9.97E-06	0.815		1,174	
LAB WASTE PLUME	UPPER	517	4.04E-04	1.568	1.750	2,258	2,521
	LOWER	2440	9.97E-06	0.182		263	

(1) Flow volume = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
(2) Flow volume = Aquifer unit area (sq ft) x flow volume (cu ft/min/sq ft) x 7.5 gal/cu ft
(3) Flow volume = Flow volume (gal/min) x 1440 min/day

ASSABET RIVER FLOW VOLUMES FROM USGS WATER-DATA REPORT MA-RI-93-1

	FLOW VOLUME (cu ft/sec)	FLOW VOLUME (gal/min)	FLOW VOLUME (gal/day)	TIME PERIOD (water year)
50% flow exceeds	125	56,250	81,000,000	1941-1993
90% flow exceeds	24	10,800	15,552,000	1941-1993
Lowest daily mean	0.20	90	129,600	02 FEB 65

VALUES FOR VARIABLES USED IN CALCULATIONS

UPPER AQUIFER
Hydraulic conductivity K = 0.004583 ft/min
Gradient i = 15 ft/170 ft = 0.0882

Discharge (Q) = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
Q = KiA = (0.004583 ft/min)(0.0882)(1 sq ft) = 0.004044 cu ft/min

LOWER AQUIFER
Hydraulic conductivity K = 0.000113 ft/min
Gradient i = 15 ft/170 ft = 0.0882

Discharge (Q) = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
Q = KiA = (0.000113 ft/min)(0.0882)(1 sq ft) = 0.00000997 cu ft/min

TABLE 3-4
AREA A7
CROSS-SECTIONAL AREAS USED IN DISCHARGE CALCULATIONS

TOTAL AREA A7 DISCHARGE
LIMITS - THE MAPPED BOUNDARY TO THE WEST AND THE STREAM TO THE EAST

UPPER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
STREAM to MW-12	110	0	0	2072
MW-12 to MW-11	125	3	375	
MW-11 to MW-9	160	6	960	
MW-9 to MW-51	170	4	680	
MW-51 to MW-52	95	0.6	57	
MW-52 to BOUNDARY	290	0	0	

LOWER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
STREAM to MW-12	110	12	1320	10900
MW-12 to MW-11	125	8	1000	
MW-11 to MW-9	160	3	480	
MW-9 to MW-51	170	8	1360	
MW-51 to MW-52	95	16	1520	
MW-52 to BOUNDARY	290	18	5220	

LAB WASTE PLUME
EASTERN LIMIT - 2/3 THE DISTANCE FROM MW-51 TO MW-9
WESTERN LIMIT - MW-52

UPPER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
MW-51 to MW-52	95	0.6	57	517
MW-51 to EAST	115	4	460	

LOWER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
MW-51 to MW-52	95	16	1520	2440
MW-51 to EAST	115	8	920	

Table 3-5
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7CD1 A7CD1A 18-May-92 0 feet	A7CD2 A7CD2A 18-May-92 0 feet	A7SO1 A7SO1A 13-Apr-92 0 feet	A7SO2 A7SO2A 13-Apr-92 0 feet	A7SO3 A7SO3A 13-Apr-92 0 feet	A7SO4 A7SO4A 13-Apr-92 0 feet
VOCs:									
Acetone	0.03	0.046	3				0.3		
Methylene chloride	0.008	0.018	0.1		0.0086	0.01		0.0085	0.018
BNAs:									
2-Methylnaphthalene			0.7						
Benzo(a)anthracene			0.7						
Benzo(a)pyrene			0.7						
PCB/Pesticides:									
Benzenehexachloride, beta	0.005	0.004							
Chlordane, alpha	0.004	0.004		0.209					
Chlordane, gamma	0.019	0.005		0.096					
Chlordane, total	0.023	0.009	1	0.305					
Dieldrin	0.010	0.023	0.03	0.262			0.0118		
Endosulfan, beta	0.007	0.005		0.0914					
Endosulfan, total	0.012	0.013	0.2	0.0914					
Endosulfan sulfate	0.013	0.008		0.0784					
Heptachlor	0.009	0.002	0.1	0.0554					
ppDDD	0.019	0.063	2						
ppDDE	0.039	0.139	2	0.112	86		0.0855		
ppDDT	0.066	0.23	2	0.645	380		0.111		
Metals:									
Barium	21.60	54.7		26.5	36.8	45.5	34.9	32.6	353
Cadmium	0.56	1.79	30	1.18	2.03				
Calcium	554.02	1170			778	558	602	1210	
Chromium	18.67	62.5	1000	200	24.3				
Cobalt	3.47	7.3			5.78			3.85	3.71
Copper	9.52	19.5		11.5	24.8		12.8	14.9	11.6
Iron	12806.69	28000		14000 B	21000 B				
Lead	51.43	110	300	400			52		82
Magnesium	1793.60	5060		2730	3580	2310	1890	3010	2200
Manganese	263.70	1100							
Mercury	0.10	0.318	10	0.221			0.109		
Nickel	9.32	23.2	300		15.2			10.7	
Potassium	450.60	700		1810	2040	1680	1130	1740	1320
Zinc	33.91	85.8	2500		41.8		44		210

Table 3-5
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7SO5 A7SO5A 13-Apr-92 0 feet	A7SO6 A7SO6A 13-Apr-92 0 feet	A7SO7 A7SO7A 13-Apr-92 0 feet	A7SO8 A7SO8A 13-Apr-92 0 feet	A7SO9 A7SO9A 13-Apr-92 0 feet	A7SO10 A7SO10A 13-Apr-92 0 feet
VOCs:									
Acetone	0.03	0.046	3						
Methylene chloride	0.008	0.018	0.1				0.0096		
BNAs:									
2-Methylnaphthalene			0.7		10				
Benzo(a)anthracene			0.7		3 S				
Benzo(a)pyrene			0.7		2				
PCB/Pesticides:									
Benzenehexachloride, beta	0.005	0.004			0.0194				
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005			0.03				
Chlordane, total	0.023	0.009	1		0.03				
Dieldrin	0.010	0.023	0.03						
Endosulfan, beta	0.007	0.005			0.192				
Endosulfan, total	0.012	0.013	0.2		0.192				
Endosulfan sulfate	0.013	0.008							
Heptachlor	0.009	0.002	0.1						
ppDDD	0.019	0.063	2				0.106	0.892	
ppDDE	0.039	0.139	2				0.0499	0.96	
ppDDT	0.066	0.23	2				0.0786	6	
Metals:									
Barium	21.60	54.7			24.2	34.9	25	57.8	39.6
Cadmium	0.56	1.79	30					1.15	0.718
Calcium	554.02	1170		868		602	650	1160	2460
Chromium	18.67	62.5	1000					30.6	34.6
Cobalt	3.47	7.3					4.83	5.64	3.69
Copper	9.52	19.5			21.3		16.5	31.1	11.6
Iron	12806.69	28000					15000	17000 X	13000
Lead	51.43	110	300			65	86	55	
Magnesium	1793.60	5060			1910	2600	2570	3520	3130
Manganese	263.70	1100					270	270	
Mercury	0.10	0.318	10					0.116	
Nickel	9.32	23.2	300				9.79	16.3	15.8
Potassium	450.60	700		1120	1100	2140	1430	1980	1530
Zinc	33.91	85.8	2500		90.5			102	88

Table 3-5
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7SO11 A7SO11A 13-Apr-92 0 feet	A7SO12 A7SO12A 13-Apr-92 0 feet
VOCs:					
Acetone	0.03	0.046	3		
Methylene chloride	0.008	0.018	0.1		
BNAs:					
2-Methylnaphthalene			0.7		
Benzo(a)anthracene			0.7		
Benzo(a)pyrene			0.7		
PCB/Pesticides:					
Benzenehexachloride, beta	0.005	0.004			
Chlordane, alpha	0.004	0.004			
Chlordane, gamma	0.019	0.005			
Chlordane, total	0.023	0.009	1		
Dieldrin	0.010	0.023	0.03		
Endosulfan, beta	0.007	0.005			
Endosulfan, total	0.012	0.013	0.2		
Endosulfan sulfate	0.013	0.008			
Heptachlor	0.009	0.002	0.1		
ppDDD	0.019	0.063	2		
ppDDE	0.039	0.139	2		
ppDDT	0.066	0.23	2		
Metals:					
Barium	21.60	54.7			36.5
Cadmium	0.56	1.79	30		
Calcium	554.02	1170		577	
Chromium	18.67	62.5	1000	18.9	
Cobalt	3.47	7.3			
Copper	9.52	19.5			11.5
Iron	12806.69	28000			
Lead	51.43	110	300		
Magnesium	1793.60	5060		3300	2680
Manganese	263.70	1100			
Mercury	0.10	0.318	10		
Nickel	9.32	23.2	300		
Potassium	450.60	700		573	1930
Zinc	33.91	85.8	2500		

Table 3-6
Area A7
Summary of Compounds Exceeding
ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A7CD1 A7CD1A 18-May-92 0 feet	A7CD2 A7CD2A 18-May-92 0 feet	A7SO2 A7SO2A 13-Apr-92 0 feet	A7SO4 A7SO4A 13-Apr-92 0 feet	A7SO5 A7SO5A 13-Apr-92 0 feet	A7SO6 A7SO6A 13-Apr-92 0 feet	A7SO7 A7SO7A 13-Apr-92 0 feet
BNAs:								
Benzo(a)anthracene	1						3 S	
Benzo(a)pyrene	1						2	
Phenanthrene	5						5	
PCB/Pesticides:								
PCBs, total	1	1.62						
ppDDD	0.5							
ppDDE	0.5		86					
ppDDT	0.5	0.645	380					
Metals:								
Arsenic	4.8	5.05	5.82	6.2		7.7	7.8	4.95
Barium	290				353			
Lead	200	400						

Table 3-6
Area A7
Summary of Compounds Exceeding
ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A7SO8 A7SO8A 13-Apr-92 0 feet	A7SO9 A7SO9A 13-Apr-92 0 feet	A7SO10 A7SO10A 13-Apr-92 0 feet	A7SO11 A7SO11A 13-Apr-92 0 feet	A7SO12 A7SO12A 13-Apr-92 0 feet
BNAs:						
Benzo(a)anthracene	1					
Benzo(a)pyrene	1					
Phenanthrene	5					
PCB/Pesticides:						
PCBs, total	1					
ppDDD	0.5		0.892			
ppDDE	0.5		0.96			
ppDDT	0.5		6			
Metals:						
Arsenic	4.8	8.1	6.29	5.1	5.48	7.1
Barium	290					
Lead	200					

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPB A7TPB1 09-Dec-91 2 feet	A7TPC A7TPC1 06-Dec-91 2 feet	A7TPC A7TPC2 06-Dec-91 4 feet	A7TPC A7TPC3 06-Dec-91 6 feet	A7TPD A7TPD1 05-Dec-91 2 feet	A7TPD A7TPD2 05-Dec-91 4 feet	A7TPD A7TPD3 05-Dec-91 6 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1					0.012		
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7							
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		0.0832						
Chlordane, gamma	0.019	0.005		0.105						
Chlordane, total	0.023	0.009	1	0.1882						
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1	0.0189						
Heptachlor epoxide	0.004	0.006	0.06	0.0254						
Lindane	0.019	0.004	0.1							
PCBs, total			2							
ppDDD	0.019	0.063	2							
ppDDE	0.039	0.139	2							
ppDDT	0.066	0.23	2							
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30							
Barium	21.60	54.7			24.4			23.9	21.9	
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	9.23 @	13.4 @	9.54 @	8.39 @	11.1 @	8.51 @	6.62 @
Calcium	554.02	1170		560 B	691 B	624 B	579 B	831 B	972 B	1050 B
Chromium	18.67	62.5	1000							
Cobalt	3.47	7.3								
Copper	9.52	19.5		11.2	11.4			11.8		

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPB A7TPB1 09-Dec-91 2 feet	A7TPC A7TPC1 06-Dec-91 2 feet	A7TPC A7TPC2 06-Dec-91 4 feet	A7TPC A7TPC3 06-Dec-91 6 feet	A7TPD A7TPD1 05-Dec-91 2 feet	A7TPD A7TPD2 05-Dec-91 4 feet	A7TPD A7TPD3 05-Dec-91 6 feet
Iron	12806.69	28000								
Lead	51.43	110	300							
Magnesium	1793.60	5060			2220			2320		
Manganese	263.70	1100								
Mercury	0.10	0.318	10					0.212 B		
Nickel	9.32	23.2	300							
Potassium	450.60	700		1180	1710	1060	1130	1280	1050	716
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500					35.2	39.5	

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPE A7TPE1 05-Dec-91 2 feet	A7TPE A7TPE2 05-Dec-91 4 feet	A7TPE A7TPE3 05-Dec-91 6 feet	A7TPF A7TPF1 06-Dec-91 2 feet	A7TPG A7TPG1 09-Dec-91 2 feet	A7TPH A7TPH1 06-Dec-91 2 feet	A7TPH A7TPH2 06-Dec-91 4 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1							
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7	0.79						
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004								
Chlordane, gamma	0.019	0.005								
Chlordane, total	0.023	0.009	1							
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1							
Heptachlor epoxide	0.004	0.006	0.06							
Lindane	0.019	0.004	0.1							
PCBs, total			2							
ppDDD	0.019	0.063	2							
ppDDE	0.039	0.139	2	0.0504						
ppDDT	0.066	0.23	2	0.132						
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30	27					15	9.5
Barium	21.60	54.7		50.3						37.9
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	12.1 @	6.33 @	9.13 @	9.33 @	9.72 @	11.7 @	27.5 @
Calcium	554.02	1170		2430 B	927 B	838 B	910 B			5420 B
Chromium	18.67	62.5	1000							23.4
Cobalt	3.47	7.3		3.78					3.52	6.7
Copper	9.52	19.5		94 B				13.4	119	250

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPE A7TPE1 05-Dec-91 2 feet	A7TPE A7TPE2 05-Dec-91 4 feet	A7TPE A7TPE3 05-Dec-91 6 feet	A7TPF A7TPF1 06-Dec-91 2 feet	A7TPG A7TPG1 09-Dec-91 2 feet	A7TPH A7TPH1 06-Dec-91 2 feet	A7TPH A7TPH2 06-Dec-91 4 feet
Iron	12806.69	28000								22000 B
Lead	51.43	110	300	53						160 X
Magnesium	1793.60	5060		2110			1840			2310
Manganese	263.70	1100								
Mercury	0.10	0.318	10	0.148 B				0.213		
Nickel	9.32	23.2	300	9.96						18.7
Potassium	450.60	700		992	1160	1210	1390	1340	1030	1560
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500	840				35		60.5

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPI A7TPI1 09-Dec-91 2 feet	A7TPJ A7TPJ1 04-Dec-91 2 feet	A7TPK A7TPK1 04-Dec-91 2 feet	A7TPL A7TPL1 04-Dec-91 2 feet	A7TPL A7TPL2 04-Dec-91 4 feet	A7TPL A7TPL3 04-Dec-91 6 feet	A7TPM A7TPM1 12-Nov-92 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3			20				
1,2-Dichloroethane			0.05			1				
Chloroform			0.1			20				
Methylene chloride	0.008	0.018	0.1		0.014					0.0099
Tetrachloroethylene			0.5			20 X				
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7							
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004				0.15		0.00568		
Chlordane, gamma	0.019	0.005				0.26				
Chlordane, total	0.023	0.009	1			0.41				
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1			0.064				
Heptachlor epoxide	0.004	0.006	0.06			0.044				
Lindane	0.019	0.004	0.1			0.52 1				
PCBs, total			2			2 S				
ppDDD	0.019	0.063	2			2.4				
ppDDE	0.039	0.139	2			0.17				
ppDDT	0.066	0.23	2			4.5				
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30							
Barium	21.60	54.7			32.8	27.6				
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	10 @	10.6 @	24.4 @	12 @	8.51 @	9.08 @	0.956
Calcium	554.02	1170			648 B	555 B	590 B			
Chromium	18.67	62.5	1000			270				
Cobalt	3.47	7.3			3.91	6.01			4.64	4.28
Copper	9.52	19.5			12.9	27.9	11			

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPI A7TPI1 09-Dec-91 2 feet	A7TPJ A7TPJ1 04-Dec-91 2 feet	A7TPK A7TPK1 04-Dec-91 2 feet	A7TPL A7TPL1 04-Dec-91 2 feet	A7TPL A7TPL2 04-Dec-91 4 feet	A7TPL A7TPL3 04-Dec-91 6 feet	A7TPM A7TPM1 12-Nov-92 2 feet
Iron	12806.69	28000				20000 B				
Lead	51.43	110	300		61	93				
Magnesium	1793.60	5060			2590	1820	2240		2210	2090
Manganese	263.70	1100								
Mercury	0.10	0.318	10		0.328 B	0.384 B				
Nickel	9.32	23.2	300		10.5					
Potassium	450.60	700		892	1580	868	1210	791	1390	1040
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500		72.8	81.9				

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPM A7TPM3 12-Nov-92 6 feet	A7TPN A7TPN1 12-Nov-92 2 feet	A7TPN A7TPN2 12-Nov-92 4 feet	A7TPO A7TPO1 11-Nov-92 2 feet	A7TPO A7TPO2 11-Nov-92 4 feet	A7TPP A7TPP1 12-Nov-92 2 feet	A7TPP DUPTP01B 12-Nov-92 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1	0.0087	0.0094	0.0091		0.012		
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7	*		*		*		
Chrysene			0.7	*		*		*		
Di-n-butyl phthalate	3.80	9		*		*		*		
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		*		*		*		
Chlordane, gamma	0.019	0.005		*		*		*		
Chlordane, total	0.023	0.009	1	*		*		*		
Dieldrin	0.010	0.023	0.03	*		*		*		
Endosulfan, beta	0.007	0.005		*		*		*		
Endosulfan, total	0.012	0.013	0.2	*		*		*		
Endrin	0.011	0.008	0.6	*		*		*		
Heptachlor	0.009	0.002	0.1	*		*		*		
Heptachlor epoxide	0.004	0.006	0.06	*		*		*		
Lindane	0.019	0.004	0.1	*		*		*		
PCBs, total			2	*		*		*		
ppDDD	0.019	0.063	2	*		*	0.031	*		
ppDDE	0.039	0.139	2	*		*	0.0684	*		
ppDDT	0.066	0.23	2	*		*	0.164	*		
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000		*	12000	*	13000	*		
Arsenic	8.95	17	30	*		*		*		
Barium	21.60	54.7		*	38.8	*	32.9	*		
Beryllium	0.30	0.638	0.4	*		*		*		
Cadmium	0.56	1.79	30	*	2.38	*	1.2	*	0.78	0.774 D
Calcium	554.02	1170		*		*	847	*		
Chromium	18.67	62.5	1000	*	22.8	*		*		
Cobalt	3.47	7.3		*	4.63	*		*		
Copper	9.52	19.5		*	18.6	*	9.56	*		

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPM A7TPM3 12-Nov-92 6 feet	A7TPN A7TPN1 12-Nov-92 2 feet	A7TPN A7TPN2 12-Nov-92 4 feet	A7TPO A7TPO1 11-Nov-92 2 feet	A7TPO A7TPO2 11-Nov-92 4 feet	A7TPP A7TPP1 12-Nov-92 2 feet	A7TPP DUPTP01B 12-Nov-92 2 feet
Iron	12806.69	28000		*	17000	*	13000	*		
Lead	51.43	110	300	*		*		*		
Magnesium	1793.60	5060		*	3610	*	2550	*	1950	
Manganese	263.70	1100		*		*		*		
Mercury	0.10	0.318	10	*		*		*		
Nickel	9.32	23.2	300	*	10.1	*	11.2	*		
Potassium	450.60	700		*	2400	*	1160	*	906	810 D
Vanadium	27.08	51.2		*	27.3	*		*		
Zinc	33.91	85.8	2500	*		*	35.5	*		

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPP A7TPP2 12-Nov-92 4 feet	A7TPQ A7TPQ1 12-Nov-93 0 feet	A7TPQ A7TPQ3 12-Nov-93 4 feet	A7TPQ A7TPQ4 12-Nov-93 5 feet	A7TPR A7TPR1 11-Nov-93 0 feet	A7TPR DUPTP02C 11-Nov-93 0 feet	A7TPR A7TPR2 11-Nov-93 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3		*	*	*			
1,2-Dichloroethane			0.05		*	*	*			
Chloroform			0.1		*	*	*			
Methylene chloride	0.008	0.018	0.1	0.0081	*	*	*		0.0094 D	
Tetrachloroethylene			0.5		*	*	*			2.9 S
BNAs:										
2-Methylnaphthalene			0.7	*	*	*	*	2 1		3
Chrysene			0.7	*	*	*	*			
Di-n-butyl phthalate	3.80	9		*	*	*	*	10		
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		*					0.48 D	0.4
Chlordane, gamma	0.019	0.005		*						
Chlordane, total	0.023	0.009	1	*					0.48 D	0.4
Dieldrin	0.010	0.023	0.03	*				0.95	4.9 D	1.5
Endosulfan, beta	0.007	0.005		*						
Endosulfan, total	0.012	0.013	0.2	*						
Endrin	0.011	0.008	0.6	*						
Heptachlor	0.009	0.002	0.1	*						
Heptachlor epoxide	0.004	0.006	0.06	*						
Lindane	0.019	0.004	0.1	*						0.67
PCBs, total			2	*					3.1 D	2.4
ppDDD	0.019	0.063	2	*			210			
ppDDE	0.039	0.139	2	*	0.79	5.9	8			
ppDDT	0.066	0.23	2	*	20	350	610			
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	450	400 D	360
Metals:										
Aluminum	10834.98	18000		*	*	*	*			
Arsenic	8.95	17	30	*	*	*	*			
Barium	21.60	54.7		*	*	*	*	31.1	37.6 D	46.7
Beryllium	0.30	0.638	0.4	*	*	*	*	0.406		
Cadmium	0.56	1.79	30	*	*	*	*			
Calcium	554.02	1170		*	*	*	*			
Chromium	18.67	62.5	1000	*	*	*	*			33.2
Cobalt	3.47	7.3		*	*	*	*			
Copper	9.52	19.5		*	*	*	*		10.6 D	

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPP A7TPP2 12-Nov-92 4 feet	A7TPQ A7TPQ1 12-Nov-93 0 feet	A7TPQ A7TPQ3 12-Nov-93 4 feet	A7TPQ A7TPQ4 12-Nov-93 5 feet	A7TPR A7TPR1 11-Nov-93 0 feet	A7TPR DUPTP02C 11-Nov-93 0 feet	A7TPR A7TPR2 11-Nov-93 2 feet
Iron	12806.69	28000		*	*	*	*			
Lead	51.43	110	300	*	*	*	*			3900
Magnesium	1793.60	5060		*	*	*	*	1970	2460 D	2880
Manganese	263.70	1100		*	*	*	*			
Mercury	0.10	0.318	10	*	*	*	*			0.467
Nickel	9.32	23.2	300	*	*	*	*			
Potassium	450.60	700		*	*	*	*	912	1620 D	1980
Vanadium	27.08	51.2		*	*	*	*			
Zinc	33.91	85.8	2500	*	*	*	*			36.1

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPS A7TPS1 12-Nov-93 0 feet	A7TPS A7TPS2 12-Nov-93 2 feet	A7TPS A7TPS3 12-Nov-93 4 feet	A7TPT A7TPT1 12-Nov-93 0 feet	A7TPT A7TPT2 12-Nov-93 2 feet	A7TPT A7TPT3 12-Nov-93 4 feet
VOCs:									
1,1,2-Trichloroethane			0.3	*	*	*	*	*	*
1,2-Dichloroethane			0.05	*	*	*	*	*	*
Chloroform			0.1	*	*	*	*	*	*
Methylene chloride	0.008	0.018	0.1	*	*	*	*	*	*
Tetrachloroethylene			0.5	*	*	*	*	*	*
BNAs:									
2-Methylnaphthalene			0.7	*	*	*	*	*	*
Chrysene			0.7	*	*	*	*	*	*
Di-n-butyl phthalate	3.80	9		*	*	*	*	*	*
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004		10	1.1	0.0312	0.0704	0.038	0.0151
Chlordane, gamma	0.019	0.005		20	2.4	0.0597		0.055 1	
Chlordane, total	0.023	0.009	1	30	3.5	0.0909	0.0704	0.093 1	
Dieldrin	0.010	0.023	0.03						
Endosulfan, beta	0.007	0.005						0.012 1	
Endosulfan, total	0.012	0.013	0.2					0.012 1	
Endrin	0.011	0.008	0.6	4.1	0.46		0.0293		
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06	0.29 1	0.05 1		0.00724	0.011	
Lindane	0.019	0.004	0.1						
PCBs, total			2						
ppDDD	0.019	0.063	2						
ppDDE	0.039	0.139	2	1.1 1	0.21			0.049	
ppDDT	0.066	0.23	2				0.117	0.23	0.0954
Phosphate:									
Phosphate	6.01	19.5		*	*	*	*	*	*
Metals:									
Aluminum	10834.98	18000				13000	*	*	*
Arsenic	8.95	17	30				*	*	*
Barium	21.60	54.7		43.6	47	67.9	*	*	*
Beryllium	0.30	0.638	0.4		0.366	0.489	*	*	*
Cadmium	0.56	1.79	30				*	*	*
Calcium	554.02	1170		2440	1570	609	*	*	*
Chromium	18.67	62.5	1000		42.8 B	24.6	*	*	*
Cobalt	3.47	7.3					*	*	*
Copper	9.52	19.5		19.8	66.1	21.2	*	*	*

Table 3-7
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPS A7TPS1 12-Nov-93 0 feet	A7TPS A7TPS2 12-Nov-93 2 feet	A7TPS A7TPS3 12-Nov-93 4 feet	A7TPT A7TPT1 12-Nov-93 0 feet	A7TPT A7TPT2 12-Nov-93 2 feet	A7TPT A7TPT3 12-Nov-93 4 feet
Iron	12806.69	28000			16000	22000	*	*	*
Lead	51.43	110	300	330	520		*	*	*
Magnesium	1793.60	5060		2410	2720	4730	*	*	*
Manganese	263.70	1100			320		*	*	*
Mercury	0.10	0.318	10	0.372			*	*	*
Nickel	9.32	23.2	300	14.2	13.9	10.6	*	*	*
Potassium	450.60	700		1130	1190	4220	*	*	*
Vanadium	27.08	51.2		145	33.8	40.1	*	*	*
Zinc	33.91	85.8	2500	136	107	49.5	*	*	*

Table 3-8
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B1 A7SB1A 13-Mar-92 4 feet	A7B2 A7SB2B 11-May-92 2 feet	A7B3 A7SB3B 11-May-92 2 feet	A7B4 A7SB4B 12-May-92 4 feet	A7B5 A7SB5B 12-May-92 4 feet	A7B6 A7SB6B 12-May-92 6 feet
VOCs:									
Acetone	0.03	0.046	3			0.027			
Chloroform			0.1						
Methylene chloride	0.01	0.018	0.1	0.012	0.023	0.019			
Tetrachloroethylene			0.5						
BNAs:									
2-Methylnaphthalene			0.7						
Benzo(a)pyrene			0.7				0.85		
Benzo(b)fluoranthene			0.7				1.2		
Di-n-butyl phthalate	3.80	9						10 S	
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004					0.125		
Chlordane, gamma	0.019	0.005					0.167		
Chlordane, total	0.023	0.009	1				0.292		
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1				0.0278		
Heptachlor epoxide	0.004	0.006	0.06				0.016		
Lindane	0.019	0.004	0.1				0.294		
ppDDD	0.019	0.063	2				1.02	0.0282	0.0513
ppDDE	0.039	0.139	2				0.172		0.0467
ppDDT	0.066	0.23	2				2.15		0.104
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30					10	11
Barium	21.60	54.7		43.7	22.6	28.6	21.9		29.8
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30	0.785			0.974	0.774	
Calcium	554.02	1170						604	
Chromium	18.67	62.5	1000				19.4		
Cobalt	3.47	7.3							
Copper	9.52	19.5		15		9.79	14.7	10.2	
Iron	12806.69	28000		16000					
Magnesium	1793.60	5060		3190	2440	2190	1840	2630	
Manganese	263.70	1100							
Mercury	0.10	0.318	10				0.859		
Nickel	9.32	23.2	300						
Potassium	450.60	700		2910	1740	1610	1220	1340	
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500				60.2		

Table 3-8
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A7-7 A7SB7A 12-Mar-92 2 feet	OHM-A7-7A A7SB7AA 14-May-92 4 feet	A7B7 A7SB7B 12-May-92 6 feet	OHM-A7-8 A7SB8A 12-Mar-92 8 feet	A7B8 A7SB8B 11-May-92 4 feet	A7B9 A7SB9B 12-May-92 4 feet
VOCs:									
Acetone	0.03	0.046	3						
Chloroform			0.1				0.3		
Methylene chloride	0.01	0.018	0.1	0.0086					
Tetrachloroethylene			0.5				0.6		
BNAs:									
2-Methylnaphthalene			0.7					1.8	
Benzo(a)pyrene			0.7						
Benzo(b)fluoranthene			0.7						
Di-n-butyl phthalate	3.80	9							
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005							
Chlordane, total	0.023	0.009	1						
Dieldrin	0.010	0.023	0.03				0.0192		
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06						
Lindane	0.019	0.004	0.1				0.51		
ppDDD	0.019	0.063	2				2.6	64	
ppDDE	0.039	0.139	2				0.195	1.6 1	
ppDDT	0.066	0.23	2				4.5	49	
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7			22.7	24.8	40.6	44.8	
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30		0.787	0.744		0.819	0.585
Calcium	554.02	1170			737	861	572	923	657
Chromium	18.67	62.5	1000					21.2	
Cobalt	3.47	7.3					5.86	5.02	
Copper	9.52	19.5					22.6	17.1	
Iron	12806.69	28000					14000 X	18000 B	
Magnesium	1793.60	5060		2420	2390	2420	2340	3500	1930
Manganese	263.70	1100							
Mercury	0.10	0.318	10				0.919		
Nickel	9.32	23.2	300	9.7				12.4	
Potassium	450.60	700		869	1760	1780	1560	2750	1460
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500				46.1		

Table 3-8
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B10 A7SB10B 11-May-92 0 feet	A7B11 A7SB11B 14-May-92 2 feet	A7B12 A7SB12B 14-May-92 2 feet	OHM-A7-13 A7SB13A 06-Mar-92 6 feet	A7B16 A7SB16B 12-Nov-93 10 feet	A7B18 A7SB18B 12-Nov-93 4 feet
VOCs:									
Acetone	0.03	0.046	3					*	*
Chloroform			0.1					*	*
Methylene chloride	0.01	0.018	0.1		0.013			*	*
Tetrachloroethylene			0.5					*	*
BNAs:									
2-Methylnaphthalene			0.7					*	*
Benzo(a)pyrene			0.7					*	*
Benzo(b)fluoranthene			0.7					*	*
Di-n-butyl phthalate	3.80	9						*	*
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004				0.91			
Chlordane, gamma	0.019	0.005				1.7			
Chlordane, total	0.023	0.009	1			2.61			
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06			0.055			
Lindane	0.019	0.004	0.1						
ppDDD	0.019	0.063	2					0.0231	0.228
ppDDE	0.039	0.139	2			0.12 1			0.0639
ppDDT	0.066	0.23	2			0.16			1.4
Metals:									
Aluminum	10834.98	18000				18000 B		*	*
Arsenic	8.95	17	30					*	*
Barium	21.60	54.7		42.5	45.5	89.3	40.1	*	*
Beryllium	0.30	0.638	0.4			0.355		*	*
Cadmium	0.56	1.79	30	0.572	1.25	3.06	0.822	*	*
Calcium	554.02	1170				771		*	*
Chromium	18.67	62.5	1000		20.2	35.9	20.5	*	*
Cobalt	3.47	7.3			4.06 7	11.9		*	*
Copper	9.52	19.5		10.1	18.1	31.2	14.3	*	*
Iron	12806.69	28000				16000 B	17000	*	*
Magnesium	1793.60	5060		3160	3280	6670	3640	*	*
Manganese	263.70	1100				480		*	*
Mercury	0.10	0.318	10			0.621		*	*
Nickel	9.32	23.2	300		10.7	16.5		*	*
Potassium	450.60	700		3070	3180	6720	3510	*	*
Vanadium	27.08	51.2				63.4	30.7	*	*
Zinc	33.91	85.8	2500			260		*	*

Table 3-8
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B19 A7SB19B 12-Nov-93 4 feet	OHM-A7-45 A7SB45A 11-May-92 6 feet	OHM-A7-46 A7SB46A 08-May-92 8 feet	OHM-A7-51 A7SB51B 28-Oct-93 8 feet	A7HA1 A7HA1A 11-Aug-92 1.5 feet	A7HA1 DUPHA01A 11-Aug-92 1.5 feet
VOCs:									
Acetone	0.03	0.046	3	*					
Chloroform			0.1	*					
Methylene chloride	0.01	0.018	0.1	*	0.026	0.023			
Tetrachloroethylene			0.5	*					
BNAs:									
2-Methylnaphthalene			0.7	*					
Benzo(a)pyrene			0.7	*					
Benzo(b)fluoranthene			0.7	*					
Di-n-butyl phthalate	3.80	9		*					
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005							
Chlordane, total	0.023	0.009	1						
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06						
Lindane	0.019	0.004	0.1						
ppDDD	0.019	0.063	2	1.2					
ppDDE	0.039	0.139	2	0.0646					
ppDDT	0.066	0.23	2	3.8					
Metals:									
Aluminum	10834.98	18000		*			11000	13000	
Arsenic	8.95	17	30	*	12				
Barium	21.60	54.7		*			61.3	58.2	30 D
Beryllium	0.30	0.638	0.4	*			0.517		
Cadmium	0.56	1.79	30	*				3.73	3.34 D
Calcium	554.02	1170		*	585		568	600	
Chromium	18.67	62.5	1000	*			26.9	27.7	20.2 D
Cobalt	3.47	7.3		*			3.67	5.29	3.9 D
Copper	9.52	19.5		*			18.8	30.9	15.4 D
Iron	12806.69	28000		*			18000	18000	15000 D
Magnesium	1793.60	5060		*		1920	3910	4400	3310 D
Manganese	263.70	1100		*					
Mercury	0.10	0.318	10	*					
Nickel	9.32	23.2	300	*			12.3	11	11 D
Potassium	450.60	700		*	753	1070	2960	3970	2070 D
Vanadium	27.08	51.2		*			29.9	46.4	
Zinc	33.91	85.8	2500	*			39.6		

Table 3-8
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7HA2 A7HA2A 11-Aug-92 1 foot
VOCs:				
Acetone	0.03	0.046	3	
Chloroform			0.1	
Methylene chloride	0.01	0.018	0.1	
Tetrachloroethylene			0.5	
BNAs:				
2-Methylnaphthalene			0.7	
Benzo(a)pyrene			0.7	
Benzo(b)fluoranthene			0.7	
Di-n-butyl phthalate	3.80	9		
PCB/Pesticides:				
Chlordane, alpha	0.004	0.004		
Chlordane, gamma	0.019	0.005		
Chlordane, total	0.023	0.009	1	
Dieldrin	0.010	0.023	0.03	
Heptachlor	0.009	0.002	0.1	
Heptachlor epoxide	0.004	0.006	0.06	
Lindane	0.019	0.004	0.1	
ppDDD	0.019	0.063	2	
ppDDE	0.039	0.139	2	
ppDDT	0.066	0.23	2	
Metals:				
Aluminum	10834.98	18000		
Arsenic	8.95	17	30	
Barium	21.60	54.7		37
Beryllium	0.30	0.638	0.4	
Cadmium	0.56	1.79	30	3.13
Calcium	554.02	1170		583
Chromium	18.67	62.5	1000	20.1
Cobalt	3.47	7.3		4.88
Copper	9.52	19.5		19.6
Iron	12806.69	28000		14000
Magnesium	1793.60	5060		3600
Manganese	263.70	1100		
Mercury	0.10	0.318	10	
Nickel	9.32	23.2	300	11.4
Potassium	450.60	700		2200
Vanadium	27.08	51.2		
Zinc	33.91	85.8	2500	

Table 3-9
Area A7
Summary of Compounds Exceeding ESAT Soil Criteria
Hand Auger Samples (ug/g)

Analyte	ESAT Soil	A7HA1 A7HA1A 11-Aug-92 1.5 feet
Metals:		
Arsenic	4.8	6.35

Table 3-10
Area A7
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A7-8 A7GW8A 25-Jun-92 Filtered met	OHM-A7-8 A7GW8B 04-Nov-92 Filtered met	OHM-A7-8 A7GW8C1 01-Dec-93 Unfilt. pest	OHM-A7-9 A7GW9A 03-Oct-91 Filtered met	OHM-A7-9 A7GW9C 05-Nov-92 Filtered met	OHM-A7-10 A7GW10A 03-Oct-91 Filtered met	OHM-A7-10 A7GW10B 25-Jun-92 Filtered met
VOCs:										
1,1,2,2-Tetrachloroethane			2							
1,1,2-Trichloroethane	5		5			7.2 S				
Acetone			3000			9000 S				
Carbon tetrachloride	5		5			16 S				
Chloroform	100		5	24	5.4	300 S				
Methylene chloride	5		5				7.45		7.65	
Tetrachloroethylene	5		5	13	15	38 S				
Trichloroethylene	5		5							
BNAs:										
Bis(2-ethylhexyl) phthalate	6		6							
PCB/Pesticides:										
Dieldrin			0.1							
Lindane	0.2		0.2	1.1	1.26	0.49				
ppDDD			0.1	0.203	0.445	0.232				
Metals:										
Aluminum		50				*	121		640	
Iron		300		534	2540	*			680	
Lead	15		15			*				
Manganese		50		164	221	*	63.8	110	66.2	58

Table 3-10
Area A7
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A7-11 A7GW11A 03-Oct-91 Filtered met	OHM-A7-11 A7GW11B 25-Jun-92 Filtered met	OHM-A7-11 A7GW11C 05-Nov-92 Filtered met	OHM-A7-12 A7GW12A 03-Oct-91 Filtered met	OHM-A7-12 A7GW12B 25-Jun-92 Filtered met	OHM-A7-13 A7GW13A 25-Jun-92 Filtered met	OHM-A7-13 A7GW13B 03-Nov-92 Filtered met
VOCs:										
1,1,2,2-Tetrachloroethane			2							
1,1,2-Trichloroethane	5		5							
Acetone			3000							
Carbon tetrachloride	5		5							
Chloroform	100		5							
Methylene chloride	5		5	8.43	6.5		7.94		5.6	
Tetrachloroethylene	5		5							
Trichloroethylene	5		5							
BNAs:										
Bis(2-ethylhexyl) phthalate	6		6							12
PCB/Pesticides:										
Dieldrin			0.1							
Lindane	0.2		0.2							
ppDDD			0.1							
Metals:										
Aluminum		50								
Iron		300								
Lead	15		15					18.7		
Manganese		50		59.3	114	56.7	57		93.6	270

Table 3-10
Area A7
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A7-45 A7GW45A 25-Jun-92 Filtered met	OHM-A7-46 A7GW46A 25-Jun-92 Filtered met	OHM-A7-46 A7GW46B 05-Nov-92 Not applic	OHM-A7-46 A7GW46C1 01-Dec-93 Unfilt pest	OHM-A7-46 A7GW46C2 01-Dec-93 Filtered pest	OHM-A7-51 A7GW51A1 01-Dec-93 Unfilt pest	OHM-A7-51 A7GW51A2 01-Dec-93 Filtered pest
VOCs:										
1,1,2,2-Tetrachloroethane			2				*	*	200 S	*
1,1,2-Trichloroethane	5		5				*	*		*
Acetone			3000				*	*		*
Carbon tetrachloride	5		5				*	*		*
Chloroform	100		5				*	*	120 S	*
Methylene chloride	5		5				*	*		*
Tetrachloroethylene	5		5		12	5.1	*	*	130 S	*
Trichloroethylene	5		5				*	*	50 S	*
BNAs:										
Bis(2-ethylhexyl) phthalate	6		6			*	*	*		*
PCB/Pesticides:										
Dieldrin			0.1	0.101		*				
Lindane	0.2		0.2		2.8 X	*	3.1 1	2.8 1	3.5 1	3.6 1
ppDDD			0.1			*				
Metals:										
Aluminum		50				*	*	*	*	*
Iron		300				*	*	*	*	*
Lead	15		15			*	*	*	*	*
Manganese		50		58	313	*	*	*	*	*

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-8 A7GW8A 25-Jun-92 Filtered metals	OHM-A7-8 A7GW8B 04-Nov-92 Filtered metals	OHM-A7-8 A7GW8C1 01-Dec-93 Unfiltered pest	OHM-A7-9 A7GW9A 03-Oct-91 Filtered metals	OHM-A7-9 A7GW9B 25-Jun-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4			16 S		
Tetrachloroethylene		840		8.85	13	15	38 S		
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013		0.029 1	0.03 1		
Chlordane, total			0.0043	0.00059	0.032	0.032			
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011		0.0134			
Lindane			0.08	0.063	1.1	1.26	0.49		
ppDDD				0.00084	0.203	0.445	0.232		
ppDDT			0.001	0.00059		0.0761			
Metals:									
Aluminum	400	87					*	121	
Arsenic	3.15		190	0.14		2.98	*		
Calcium	8520					9050	*	9900	12000
Chromium	3.16	11	11				*		
Copper	10	3.6	3.6				*	4.56	
Lead	10.3	0.55	0.55			5.96	*		
Magnesium	1890					2800	*	2600	2400
Manganese	156				164	221	*		
Mercury		0.012	0.012	0.15			*		
Potassium	2060				3580	3210	*	4000 T	3600
Vanadium	4.72						*		
Zinc	13.3	33	33		91.9	68.8	*	24.6	20.1

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-9 A7GW9C 05-Nov-92 Filtered metals	OHM-A7-10 A7GW10A 03-Oct-91 Filtered metals	OHM-A7-10 A7GW10B 25-Jun-92 Filtered metals	OHM-A7-10 A7GW10C 04-Nov-92 Filtered metals	OHM-A7-11 A7GW11A 03-Oct-91 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					0.011 U
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063					
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87				640			
Arsenic	3.15		190	0.14					
Calcium	8520				11600				19000
Chromium	3.16	11	11						5.27
Copper	10	3.6	3.6		7.29	8.54			
Lead	10.3	0.55	0.55		4.35		3.2	4.11	
Magnesium	1890				2740				4700
Manganese	156								
Mercury		0.012	0.012	0.15					
Potassium	2060				3600	2080 T	2810		4900 T
Vanadium	4.72					5.09			
Zinc	13.3	33	33		24.7			20	

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-11 A7GW11B 25-Jun-92 Filtered metals	OHM-A7-11 A7GW11C 05-Nov-92 Filtered metals	OHM-A7-12 A7GW12A 03-Oct-91 Filtered metals	OHM-A7-12 A7GW12B 25-Jun-92 Filtered metals	OHM-A7-12 A7GW12C 04-Nov-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063					
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					
Calcium	8520				21200	24100			
Chromium	3.16	11	11						
Copper	10	3.6	3.6				7.02		
Lead	10.3	0.55	0.55		2.19	4.57	6.99	18.7	4.26
Magnesium	1890				5080	4990			
Manganese	156								
Mercury		0.012	0.012	0.15					
Potassium	2060				4880	4950		2610	
Vanadium	4.72								
Zinc	13.3	33	33			17.6			16.7

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-13 A7GW13A 25-Jun-92 Filtered metals	OHM-A7-13 A7GW13B 03-Nov-92 Filtered metals	OHM-A7-45 A7GW45A 25-Jun-92 Filtered metals	OHM-A7-45 A7GW45B 05-Nov-92 Filtered metals	OHM-A7-46 A7GW46A 25-Jun-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					12
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9		12			
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					0.269
Chlordane, total			0.0043	0.00059			0.0637		
Dieldrin			0.0019	0.00014			0.101		
Endrin		0.0023	0.0023	0.81			0.144		0.0627
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011			0.171		
Lindane			0.08	0.063					2.8 X
ppDDD				0.00084					
ppDDT			0.001	0.00059			0.0374		
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					
Calcium	8520					9510			
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Lead	10.3	0.55	0.55		1.9	2.88	2.7		2.68
Magnesium	1890					2090			
Manganese	156					270			313
Mercury		0.012	0.012	0.15	0.205				
Potassium	2060				3210	5920	3170	2120	5620
Vanadium	4.72								
Zinc	13.3	33	33			35.1	15.7	18.9	

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-46 A7GW46C1 01-Dec-93 Unfiltered pest	OHM-A7-46 A7GW46C2 01-Dec-93 Filtered pest	OHM-A7-51 A7GW51A1 01-Dec-93 Unfiltered pest	OHM-A7-51 A7GW51A2 01-Dec-93 Filtered pest	OHM-A7-52 A7GW52A1 01-Dec-93 Unfiltered pest
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11	*	*	200 S	*	*
Carbon tetrachloride				4.4	*	*		*	*
Tetrachloroethylene		840		8.85	*	*	130 S	*	*
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9	*	*		*	*
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013	0.143	0.149			
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063	3.1 1	2.8 1	3.5 1	3.6 1	0.0669
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87			*	*	*	*	*
Arsenic	3.15		190	0.14	*	*	*	*	*
Calcium	8520				*	*	*	*	*
Chromium	3.16	11	11		*	*	*	*	*
Copper	10	3.6	3.6		*	*	*	*	*
Lead	10.3	0.55	0.55		*	*	*	*	*
Magnesium	1890				*	*	*	*	*
Manganese	156				*	*	*	*	*
Mercury		0.012	0.012	0.15	*	*	*	*	*
Potassium	2060				*	*	*	*	*
Vanadium	4.72				*	*	*	*	*
Zinc	13.3	33	33		*	*	*	*	*

Table 3-11
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-52 A7GW52A2 01-Dec-93 Filtered pest
VOCs:					
1,1,2,2-Tetrachloroethane		2400		11	*
Carbon tetrachloride				4.4	*
Tetrachloroethylene		840		8.85	*
BNAs:					
Bis(2-ethylhexyl) phthalate		360		5.9	*
PCB/Pesticides:					
Benzene hexachloride, alpha				0.013	
Chlordane, total			0.0043	0.00059	
Dieldrin			0.0019	0.00014	
Endrin		0.0023	0.0023	0.81	
Heptachlor		0.0038	0.0038	0.00021	
Heptachlor epoxide		0.0038	0.0038	0.00011	
Lindane			0.08	0.063	0.0793
ppDDD				0.00084	
ppDDT			0.001	0.00059	
Metals:					
Aluminum	400	87			*
Arsenic	3.15		190	0.14	*
Calcium	8520				*
Chromium	3.16	11	11		*
Copper	10	3.6	3.6		*
Lead	10.3	0.55	0.55		*
Magnesium	1890				*
Manganese	156				*
Mercury		0.012	0.012	0.15	*
Potassium	2060				*
Vanadium	4.72				*
Zinc	13.3	33	33		*

Table 3-12
Detections of Methylene Chloride in Analytical Lot VGM

Site ID	OHM-A7-9	OHM-A7-10	OHM-A7-11	OHM-A7-12	OHM-BW-1	OHM-BW-2	OHM-BW-3	OHM-BW-1	TRIP BLANK	TRIP BLANK
Field Sample No.	A7GW9A	A7GW10A	A7GW11A	A7GW12A	BKGGW01A	BKGGW02A	BKGGW03A	RSBGW01A	TRPGW00A	TRPGW02A
Sample Date	03-Oct-91	03-Oct-91	03-Oct-91	03-Oct-91	01-Oct-91	02-Oct-91	02-Oct-91	01-Oct-91	02-Oct-91	03-Oct-91
Methylene chloride	7.45	7.65	8.43	7.94	8.92	13.7	11.8	8.04	9.12	9.31

Table 3-13
Areas A7 and P9
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A7SW1 A7SW1A 04-May-92 0 feet	A7SW2 A7SW2A 04-May-92 0 feet	A7SW3 A7SW3B 02-Nov-93 0 feet	A7SW3 DUPSW01C 02-Nov-93 0 feet	P9SW1 P9SW1A 29-Apr-92 0 feet	E3-BCK-D03 WXBCK031 17-Sept-93 0 feet
Metals:										
Aluminum	400	87				650	140	152 D		
Arsenic	3.15		190	0.14		9.44				1.52 J
Calcium	8520						13100	12200 D		8760
Lead	10.3	0.55	0.55		2.58	5.31			2.03	1.04 J
Magnesium	1890							1910 D		1950
Manganese	156					261	194	208 D		
Potassium	2060						2260	2260 D		4460
Zinc	13.3	33	33		15.8 B	18.1 B	600 B	497 B		17.3 J

Table 3-14
Areas A7 and P9
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Max Bkgrnd	ESAT Sed Value	A7SD1 A7SD1A 04-May-92 0.25 feet	A7SD2 A7SD2A 04-May-92 2 feet	A7SD3 A7SD3B 02-Nov-93 0.5 feet	A7SD3 DUPSD01C 02-Nov-93 0.5 feet	P9SD1 P9SD1A 29-Apr-92 0.5 feet	P9SD2 P9SD2A 29-Apr-92 0.5 feet
PCB/Pesticides:								
Chlordane, total		0.0005						0.287 1
ppDDD		0.002						0.0182
ppDDE		0.002						
ppDDT		0.001						0.0143
Metals:								
Aluminum	5020			15000 B	9020	9370 D	5400 B	
Arsenic	2.03	6	14	12	28	35 D	11	10
Barium	23.9	20	21.2	27.2	66.4	68.4 D	34.1	
Beryllium	0.18			0.379				
Calcium	562		663		5690	5370 D	702	895
Chromium	9.66	26		17.2	14.2	15.2 D	11.3	
Cobalt	3.74		5.27	11.6				
Copper	6.33	16		17				7.7
Iron	7590		11000 B	16000 B	14000	17000 D	11000 B	11000 B
Lead	4.48	31	12	6.1	12	16 D	5.9	11
Magnesium	2140			2230				
Manganese	70.5		1900	99.4	460	529 D	170	130
Nickel	5.92	16	7.75	25.7			6.14	7.6
Potassium	1520						1900	
Selenium	0.2	1			2.4	2.2 D		
Vanadium	17			17.9	17.3	20.2 D	17.4	
Zinc	20.8	120	23.6	29.9	44	50.8 D	27.3	21.4

Table 3-14
Areas A7 and P9
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Max Bkgrnd	ESAT Sed Value	P9SD3 P9SD3A 30-Apr-92 0.5 feet	P9SD4 P9SD4A 29-Apr-92 0.5 feet	E3-BCK-D03 DXBCK031 17-Sept-93 0 feet	SED8 10-Oct-84 0.49 feet
PCB/Pesticides:						
Chlordane, total		0.0005	0.085			
ppDDD		0.002	0.0152 1			
ppDDE		0.002	0.0156 1		0.038	
ppDDT		0.001	0.0155		0.003	
Metals:						
Aluminum	5020		5700 B	8300 B		
Arsenic	2.03	6	2.66	3.94	2.95	30
Barium	23.9	20	29.1	34.3		
Beryllium	0.18					
Calcium	562		1190			
Chromium	9.66	26	16.1	18.8		
Cobalt	3.74				4.81	
Copper	6.33	16	9.39	10.2	13.1 L	
Iron	7590		11000 B	13000 B	9030	
Lead	4.48	31	13	8.9	18 J	15.5
Magnesium	2140		2840	3230		
Manganese	70.5		110	140	108	
Nickel	5.92	16	10.1	9.61	7.8	
Potassium	1520		1800	2360		
Selenium	0.2	1				
Vanadium	17		17.5	20.5		
Zinc	20.8	120	25.4	22.9	28.3 J	32.4

Table 3-15
Assabet River
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	FWISW14 FWISW14A 13-May-92 0 feet	FWISW15 FWISW15A 13-May-92 0 feet	FWISW16 FWISW16A 13-May-92 0 feet	FWISW16 DUPSW05A 13-May-92 0 feet
BNAs:								
Bis(2-ethylhexyl) phthalate		360		5.9	200	28		6.9 1
Metals:								
Calcium	8520				13600		12800	13200 D
Lead	10.3	0.55	0.55		2.92 B	3.68 B	2.47 B	2.77 B
Magnesium	1890				2210		2120	2180 D
Potassium	2060				3130		2710	2870 D
Sodium	14000				27100		24800	25500 D

Table 3-16
Assabet River
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	FWISD14 FWSD14A1 13-May-92 0 feet	FWISD14 FWSD14A2 13-May-92 1 foot	FWISD14 FWSD14A3 13-May-92 3 feet	FWISD15 FWSD15A1 13-May-92 0 feet	FWISD15 FWSD15A2 13-May-92 1 foot	FWISD15 FWSD15A3 13-May-92 3 feet	FWISD16 FWSD16A1 13-May-92 0 feet
BNAs:									
Benzo(a)pyrene		0.4	1.4						
PCB/Pesticides:									
Chlordane, total		0.0005				0.0497	0.356		
PCBs, total		0.05						0.49 T	
ppDDD		0.002					0.254	0.0885	
ppDDE		0.002					0.112		
ppDDT		0.001					0.0763		
Metals:									
Aluminum	5020		6800 B	8100 B	5500 B	13000 B	11000 B	12000 B	13000 B
Arsenic	2.03	6	18	88	34	140	120	140	20
Barium	23.9	20	26.7	175	28.8	107	88.2	97.1	28.5
Cadmium	0.5	0.6	0.664	1.61	0.92	4.46	2.47	3.48	
Calcium	562		781	669		7690	6900	6630	1000
Chromium	9.66	26	17.5	16.7	13		24.6	24.1	20.2
Cobalt	3.74		4.13 7	320 B	33.9 7		15.5 7	20.5 7	
Copper	6.33	16		21.4	11.2	28.1	26.5	29.2	9.5
Iron	7590		7800 B	9700 B	14000 B	42000 B	35000 B	36000 B	16000 B
Lead	4.48	31				8.2	5.42		
Magnesium	2140		2500	2520					
Manganese	70.5		160	3500	700	1100	990	800	157
Mercury		0.15				0.414	0.372	0.438	
Nickel	5.92	16	16.4	101	22.2	26.3	31.5	31.1	11.2
Potassium	1520			1530					
Vanadium	17					22.8	20.8	24.9	21.4
Zinc	20.8	120	23.2	56.8	27	248	183	237	34.8

Table 3-16
Assabet River
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	FWISD16 DUPSD05A 13-May-92 0 feet	FWISD16 FWSD16A2 13-May-92 1 foot	FWISD16 FWSD16A3 13-May-92 3 feet
BNAs:					
Benzo(a)pyrene		0.4			
PCB/Pesticides:					
Chlordane, total		0.0005			
PCBs, total		0.05			
ppDDD		0.002			
ppDDE		0.002			
ppDDT		0.001			
Metals:					
Aluminum	5020		17000 B		15000 B
Arsenic	2.03	6	19 D	25	12
Barium	23.9	20	31.4 D	49	36.4
Cadmium	0.5	0.6	1.13 D	1.3	
Calcium	562		1310 D	2020	770
Chromium	9.66	26	29.1 D	41.1	25.9
Cobalt	3.74		7.33 7	11.8 7	7.18 7
Copper	6.33	16	14.7 D	23.3	9.91
Iron	7590		15000 B	21000 B	11000 B
Lead	4.48	31			
Magnesium	2140		2410 D	3430	3000
Manganese	70.5		208 D	288	138
Mercury		0.15	0.23 D	0.246	
Nickel	5.92	16	16.9 D	22.7	25.1
Potassium	1520				
Vanadium	17		25.5 D	34.9	20.3
Zinc	20.8	120	85.3 D	118	82.1

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TABLE 4-1 - PHASE II SAMPLING - AREA A9

Site ID	Sample Number	Sampling Media	Analytical Parameters
A9HA5	A9HA5B	Subsurface soil (hand auger)	Metals
A9HA6	A9HA6B	Subsurface soil (hand auger)	Metals
A9HA7	A9HA7B	Subsurface soil (hand auger)	Metals
A9HA8	A9HA8B	Subsurface soil (hand auger)	Metals
A9B10	A9SB10B	Subsurface soil (boring)	Metals
A9B11	A9SB11B	Subsurface soil (boring)	Metals
OHM-A9-53	A9SB53B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
OHM-A9-54	A9SB54B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
OHM-A9-55	A9SB55B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
OHM-A9-56	A9SB56B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
OHM-A9-57	A9SB57B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
OHM-A9-58	A9SB58B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, Expl, TOC
OHM-BW-5	FWSB5B	Subsurface soil (well)	BNA, VOC, Metals, PCB/Pest, OP Pest, TOC
A9SO7	A9SO7B	Surface soil	Metals
A9SO8	A9SO8B	Surface soil	Metals
A9SO9	A9SO9B	Surface soil	Metals
A9SO10	A9SO10B	Surface soil	Metals
DM8	DMGW8C	Groundwater	BNA, VOC, Metals TOT, PCB/Pest, OP Pest
DM9A	DMGW9AC	Groundwater	BNA, VOC, Metals TOT, PCB/Pest, OP Pest
OHM-A9-47	A9GW47C	Groundwater	BNA, VOC, Metals TOT, PCB/Pest, OP Pest
OHM-A9-53	A9GW53A	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest
OHM-A9-54	A9GW54A	Groundwater	BNA, VOC, Metals, OP Pest
OHM-A9-55	A9GW55A	Groundwater	BNA, VOC, Metals, OP Pest
OHM-A9-56	A9GW56A,B	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest
OHM-A9-57	A9GW57A,B	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest
OHM-A9-58	A9GW58A	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest
OHM-BW-5	FWGW5A	Groundwater	BNA, VOC, Metals, PCB/Pest, OP Pest

TABLE 4-2
AREA A9
CHEMICAL RESULTS FROM PRIOR SOIL SAMPLING EVENTS

	SAMPLE NO.	SS3	1	2	3	4	5	6	7	8	8	9	9
	COMPANY	D&M	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI
	DEPTH	surf	surf	surf	surf	surf	surf	surf	surf	surf	0.5 ft	surf	0.5 ft
ANALYSIS	Soil pH	** (1)	4.63	4.66	4.77	4.73	4.87	4.85	4.35	6.2	6.36	4.68	4.17
(units)	Oil/Grease (mg/kg)	300	149	57.8	-- (2)	--	167	12831	12883	111676	63045	12779	745
EP TOX METALS (mg/L)	Arsenic	**	--	--	--	--	--	--	--	--	--	--	--
	Barium	**	0.09	--	--	--	--	--	--	--	--	--	--
	Cadmium	**	--	--	--	--	--	--	--	--	0.09	--	--
	Lead	**	--	--	--	--	--	--	--	--	--	--	--
	Mercury	**	0.0004	--	--	--	--	--	--	0.0002	--	--	--
	Selenium	**	--	--	--	--	--	--	--	--	--	--	--
PCBs (mg/kg)	PCB-1221	**	--	--	--	--	--	--	--	13.38	19.197	5.588	1.625
	PCB-1242	**	0.07	0.0648	0.123	0.154	0.1785	0.521	0.334	4.13	0.960	0.68	0.052
	PCB-1248	**	0.084	--	--	--	--	--	--	--	--	--	--
	PCB-1254	**	0.0132	--	0.0023	0.007	0.0039	0.343	--	5.40	--	--	0.002
	PCB-1260	**	0.0023	0.0216	--	--	--	0.261	0.278	--	--	--	--
	PCBs, total	**	0.17	0.087	0.125	0.161	0.1824	1.125	0.612	22.91	20.157	6.268	1.679
VOCs (mg/kg)	Benzene	**	--	--	--	--	--	--	--	1.54	3.45	--	--
	1,1-Dichloroethane	**	--	--	--	--	--	--	--	5.90	8.28	--	--
	Methylene chloride	**	0.04	0.05	0.05	0.05	0.04	0.10	0.02	0.12	0.07	0.08	0.02
	Toluene	**	--	0.14	--	--	0.04	0.02	0.20	39.2	25	0.09	0.08
	1,1,1-Trichloroethane	**	0.97	0.47	--	--	0.133	--	0.77	71.0	72	0.89	1.72
BNAs (ug/g)	Benzo(a)anthracene	0.3	**	**	**	**	**	**	**	**	**	**	**
	Benzo(a)pyrene	0.4	**	**	**	**	**	**	**	**	**	**	**
	Benzo(k)fluoranthene	0.4	**	**	**	**	**	**	**	**	**	**	**
	Bis(2-ethylhexyl)phthalate	8	**	**	**	**	**	**	**	**	**	**	**
	Di-n-butylphthalate	0.5	**	**	**	**	**	**	**	**	**	**	**
	2,2,4,4,7,7-Hexamethyl-octahydro-1H-indene	0.4	**	**	**	**	**	**	**	**	**	**	**
	Hydrocarbons, total	0.4	**	**	**	**	**	**	**	**	**	**	**
	Pyrene	0.1	**	**	**	**	**	**	**	**	**	**	**
	Unknowns (total)	1.3	**	**	**	**	**	**	**	**	**	**	**

Notes: (1) ** = Not analyzed for this compound
(2) = Analyzed for but not detected

	SAMPLE NO.	10	10	11	11	12	13	13	14	14	15	15	16
	COMPANY	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI
	DEPTH	surf	1.0 ft	surf	0.67 ft	surf	surf	1.0 ft	surf	1.0 ft	surf	1.0 ft	surf
ANALYSIS	Soil pH	4.80	4.68	5.48	6.48	5.23	4.65	5.31	5.03	4.86	4.65	5.29	5.18
(units)	Oil/Grease (mg/kg)	3904	--	76379	29794	307	3684	814	172	167	39885	186	70.8
EP TOX	Arsenic	--	--	--	--	--	--	--	--	--	--	--	--
METALS	Barium	--	0.06	--	--	--	--	--	--	--	--	--	--
(mg/L)	Cadmium	--	--	--	--	--	--	--	--	--	0.04	--	--
	Lead	--	--	--	0.08	--	--	--	--	--	--	--	--
	Mercury	--	--	0.0005	--	0.0004	--	--	0.0003	0.0011	0.0004	--	--
	Selenium	--	--	--	0.007	--	--	--	--	--	--	--	--
PCBs	PCB-1221	1.148	0.053	--	--	0.717	2.232	--	0.174	--	--	--	0.517
(mg/kg)	PCB-1242	0.222	0.119	1.267	0.674	0.222	0.427	3.46	0.183	0.156	0.009	0.016	0.197
	PCB-1248	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-1254	0.212	0.003	0.073	0.007	0.006	0.171	0.004	--	0.003	0.086	--	0.005
	PCB-1260	0.150	--	--	--	--	1.330	--	--	--	--	--	--
	PCBs, total	1.732	0.175	1.34	0.681	0.945	4.16	3.464	0.357	0.159	0.095	0.016	0.719
VOCs	Benzene	--	--	2.49	2.76	--	--	--	0.03	0.03	--	--	--
(mg/kg)	1,1-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	0.16
	Methylene chloride	0.08	0.10	0.23	0.20	0.17	0.11	0.15	0.06	0.11	0.04	0.03	0.08
	Toluene	0.36	0.41	2.78	3.88	--	0.14	0.19	0.03	0.05	--	--	0.36
	1,1,1-Trichloroethane	1.10	0.95	67.0	61.0	--	--	--	0.10	0.14	--	--	1.10
BNAs	Benzo(a)anthracene	**	**	**	**	**	**	**	**	**	**	**	**
(ug/g)	Benzo(a)pyrene	**	**	**	**	**	**	**	**	**	**	**	**
	Benzo(k)fluoranthene	**	**	**	**	**	**	**	**	**	**	**	**
	Bis(2-ethylhexyl)phthalate	**	**	**	**	**	**	**	**	**	**	**	**
	Di-n-butylphthalate	**	**	**	**	**	**	**	**	**	**	**	**
	2,2,4,4,7,7-Hexamethyl-octahydro-1H-indene	**	**	**	**	**	**	**	**	**	**	**	**
	Hydrocarbons, total	**	**	**	**	**	**	**	**	**	**	**	**
	Pyrene	**	**	**	**	**	**	**	**	**	**	**	**
	Unknowns (total)	**	**	**	**	**	**	**	**	**	**	**	**

	SAMPLE NO.	17	18	19	20	21	22	23	24	TMI
	COMPANY	TMI	TMI	TMI	TMI	TMI	TMI	TMI	TMI	FIELD
	DEPTH	surf	surf	surf	surf	surf	surf	surf	surf	BLANK
ANALYSIS	Soil pH	4.69	4.65	4.65	4.78	4.66	4.73	4.64	4.85	6.85
(units)	Oil/Grease (mg/kg)	332	305	240	140	104	183	284	390	--
EP TOX	Arsenic	0.001	--	--	--	--	--	--	0.002	--
METALS	Barium	--	--	--	--	--	--	--	--	--
(mg/L)	Cadmium	--	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--	--
	Mercury	--	--	--	--	--	--	--	--	--
	Selenium	--	--	--	--	--	--	--	--	--
PCBs	PCB-1221	--	1.24	0.123	0.304	--	--	--	0.184	--
(mg/kg)	PCB-1242	0.096	0.33	0.094	0.120	0.052	0.017	0.256	0.184	--
	PCB-1248	--	--	--	--	--	--	--	--	--
	PCB-1254	--	0.01	--	0.012	--	--	0.002	0.013	--
	PCB-1260	--	--	--	--	--	--	--	0.046	--
	PCBs, total	0.096	1.58	0.217	0.436	0.052	0.017	0.258	0.427	--
VOCs	Benzene	--	--	--	0.90	--	--	0.04	0.04	--
(mg/kg)	1,1-Dichloroethane	0.31	--	--	--	--	0.18	--	--	--
	Methylene chloride	0.10	0.15	0.09	0.04	0.05	0.05	0.03	0.04	--
	Toluene	0.85	--	--	0.29	--	0.26	0.11	0.08	--
	1,1,1-Trichloroethane	10.0	--	--	0.14	--	0.76	0.35	--	--
BNAs	Benzo(a)anthracene	**	**	**	**	**	**	**	**	**
(ug/g)	Benzo(a)pyrene	**	**	**	**	**	**	**	**	**
	Benzo(k)fluoranthene	**	**	**	**	**	**	**	**	**
	Bis(2-ethylhexyl)phthalate	**	**	**	**	**	**	**	**	**
	Di-n-butylphthalate	**	**	**	**	**	**	**	**	**
	2,2,4,4,7,7-Hexamethyl-octahydro-1H-indene	**	**	**	**	**	**	**	**	**
	Hydrocarbons, total	**	**	**	**	**	**	**	**	**
	Pyrene	**	**	**	**	**	**	**	**	**
	Unknowns (total)	**	**	**	**	**	**	**	**	**

TABLE 4-3
AREA A9
CHEMICAL RESULTS FROM PRIOR GROUNDWATER SAMPLING EVENTS

	MONITORING WELL	DM-8					DM-9A					DM-10				
	COMPANY	D&M	Zecco	Zecco	Zecco	Zecco	D&M	Zecco	Zecco	Zecco	Zecco	D&M	Zecco	Zecco	Zecco	Zecco
	SAMPLING DATE	OCT 1984	SEP 1987	DEC 1987	MAR 1988	JUN 1988	OCT 1984	SEP 1987	DEC 1987	MAR 1988	JUN 1988	OCT 1984	SEP 1987	DEC 1987	MAR 1988	JUN 1988
ANALYSIS (units)	Oil/Grease (ug/L)	20	--	--	**	**	--	--	8000	**	**	--	--	--	**	**
	Hydrocarbons, total (ug/L)	**	--	--	--	--	**	<5000	93700	<1000	9000	**	--	--	--	--
VOCs (ug/L)	Acetone	--	--	--	--	--	(B) 7	--	--	--	--	(B) 3	--	--	--	--
	Carbon tetrachloride	--	--	--	--	5.3	--	--	--	--	--	--	--	--	--	--
	1,1-Dichloroethene	--	--	34	13.8	10	--	--	--	--	--	--	--	--	--	--
	Dimethoxydimethylsilane	--	--	--	--	--	(B) 2	--	--	--	--	(B) 4	--	--	--	--
	Ethyl benzene	--	--	--	--	--	--	--	--	150.6	--	--	--	--	--	--
	Hexamethylcyclotrisiloxane	(B) 6	--	--	--	--	--	--	--	--	--	(B) 8	--	--	--	--
	Methylene chloride	(B) 10	--	--	--	--	(B) 10	--	--	--	--	(B) 20	14	9	--	--
	Toluene	--	--	7	--	--	--	--	24	28.6	12	--	--	--	--	--
	1,1,1-Trichloroethane	300	159	346	125.3	54	--	--	--	--	--	--	--	24	14.3	7.1
	Xylenes, total	--	--	--	--	--	--	--	444	397.6	330	--	--	--	--	--
	Unknowns, total	--	--	--	--	--	700	--	--	--	--	7	--	--	--	--
	VOCs, total	300	159	387	139.1	69.3	700	0	468	576.8	342	7	14	33	14.3	7.1
BNAs (ug/L)	Alchohols (high mol. wts.)	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Bis(2-ethylhexyl)phthalate	1000	--	--	--	--	--	--	--	--	--	30	--	--	--	--
	Dioxtyl adipate	1000	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Ethylbenzene	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
	1-Hydroxy-2,3-methyleneindan	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--
	1-Methylindan	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
	2-Methylnapthalene	--	--	--	1.33	--	--	--	--	9.96	--	--	--	--	--	--
	Napthalene	--	--	--	--	--	10	--	--	33.3	--	--	--	--	--	--
	Phthalates	--	--	--	--	--	--	--	--	--	--	50	--	--	--	--
	Trimethylbenzenes	--	--	--	--	--	200	--	--	--	--	--	--	--	--	--
	Unknowns, total	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--
	Xylene	--	--	--	--	--	100	--	--	--	--	--	--	--	--	--
METALS (ug/L) 13 PP Metals plus Barium	Antimony	**	--	1	--	--	**	--	--	--	--	**	--	--	--	--
	Arsenic	**	11	28	--	--	**	--	--	--	--	**	5	--	--	--
	Barium	**	40	50	--	23	**	--	--	--	7	**	--	--	--	15
	Beryllium	**	--	--	--	--	**	--	--	--	9	**	--	--	--	9
	Cadmium	**	--	1	--	--	**	--	3	--	--	**	--	--	--	--
	Chromium, total	**	12	22	--	--	**	1	3	--	--	**	--	--	--	--
	Copper	**	--	--	--	--	**	50	--	--	--	**	50	--	22	--
	Lead	**	5	11	--	--	**	1	39	--	--	**	2	2	--	--
	Nickel	**	8	35	--	1200	**	--	3	--	1400	**	--	--	--	1100
	Selenium	**	5	--	--	--	**	5	--	--	--	**	--	--	--	--
	Silver	**	--	2	--	--	**	--	7	--	--	**	--	--	--	--
	Thallium	**	--	--	--	--	**	--	--	--	--	**	--	--	75	--
	Zinc	**	80	230	--	--	**	--	--	--	--	**	60	--	--	--
PCB/PEST (ug/L)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTES:
(B) = Compound also present in method blank.
** = Not analyzed for this compound
-- = Not detected

TABLE 4-4
AREA A9
GROUNDWATER DISCHARGE ESTIMATES

AREA A9 - DISCHARGE ESTIMATES

	AQUIFER UNIT	X-SECTION AREA (sq ft)	FLOW VOLUME (1) (cu ft/min/sq ft)	FLOW VOLUME (2) (gal/min)	TOTAL FLOW (gal/min)	FLOW VOLUME (3) (gal/day)	TOTAL FLOW (gal/day)
ENTIRE	UPPER	12674	8.55E-05	8.124	8.519	11,698	12,267
AREA	LOWER	12319	4.27E-06	0.395		569	
CHLOR VOC	UPPER	4410	8.55E-05	2.827	3.017	4,070	4,345
PLUME	LOWER	5950	4.27E-06	0.191		275	
XYLENE	UPPER	6190	8.55E-05	3.968	4.098	5,713	5,902
PLUME	LOWER	4080	4.27E-06	0.131		188	

(1) Flow volume = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
(2) Flow volume = Aquifer unit area (sq ft) x flow volume (cu ft/min/sq ft) x 7.5 gal/cu ft
(3) Flow volume = Flow volume (gal/min) x 1440 min/day

ASSABET RIVER FLOW VOLUMES FROM USGS WATER-DATA REPORT MA-RI-93-1

	FLOW VOLUME (cu ft/sec)	FLOW VOLUME (gal/min)	FLOW VOLUME (gal/day)	TIME PERIOD (water year)
50% flow exceeds	125	56,250	81,000,000	1941-1993
90% flow exceeds	24	10,800	15,552,000	1941-1993
Lowest daily mean	0.20	90	129,600	02 FEB 65

VALUES FOR VARIABLES USED IN CALCULATIONS

UPPER AQUIFER
Hydraulic conductivity K = 0.002393 ft/min
Gradient i = 8 ft/224 ft = 0.0357

Discharge (Q) = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
Q = KiA = (0.0023 ft/min)(0.0357)(1 sq ft) = 0.0000821 cu ft/min

LOWER AQUIFER
Hydraulic conductivity K = 0.0002 ft/min
Gradient i = 5 ft/234 ft = 0.0214

Discharge (Q) = Hydraulic conductivity (K) x gradient (i) x cross-sectional area (1 sq ft)
Q = KiA = (0.0002 ft/min)(0.0214)(1 sq ft) = 0.00000427 cu ft/min

TABLE 4-5
AREA A9
CROSS-SECTIONAL AREAS USED IN DISCHARGE CALCULATIONS

TOTAL AREA A9 DISCHARGE
MAPPED BOUNDARIES OF SITE

UPPER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-17	182	12	2184	12674
MW-17 to MW-18	375	22	8250	
MW-18 to EAST EDGE	70	32	2240	

LOWER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-17	182	22	4004	12319
MW-17 to MW-18	375	19	7125	
MW-18 to EAST EDGE	70	17	1190	

CHLORINATED VOC PLUME
LIMITS - 70 FT WEST OF MW-17 TO 210 FEET EAST

UPPER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-17	70	12	840	4410
MW-17 to EAST EDGE	210	17	3570	

LOWER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-17	70	22	1540	5950
MW-17 to EAST EDGE	210	21	4410	

XYLENES PLUME
LIMITS - EAST EDGE OF VOC PLUME ON WEST, TO 50 FEET EAST OF MW-18

UPPER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-18	170	27	4590	6190
MW-18 to 50 FEET EAST	50	32	1600	

LOWER AQUIFER UNIT

INTERVAL BOUNDARIES	DISTANCE (ft)	SATURATED THICKNESS (ft)	AREA (sq ft)	TOTAL AREA (sq ft)
WEST EDGE to MW-18	170	19	3230	4080
MW-18 to 50 FEET EAST	50	17	850	

Table 4-6
Area A9
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9CD1 A9CD1A 18-May-92 0 feet	A9SO1 A9SO1A 15-Apr-92 0 feet	A9SO2 A9SO2A 15-Apr-92 0 feet	A9SO3 A9SO3A 15-Apr-92 0 feet	A9SO4 A9SO4A 15-Apr-92 0 feet	A9SO5 A9SO5A 15-Apr-92 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1		0.012	0.011			0.011
BNAs:									
Di-n-butyl phthalate	3.80	9					4 S		
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30		46		18		
Barium	21.60	54.7		22.8	22.5	50.6	22.3	28.4	21.9
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30	1.44		0.671			
Calcium	554.02	1170				647			566
Chromium	18.67	62.5	1000	22.7		24.5			
Cobalt	3.47	7.3				6.1			
Copper	9.52	19.5		10.7		10.9		11.2	
Iron	12806.69	28000		13000 B		15000 X			
Lead	51.43	110	300	450					
Magnesium	1793.60	5060		2120	2260	4070	1960	2660	1930
Nickel	9.32	23.2	300			13.9			
Potassium	450.60	700		987	1080	2870	1050	1660	1210
Selenium	0.37	0.571	300						
Sodium	122.50	122							
Thallium			8						
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500		109	95.5	35.1		

Table 4-6
Area A9
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9SO6 A9SO6A 15-Apr-92 0 feet	A9SO7 A9SO7B 15-Nov-93 0 feet	A9SO8 A9SO8B 15-Nov-93 0 feet	A9SO9 A9SO9B 15-Nov-93 0 feet	A9SO10 A9SO10B 15-Nov-93 0 feet
VOCs:								
Methylene chloride	0.008	0.018	0.1	0.01	*	*	*	*
BNAs:								
Di-n-butyl phthalate	3.80	9			*	*	*	*
Metals:								
Aluminum	10834.98	18000			14000	11000		11000
Arsenic	8.95	17	30		20			9.3
Barium	21.60	54.7		23.8	32.8	75.8	38.5	31.5
Beryllium	0.30	0.638	0.4		0.547			0.547
Cadmium	0.56	1.79	30					
Calcium	554.02	1170				2010	926	
Chromium	18.67	62.5	1000			53.9		
Cobalt	3.47	7.3			3.76	3.96		3.76
Copper	9.52	19.5				11.7		
Iron	12806.69	28000				16000		
Lead	51.43	110	300					270
Magnesium	1793.60	5060		2600	2020	5720	2260	1830
Nickel	9.32	23.2	300			12		
Potassium	450.60	700		1540	766	2990	1020	608
Selenium	0.37	0.571	300		0.45			0.51
Sodium	122.50	122				280		
Thallium			8		304			
Vanadium	27.08	51.2				48.7		
Zinc	33.91	85.8	2500			42.3		

Table 4-7
Area A9
Summary of Compounds Exceeding ESAT Soil Values
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A9CD1 A9CD1A 18-May-92 0 feet	A9SO1 A9SO1A 15-Apr-92 0 feet	A9SO2 A9SO2A 15-Apr-92 0 feet	A9SO3 A9SO3A 15-Apr-92 0 feet	A9SO4 A9SO4A 15-Apr-92 0 feet	A9SO5 A9SO5A 15-Apr-92 0 feet	A9SO6 A9SO6A 15-Apr-92 0 feet	A9SO7 A9SO7B 15-Nov-93 0 feet	A9SO9 A9SO9B 15-Nov-93 0 feet	A9SO10 A9SO10B 15-Nov-93 0 feet
Metals:											
Arsenic	4.8	8.1	46	5.7	18	5.95	5.68	8	20	6.9	9.3
Lead	200	450									270

Table 4-8
Area A9
Summary of Compounds Exceeding Soil Criteria
Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9HA1 A9HA1A 15-Oct-92 0 feet	A9HA2 A9HA2A 15-Oct-92 0.5 feet	A9HA3 A9HA3A 15-Oct-92 0.5 feet	A9HA4 A9HA4A 15-Oct-92 0.5 feet	A9HA5 A9HA5B 15-Nov-93 0.5 feet	A9HA6 A9HA6B 15-Nov-93 0.5 feet
Metals:									
Aluminum	10834.98	18000		11000 B		11000 B	12000 B	15000	17000
Arsenic	8.95	17	30	56	59	70	65	140	14
Barium	21.60	54.7						42.7	31.5
Beryllium	0.30	0.638	0.4			0.305	0.336	0.676	0.692
Cadmium	0.56	1.79	30	1.64	1.39	1.63	1.13	0.774	
Calcium	554.02	1170							
Chromium	18.67	62.5	1000						19.3
Cobalt	3.47	7.3						4.86	4.85
Copper	9.52	19.5		10.1					
Iron	12806.69	28000						13000	15000
Magnesium	1793.60	5060		2370	2170	2180	1990	2030	2170
Nickel	9.32	23.2	300					9.45	10.3
Potassium	450.60	700		939	938	962	708	547	
Selenium	0.37	0.571	300					0.54	0.49
Zinc	33.91	85.8	2500	44.5				34.3	

Table 4-8
Area A9
Summary of Compounds Exceeding Soil Criteria
Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9HA7 A9HA7B 15-Nov-93 0.5 feet	A9HA8 A9HA8B 15-Nov-93 0.5 feet
Metals:					
Aluminum	10834.98	18000			
Arsenic	8.95	17	30		
Barium	21.60	54.7			
Beryllium	0.30	0.638	0.4		
Cadmium	0.56	1.79	30		
Calcium	554.02	1170		601	
Chromium	18.67	62.5	1000		
Cobalt	3.47	7.3			
Copper	9.52	19.5			
Iron	12806.69	28000			
Magnesium	1793.60	5060		2150	2730
Nickel	9.32	23.2	300		10.6
Potassium	450.60	700		1110	1250
Selenium	0.37	0.571	300		
Zinc	33.91	85.8	2500		

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B1 A9SB1A 27-Feb-92 4 feet	A9B1 A9SB1B 27-Feb-92 14 feet	A9B1 A9SB1C 27-Feb-92 20 feet	A9B2 A9SB2A 27-Feb-92 8 feet	A9B2 A9SB2B 27-Feb-92 16 feet	A9B2 A9SB2C 27-Feb-92 18 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1	0.0086		0.016	0.01	0.013	
BNAs:									
2-Methylnaphthalene			0.7						10
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						0.0156
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30	17					
Barium	21.60	54.7		23.7		29.8	29.3		
Cadmium	0.56	1.79	30						
Calcium	554.02	1170			556	1450			743
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5					9.89		
Iron	12806.69	28000							
Magnesium	1793.60	5060		2110	1870	2510	2520	1900	
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		1040	1020	1920	1580	1160	1080
Selenium	0.37	0.571	300						

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B3 A9SB3A 28-Feb-92 10 feet	A9B3 A9SB3B 28-Feb-92 16 feet	A9B3 A9SB3C 28-Feb-92 18 feet	A9B4 A9SB4A 28-Feb-92 4 feet	A9B4 A9SB4B 28-Feb-92 12 feet	A9B4 A9SB4C 28-Feb-92 18 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1	0.0099		0.011			0.0087
BNAs:									
2-Methylnaphthalene			0.7						
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7				25	22	23.5	32.5
Cadmium	0.56	1.79	30						
Calcium	554.02	1170		957		1360		1160	1310
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							10.7
Iron	12806.69	28000							
Magnesium	1793.60	5060				2210	2280	1990	2810
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						11.1
Potassium	450.60	700		719	812	1550	1790	1270	1640
Selenium	0.37	0.571	300						

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B5 A9SB5A 28-Feb-92 8 feet	A9B5 A9SB5B 28-Feb-92 14 feet	A9B5 A9SB5C 28-Feb-92 20 feet	A9B6 A9SB6A 19-May-92 8 feet	A9B6 A9SB6B 19-May-92 12 feet	A9B7 A9SB7A 19-May-92 2 feet
VOCs:									
Acetone	0.026	0.046	3						0.032
Methylene chloride	0.008	0.018	0.1			0.0099			
BNAs:									
2-Methylnaphthalene			0.7						
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							12000 B
Arsenic	8.95	17	30		9.5				
Barium	21.60	54.7				25.8			30.5
Cadmium	0.56	1.79	30					0.902	0.586
Calcium	554.02	1170		848	1280	1190	960	1040	557
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							17000 B
Magnesium	1793.60	5060				2470		1860	
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300			12.3			
Potassium	450.60	700		1070	1070	1490	774	1120	578
Selenium	0.37	0.571	300						

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B7 A9SB7B 19-May-92 14 feet	A9B8 A9SB8A 19-May-92 2 feet	A9B8 A9SB8B 19-May-92 8 feet	A9B9 A9SB9A 18-May-92 10 feet	A9B9 A9SB9B 18-May-92 18 feet	A9B10 A9SB10B 15-Nov-93 4 feet
VOCs:									
Acetone	0.026	0.046	3						*
Methylene chloride	0.008	0.018	0.1						*
BNAs:									
2-Methylnaphthalene			0.7						*
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005						*	*
Heptachlor epoxide	0.004	0.006	0.06					*	*
ppDDD	0.019	0.063	2		0.0891			*	*
Metals:									
Aluminum	10834.98	18000			11000 B				
Arsenic	8.95	17	30						
Barium	21.60	54.7			35.6				
Cadmium	0.56	1.79	30		0.827	0.942			
Calcium	554.02	1170		799	684	643	1190	1380	
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060							1820
Manganese	263.70	1100				410			
Mercury	0.10	0.318	10		0.112				
Nickel	9.32	23.2	300						
Potassium	450.60	700		1410	498	1030	814	696	1100
Selenium	0.37	0.571	300						

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B11 A9SB11B 15-Nov-93 4 feet	OHM-A9-16 A9SB16A 11-Feb-92 14 feet	OHM-A9-17 A9SB17A 25-Feb-92 28 feet	OHM-A9-18 A9SB18A 19-Feb-92 20 feet	OHM-A9-47 A9SB47A 15-May-92 10 feet	OHM-A9-48 A9SB48A 15-May-92 12 feet
VOCs:									
Acetone	0.026	0.046	3	*					
Methylene chloride	0.008	0.018	0.1	*		0.02			
BNAs:									
2-Methylnaphthalene			0.7	*					
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005		*					
Heptachlor epoxide	0.004	0.006	0.06	*					
ppDDD	0.019	0.063	2	*					
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30				13		
Barium	21.60	54.7		22.7		27.6			
Cadmium	0.56	1.79	30					0.784	0.787
Calcium	554.02	1170		865	912	1130	844	712	1550
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060		1810		2390			
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		1020	939	1390	867	1120	1180
Selenium	0.37	0.571	300						

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A9-49 A9SB49A 14-May-92 8 feet	OHM-A9-53 A9SB53B 09-Nov-93 32 feet	OHM-A9-53 DUPSB01C 09-Nov-93 32 feet	OHM-A9-54 A9SB54B 01-Nov-93 24 feet	OHM-A9-55 A9SB55B 02-Nov-93 18 feet	OHM-A9-56 A9SB56B 03-Nov-93 24 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1						
BNAs:									
2-Methylnaphthalene			0.7			*		2.2	
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005				*		0.0102 1	
Heptachlor epoxide	0.004	0.006	0.06			*			
ppDDD	0.019	0.063	2			*			
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7		30.1			27.1	22.9	
Cadmium	0.56	1.79	30	0.791					
Calcium	554.02	1170		1040	707	828 D	1140	1100	1060
Chromium	18.67	62.5	1000					99.1	
Cobalt	3.47	7.3						3.54	
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060		2740					
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		2020	898	727 D	1040	1260	1050
Selenium	0.37	0.571	300					2.8	

Table 4-9
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A9-57 A9SB57B 04-Nov-93 24 feet	OHM-A9-58 A9SB58B 08-Nov-93 30 feet	OHM-BW-5 FWSB5B 11-Nov-93 30 feet
VOCs:						
Acetone	0.026	0.046	3			
Methylene chloride	0.008	0.018	0.1			
BNAs:						
2-Methylnaphthalene			0.7			
PCB/Pesticides:						
Endosulfan, beta	0.007	0.005				
Heptachlor epoxide	0.004	0.006	0.06			
ppDDD	0.019	0.063	2			
Metals:						
Aluminum	10834.98	18000				
Arsenic	8.95	17	30			10
Barium	21.60	54.7		22.1		36.5
Cadmium	0.56	1.79	30			
Calcium	554.02	1170		1190	1100	1690
Chromium	18.67	62.5	1000			
Cobalt	3.47	7.3				
Copper	9.52	19.5				
Iron	12806.69	28000				
Magnesium	1793.60	5060		1930	1950	2350
Manganese	263.70	1100				
Mercury	0.10	0.318	10			
Nickel	9.32	23.2	300			
Potassium	450.60	700		1240	851	1750
Selenium	0.37	0.571	300			

Table 4-10
Area A9
Summary of Compounds Exceeding ESAT Soil Values
Hand Auger Samples (ug/g)

Analyte	ESAT Soil	A9HA1 A9HA1A 15-Oct-92 0.5 feet	A9HA2 A9HA2A 15-Oct-92 0.5 feet	A9HA3 A9HA3A 15-Oct-92 0.5 feet	A9HA4 A9HA4A 15-Oct-92 0.5 feet	A9HA5 A9HA5B 15-Nov-93 0.5 feet	A9HA6 A9HA6B 15-Nov-93 0.5 feet	A9HA7 A9HA7B 15-Nov-93 0.5 feet	A9HA8 A9HA8B 15-Nov-93 0.5 feet
Metals:									
Arsenic	4.8	56	59	70	65	140	14	6.4	7.6
Beryllium	0.55					0.676	0.692		

Table 4-11
Area A9
Summary of Compound Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	DM8 DMGW8C 07-Dec-93 Unfiltered met	DM9A DMGW9AA 30-Jun-92 Filtered met	DM9A DMGW9AB 05-Nov-92 Filtered met	DM9A DMGW9AC 07-Dec-93 Unfiltered met	DM10 DMGW10A 30-Jun-92 Filtered met	OHM-A9-16 A9GW16A 29-Jun-92 Filtered met
VOCs:									
1,1,1-Trichloroethane	200		200						
1,1-Dichloroethene	7		7						
Ethylbenzene	700		700						
Methylene chloride	5		5						7.7
Toluene	1000		1000						
Trichloroethylene	5		5						
BNAs:									
2-Methylnaphthalene			10		27	10	22 S		
Bis(2-ethylhexyl) phthalate	6		6					40	
Naphthalene			20		57	39	83 S		
Metals:									
Aluminum		50		371			880		
Iron		300		496			904		
Lead	15		15						
Manganese		50			533	485	478		
Sodium									

Table 4-11
Area A9
Summary of Compound Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A9-17 A9GW17A 30-Jun-92 Filtered met	OHM-A9-17 A9GW17B 04-Nov-92 Filtered met	OHM-A9-47 A9GW47A 30-Jun-92 Filtered met	OHM-A9-47 A9GW47B 04-Nov-92 Filtered met	OHM-A9-47 A9GW47C 06-Dec-93 Unfiltered met	OHM-A9-48 A9GW48A 30-Jun-92 Filtered met
VOCs:									
1,1,1-Trichloroethane	200		200			400		500 S	
1,1-Dichloroethene	7		7					17 S	
Ethylbenzene	700		700						
Methylene chloride	5		5			100			9.5
Toluene	1000		1000						
Trichloroethylene	5		5					7.4 S	
BNAs:									
2-Methylnaphthalene			10						
Bis(2-ethylhexyl) phthalate	6		6						
Naphthalene			20						
Metals:									
Aluminum		50						2220	
Iron		300		2440	3250			2260	
Lead	15		15						
Manganese		50		328	274	232	542	701	71.9
Sodium									

Table 4-11
Area A9
Summary of Compound Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-A9-53 A9GW53A 03-Dec-93 Filtered met	OHM-A9-54 A9GW54A 06-Dec-93 Filtered met	OHM-A9-55 A9GW55A 06-Dec-93 Filtered met	OHM-A9-56 A9GW56A 02-Dec-93 Filtered met	OHM-A9-58 A9GW58A 03-Dec-93 Filtered met	OHM-BW-5 FWGW5A 03-Dec-93 Filtered met
VOCs:									
1,1,1-Trichloroethane	200		200			900 S	2000 S		
1,1-Dichloroethene	7		7			20 S	70 S		
Ethylbenzene	700		700	1000 S	2000 S				
Methylene chloride	5		5						
Toluene	1000		1000		2000 S				
Trichloroethylene	5		5						
BNAs:									
2-Methylnaphthalene			10	33 S	81 S	81 S			
Bis(2-ethylhexyl) phthalate	6		6						
Naphthalene			20	150 S	90 S	400 S			
Metals:									
Aluminum		50		173	113			147	
Iron		300		7010					
Lead	15		15		41				
Manganese		50		1660	709	222	1280		117
Sodium									

Table 4-12
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	DM8 DMGW8A 29-Jun-92 Filtered metals	DM8 DMGW8C 07-Dec-93 Unfilt. metals	DM9A DMGW9AA 30-Jun-92 Filtered metals	DM9A DMGW9AB 05-Nov-92 Filtered metals	DM9A DMGW9AC 07-Dec-93 Unfilt. metals	DM10 DMGW10A 30-Jun-92 Filtered metals
VOCs:										
1,1-Dichloroethene				3.2						
Ethylbenzene		1600		29000						
Toluene		875		200000						
BNAs:										
Bis(2-ethylhexyl) phthalate		360		5.9						40
PCB/Pesticides:										
Chlordane, total			0.0043	0.00059						
Heptachlor epoxide		0.0038	0.0038	0.00011						
PCB 1254			0.014	4.5E-05						
Metals:										
Aluminum	400	87				371			880	
Arsenic	3.15		190	0.14						
Barium										
Calcium	8520					11000 G			14600 G	
Chromium	3.16	11	11							
Copper	10	3.6	3.6					7.29		7.19
Iron	4810									
Lead	10.3	0.55	0.55		4.3		2.52			2.05
Magnesium	1890									
Manganese	156						533	485	478	
Potassium	2060				2510		2270			2450
Sodium	14000									
Zinc	13.3	33	33			575 B		20.2	969 BG	14.4

Table 4-12
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	DM10 DMGW10B 04-Nov-92 Filtered metals	OHM-A9-16 A9GW16A 29-Jun-92 Filtered metals	OHM-A9-16 A9GW16B 04-Nov-92 Filtered metals	OHM-A9-17 A9GW17A 30-Jun-92 Filtered metals	OHM-A9-17 A9GW17B 04-Nov-92 Filtered metals
VOCs:									
1,1-Dichloroethene				3.2					
Ethylbenzene		1600		29000					
Toluene		875		200000					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Chlordane, total			0.0043	0.00059					
Heptachlor epoxide		0.0038	0.0038	0.00011					
PCB 1254			0.014	4.5E-05					
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					4.11
Barium									
Calcium	8520							9080	
Chromium	3.16	11	11			14.4 7			
Copper	10	3.6	3.6						
Iron	4810								
Lead	10.3	0.55	0.55		3.35	4.78	3.53	3.55	9.54
Magnesium	1890							2690	2310
Manganese	156							328	274
Potassium	2060					2940		3570	2890
Sodium	14000								
Zinc	13.3	33	33			64.1	25.2		

Table 4-12
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-47 A9GW47A 30-Jun-92 Filtered metals	OHM-A9-47 A9GW47B 04-Nov-92 Filtered metals	OHM-A9-47 A9GW47C 06-Dec-93 Unfilt. metals	OHM-A9-48 A9GW48A 30-Jun-92 Filtered metals	OHM-A9-48 A9GW48B 04-Nov-92 Filtered metals	OHM-A9-49 A9GW49A 29-Jun-92 Filtered metals
VOCs:										
1,1-Dichloroethene				3.2	5.1		17 S			
Ethylbenzene		1600		29000						
Toluene		875		200000						
BNAs:										
Bis(2-ethylhexyl) phthalate		360		5.9						
PCB/Pesticides:										
Chlordane, total			0.0043	0.00059						0.0287
Heptachlor epoxide		0.0038	0.0038	0.00011						0.0463
PCB 1254			0.014	4.5E-05		0.104 T				
Metals:										
Aluminum	400	87					2220			
Arsenic	3.15		190	0.14						
Barium							27.2			
Calcium	8520						16700			9080
Chromium	3.16	11	11							
Copper	10	3.6	3.6							
Iron	4810									
Lead	10.3	0.55	0.55		2.07	1.54		1.91	1.67	4.22
Magnesium	1890									
Manganese	156				232	542	701			
Potassium	2060				2630	2450	3150	2800		2680
Sodium	14000									26400
Zinc	13.3	33	33				863 B			15.5

Table 4-12
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-53 A9GW53A 03-Dec-93 Filtered metals	OHM-A9-54 A9GW54A 06-Dec-93 Filtered metals	OHM-A9-55 A9GW55A 06-Dec-93 Filtered metals	OHM-A9-56 A9GW56A 02-Dec-93 Filtered metals	OHM-A9-57 A9GW57A 02-Dec-93 Filtered metals
VOCs:									
1,1-Dichloroethene				3.2			20 S	70 S	
Ethylbenzene		1600		29000		2000 S			
Toluene		875		200000		2000 S			
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Chlordane, total			0.0043	0.00059		*	*	*	*
Heptachlor epoxide		0.0038	0.0038	0.00011		*	*	*	*
PCB 1254			0.014	4.5E-05		*	*	*	*
Metals:									
Aluminum	400	87			173	113			
Arsenic	3.15		190	0.14	20				
Barium									
Calcium	8520				18400	11200	11100	10300	11800
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Iron	4810				7010				
Lead	10.3	0.55	0.55			41			
Magnesium	1890								
Manganese	156				1660	709	222	1280	
Potassium	2060				2080			2800	2830
Sodium	14000								
Zinc	13.3	33	33		1070 B	629 B	549 B	373	564

Table 4-12
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-57 DUPGW01C 02-Dec-93 Filtered metals	OHM-A9-58 A9GW58A 03-Dec-93 Filtered metals	OHM-BW-5 FWGW5A 03-Dec-93 Filtered metals
VOCs:							
1,1-Dichloroethene				3.2			
Ethylbenzene		1600		29000			
Toluene		875		200000			
BNAs:							
Bis(2-ethylhexyl) phthalate		360		5.9			
PCB/Pesticides:							
Chlordane, total			0.0043	0.00059			
Heptachlor epoxide		0.0038	0.0038	0.00011			
PCB 1254			0.014	4.5E-05			
Metals:							
Aluminum	400	87				147	
Arsenic	3.15		190	0.14			
Barium							
Calcium	8520				11700 D	13700	
Chromium	3.16	11	11				
Copper	10	3.6	3.6				
Iron	4810						
Lead	10.3	0.55	0.55				
Magnesium	1890						
Manganese	156						
Potassium	2060				3150 D		
Sodium	14000						
Zinc	13.3	33	33		541 B	837 B	436 B

Table 4-13
Detections of Methylene Chloride in Analytical Lot VCL

Site ID	EHA3	OHM-A5-44	OHM-A8-14	OHM-A8-15	OHM-A9-16	OHM-A9-47	OHM-A9-48	EHA3	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK
Field Sample No.	EHAGW3A	A5GW44B	A8GW14A	A8GW15A	A9GW16A	A9GW47A	A9GW48A	RSBGW07A	TRP0626C	TRP0626A	TRP0626E	TRP0626B
Sample Date	26-Jun-92	26-Jun-92	26-Jun-92	26-Jun-92	29-Jun-92	30-Jun-92	30-Jun-92	26-Jun-92	26-Jun-92	26-Jun-92	26-Jun-92	26-Jun-92
Methylene chloride	7.3	7.8	7.6	7.5	7.7	100	9.5	7.5	7.2	7.3	7.4	7.8

Note:

Four additional samples were analyzed as part of this lot. Methylene chloride was not detected in these samples.

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TABLE 5-1 - PHASE II STUDY AREA SAMPLING

Site ID	Sample Number	Sampling Media	Analytical Parameters
AREA A3/P5			
A3TPA	A3TPA1, A3TPA2 A3TPA3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest
A3TPB	A3TPB1	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest
A3TPC	A3TPC1, A3TPC2 A3TPC3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest
A3TPD	A3TPD1, A3TPD2 A3TPD3	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest, Expl
A3TPE	A3TPE1, A3TPE2 A3TPE2	Subsurface soil (test pit)	BNA, Metals, PCB/Pest, OP Pest
P5SD2	P5SD2B	Surface sediment	Metals
P5SD3	P5SD3B	Surface sediment	Metals
P5SD4	P5SD4B	Surface sediment	Metals
P5SW2	P5SW2B	Surface water	Metals
P5SW3	P5SW3B	Surface water	Metals
P5SW4	P5SW4B	Surface water	Metals
P5SO1	P5SO1B	Surface soil	Metals
P5SO2	P5SO2B	Surface soil	Metals
P5SO3	P5SO3B	Surface soil	Metals
P5SO4	P5SO4B	Surface soil	Metals
AREA P4			
P4SO1	P4SO1B,C	Surface soil	BNA, Metals, PCB/Pest, OP Pest
P4SO2	P4SO2B,C	Surface soil	BNA, Metals, PCB/Pest, OP Pest
P4SO3	P4SO3B,C	Surface soil	BNA, Metals, PCB/Pest, OP Pest
P4SO4	P4SO4B,C	Surface soil	BNA, Metals, PCB/Pest, OP Pest
AREA P7			
OHM- P7-28	P7GW28C	Groundwater	VOC
OHM- P7-30	P7GW30C	Groundwater	VOC
OHM- P7-31	P7GW31C	Groundwater	VOC
AREA P17			
P17SO1	P17SO1B,C	Surface soil	Metals, PCB/Pest, OP Pest
P17SO2	P17SO2B,C	Surface soil	Metals, PCB/Pest, OP Pest
P17SO3	P17SO3B,C	Surface soil	Metals, PCB/Pest, OP Pest
P17SO4	P17SO4B,C	Surface soil	Metals, PCB/Pest, OP Pest
AREA P19			
P19CD1	P19CD1B	Surface soil	BNA, VOC, Metals, PCB/Pest, OP Pest
AREA P20			
P20SO2	P20SO2B	Surface soil	Metals
P20SO3	P20SO3B	Surface soil	Metals
P20SO4	P20SO4B	Surface soil	Metals
P20SO5	P20SO5B	Surface soil	Metals
AREA P25			
P25SO2	P25SO2B	Surface soil	Metals, PCB/Pest, OP Pest
P25SO3	P25SO3B	Surface soil	Metals, PCB/Pest, OP Pest
P25SO4	P25SO4B	Surface soil	Metals, PCB/Pest, OP Pest
P25SO5	P25SO5B	Surface soil	Metals, PCB/Pest, OP Pest

TABLE 5-1 - PHASE II STUDY AREA SAMPLING

Site ID	Sample Number	Sampling Media	Analytical Parameters
	AREA P35		
P35SO2	P35SO2B	Surface soil	Metals, PCB/Pest, OP Pest
P35SO3	P35SO3B	Surface soil	Metals, PCB/Pest, OP Pest
P35SO4	P35SO4B	Surface soil	Metals, PCB/Pest, OP Pest
P35SO5	P35SO5B	Surface soil	Metals, PCB/Pest, OP Pest
	AREA P49		
P49SO1	P49SO1B,C	Surface soil	VOC, PCB/Pest, OP Pest
P49SO2	P49SO2B,C	Surface soil	VOC, PCB/Pest, OP Pest
P49SO3	P49SO3B,C	Surface soil	VOC, PCB/Pest, OP Pest
P49SO4	P49SO4B,C	Surface soil	VOC, PCB/Pest, OP Pest
	AREA P51		
P51SO1	P51S01B	Surface soil	Metals, PCB/Pest, OP Pest
P51SO2	P51S02B	Surface soil	Metals, PCB/Pest, OP Pest
P51SO3	P51S03B	Surface soil	Metals, PCB/Pest, OP Pest
P51SO4	P51S04B	Surface soil	Metals, PCB/Pest, OP Pest
	AREA P59		
FWISD21	FWISD21B	Surface sediment	BNA, Metals, PCB/Pest, OP Pest
FWISD22	FWISD22B	Surface sediment	BNA, Metals, PCB/Pest, OP Pest
FWISD23	FWISD23B	Surface sediment	BNA, Metals, PCB/Pest, OP Pest
FWISD24	FWISD24B	Surface sediment	BNA, Metals, PCB/Pest, OP Pest
FWISD25	FWISD25B	Surface sediment	BNA, Metals, PCB/Pest, OP Pest
	AREA P60		
FWICD1	FWICD1B	Surface soil	BNA, Metals, PCB/Pest, OP Pest
FWICD2	FWICD2B	Surface soil	BNA, Metals, PCB/Pest, OP Pest

Table 5-2
Area A3/P5
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A3CD1 A3CD1A 29-May-92 0 feet	A3CD2 A3CD2A 29-May-92 0 feet	A3CD3 A3CD3A 29-May-92 0 feet	A3CD4 A3CD4A 29-May-92 0 feet	P5CD1 P5CD1A 28-May-92 0 feet	P5CD2 P5CD2A 28-May-92 0 feet	P5CD3 P5CD3A 28-May-92 0 feet
VOCs:										
Methylene chloride	0.008	0.018	0.1			0.0096		0.0083		
PCB/Pesticides:										
ppDDD	0.019	0.063	2					0.159	0.055	0.0413
ppDDE	0.039	0.139	2	0.0635	0.0589			0.117		0.0878
ppDDT	0.066	0.23	2	0.0892	0.167			0.15	0.13	0.0688
Metals:										
Aluminum	10834.976	18000			11000 B			12000 B		11000 B
Arsenic	8.951	17	30						11	10
Barium	21.603	54.7		27	41.9	27		22.1		
Beryllium	0.298	0.638	0.4					0.325		
Calcium	554.016	1170			612	840				
Chromium	18.666	62.5	1000					18.8		68.3 X
Cobalt	3.472	7.3		6.24				3.84		
Copper	9.521	19.5		12.9	10.3	10.8				13.2
Iron	12806.693	28000		13000 X	13000 B					20000 B
Lead	51.432	110	300			78 B				220 B
Magnesium	1793.596	5060		2840	2960			2570	2120	
Nickel	9.322	23.2	300	9.74	10.4			9.9		
Potassium	450.597	700		2140	1740	1060	720	1080	597	676
Zinc	33.907	85.8	2500		36.9		57.5			

Table 5-2
Area A3/P5
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A3SO1 A3SO1A 21-Apr-92 0 feet	P5SO1 P5SO1B 25-Oct-93 0 feet	P5SO2 P5SO2B 25-Oct-93 0 feet	P5SO3 P5SO3B 25-Oct-93 0 feet	P5SO4 P5SO4B 25-Oct-93 0 feet
VOCs:								
Methylene chloride	0.008	0.018	0.1	0.013	*	*	*	*
PCB/Pesticides:								
ppDDD	0.019	0.063	2		*	*	*	*
ppDDE	0.039	0.139	2		*	*	*	*
ppDDT	0.066	0.23	2		*	*	*	*
Metals:								
Aluminum	10834.976	18000		11000 B				
Arsenic	8.951	17	30		9.4		12	18
Barium	21.603	54.7		28.7	21.9		23.6	32.5
Beryllium	0.298	0.638	0.4	0.443	0.406	0.415	0.426	0.547
Calcium	554.016	1170					696	1040
Chromium	18.666	62.5	1000		19.5			
Cobalt	3.472	7.3			3.58			
Copper	9.521	19.5						
Iron	12806.693	28000						
Lead	51.432	110	300		85			60
Magnesium	1793.596	5060			2030			
Nickel	9.322	23.2	300					
Potassium	450.597	700			774	624	584	536
Zinc	33.907	85.8	2500					

Table 5-3
Area A3/P5
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P5CD1 P5CD1A 28-May-92 0 feet	P5CD2 P5CD2A 28-May-92 0 feet	P5CD3 P5CD3A 28-May-92 0 feet	P5SO1 P5SO1B 25-Oct-93 0 feet	P5SO2 P5SO2B 25-Oct-93 0 feet	P5SO3 P5SO3B 25-Oct-93 0 feet	P5SO4 P5SO4B 25-Oct-93 0 feet
Metals:								
Arsenic	4.8	7.7	11	10	9.4	8.4	12	18
Lead	200			220 B				

Table 5-4
Area A3/P5
Summary of Compounds Exceeding Soil Criteria
Test Pits (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A3TPA A3TPA1 10-Nov-93 0 feet	A3TPA A3TPA2 10-Nov-93 2 feet	A3TPA A3TPA3 10-Nov-93 4 feet	A3TPB A3TPB1 10-Nov-93 0 feet	A3TPC A3TPC1 10-Nov-93 0 feet	A3TPC A3TPC2 10-Nov-93 2 feet
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004					0.0069		
Heptachlor epoxide	0.004	0.006	0.06						
PCBs, total			2						2.3 Z
ppDDD	0.019	0.063	2				0.0368		0.0335
ppDDE	0.039	0.139	2						0.0791
ppDDT	0.066	0.23	2						0.236
Metals:									
Aluminum	10834.976	18000						13000	
Arsenic	8.951	17	30						
Barium	21.603	54.7		35.6	26.7	38.3	31.1	30	37.7
Beryllium	0.298	0.638	0.4			0.376	0.379	0.561	0.522
Calcium	554.016	1170		872		620			
Chromium	18.666	62.5	1000						
Cobalt	3.472	7.3			4.65				
Copper	9.521	19.5		10.5					
Iron	12806.693	28000							
Magnesium	1793.596	5060		3130	2350	1820	1820	2350	1900
Potassium	450.597	700		2000	1540	1510	1320	1010	1430
Selenium	0.368	0.571	300						0.44
Zinc	33.907	85.8	2500					38.6	

Table 5-4
Area A3/P5
Summary of Compounds Exceeding Soil Criteria
Test Pits (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A3TPC A3TPC3 10-Nov-93 4 feet	A3TPD A3TPD1 10-Nov-93 0 feet	A3TPD A3TPD2 10-Nov-93 2 feet	A3TPD A3TPD3 10-Nov-93 4 feet	A3TPE A3TPE1 10-Nov-93 0 feet	A3TPE A3TPE2 10-Nov-93 2 feet	A3TPE A3TPE3 10-Nov-93 4 feet
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004								
Heptachlor epoxide	0.004	0.006	0.06							0.00735
PCBs, total			2							
ppDDD	0.019	0.063	2		0.0538		0.0495	0.0367		
ppDDE	0.039	0.139	2					0.0685		
ppDDT	0.066	0.23	2					0.0778		
Metals:										
Aluminum	10834.976	18000		12000			11000	13000		
Arsenic	8.951	17	30					9.9		
Barium	21.603	54.7		57.5	31.4	37.6	44.3	37.6	60.2	41.3
Beryllium	0.298	0.638	0.4	0.506	0.541	0.41	0.535	0.568	0.5	0.511
Calcium	554.016	1170						606		
Chromium	18.666	62.5	1000				22			
Cobalt	3.472	7.3								
Copper	9.521	19.5		10.8		14.9				9.58
Iron	12806.693	28000				13000	13000	13000		
Magnesium	1793.596	5060		2470		2080	3030		2220	2030
Potassium	450.597	700		1940	985	1390	1600	471	1930	1550
Selenium	0.368	0.571	300							
Zinc	33.907	85.8	2500			53	36.7	43.7		

Table 5-5
Area A3/P5
Summary of Compounds Exceeding Soil Criteria
Boring Samples

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A3-1 A3SB1A 03-Feb-92 2 feet	OHM-A3-2 A3SB2A 30-Jan-92 6 feet	OHM-A3-2A A3SB2AA 23-Mar-92 4 feet	OHM-A3-3 A3SB3A 31-Jan-92 4 feet
VOCs:							
Acetone	0.026	0.046	3			0.035	
BNAs:							
Di-n-butyl phthalate	3.801	9			8.4 S		
Metals:							
Aluminum	10834.976	18000		14000	13000		
Arsenic	8.951	17	30	9.5			
Barium	21.603	54.7			54.2	41.5	26.9
Beryllium	0.298	0.638	0.4	0.474	0.354		
Cadmium	0.563	1.79	30		0.653		
Calcium	554.016	1170		897		630	
Cobalt	3.472	7.3			3.62		
Copper	9.521	19.5			10.7	11.6	
Iron	12806.693	28000			16000 X		14000
Magnesium	1793.596	5060			2800	2220	2730
Potassium	450.597	700			2300	1800	2180

Table 5-6
Area A3/P5
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	EHA6 EHAGW6A 22-Jun-92 Filtered metals	OHM-A3-1 A3GW1A 22-Jun-92 Filtered metals	OHM-A3-1 DUPGW02A 22-Jun-92 Filtered metals	OHM-A3-1 A3GW1B 30-Oct-92 Filtered metals	OHM-A3-3 A3GW3A 22-Jun-92 Filtered metals
VOCs:								
Methylene chloride	5		5	7.1				
Metals:								
Manganese		50			84.7	78.6 D	78	132

Table 5-7
Area P4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P4CD1 P4CD1A 19-May-92 0 feet	P4CD2 P4CD2A 19-May-92 0 feet	P4SO1 P4SO1B 26-Oct-93 0 feet	P4SO1 P4SO1C 15-Nov-93 0 feet	P4SO2 P4SO2B 26-Oct-93 0 feet	P4SO3 P4SO3B 26-Oct-93 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1		0.012	*		*	*
BNAs:									
Benzo(a)anthracene			0.7			*		*	*
Benzo(a)pyrene			0.7			*		*	*
Benzo(b)fluoranthene			0.7			*		*	*
Benzo(k)fluoranthene			0.7			*		*	*
Chrysene			0.7			*		*	*
Indeno[1,2,3-C,D]pyrene			0.7			*		*	*
PCB/Pesticides:									
Dieldrin	0.010	0.023	0.03			*		*	*
Endosulfan, beta	0.007	0.005		0.0364		*		*	*
Endrin	0.011	0.008	0.6			*		*	*
ppDDD	0.019	0.063	2	0.104		*		*	*
ppDDE	0.039	0.139	2	0.191		*	0.0606	*	*
ppDDT	0.066	0.23	2	0.47	0.0848	*		*	*
Metals:									
Antimony	0.822	0.578	10	2.89			*		
Arsenic	8.951	17	30	200	16		*		130
Barium	21.603	54.7		23.2		23	*		33.8
Cadmium	0.563	1.79	30	1.66	0.952		*		
Calcium	554.016	1170					*		625
Cobalt	3.472	7.3			3.6		*		
Copper	9.521	19.5		14.3	10.7		*		18.1
Iron	12806.693	28000		15000 B			*		16000
Magnesium	1793.596	5060		2240		1990	*		
Nickel	9.322	23.2	300		9.58		*		
Potassium	450.597	700		1180	511	1370	*	626	722
Selenium	0.368	0.571	300			0.43	*		1.7
Vanadium	27.081	51.2				33.3	*		

Table 5-7
Area P4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P4SO3 P4SO3C 15-Nov-93 0 feet	P4SO4 P4SO4B 26-Oct-93 0 feet	P4SO4 P4SO4C 15-Nov-93 0 feet
VOCs:						
Methylene chloride	0.008	0.018	0.1		*	
BNAs:						
Benzo(a)anthracene			0.7		*	1.4
Benzo(a)pyrene			0.7		*	1.6
Benzo(b)fluoranthene			0.7		*	2.2
Benzo(k)fluoranthene			0.7		*	2.4
Chrysene			0.7		*	2.8
Indeno[1,2,3-C,D]pyrene			0.7		*	1.6
PCB/Pesticides:						
Dieldrin	0.010	0.023	0.03	0.0177	*	
Endosulfan, beta	0.007	0.005			*	
Endrin	0.011	0.008	0.6		*	0.0392 JI
ppDDD	0.019	0.063	2		*	
ppDDE	0.039	0.139	2	0.411 X	*	0.0484
ppDDT	0.066	0.23	2	0.232	*	0.145
Metals:						
Antimony	0.822	0.578	10	*		*
Arsenic	8.951	17	30	*	210	*
Barium	21.603	54.7		*	24.2	*
Cadmium	0.563	1.79	30	*		*
Calcium	554.016	1170		*		*
Cobalt	3.472	7.3		*		*
Copper	9.521	19.5		*	12.5	*
Iron	12806.693	28000		*		*
Magnesium	1793.596	5060		*	2000	*
Nickel	9.322	23.2	300	*		*
Potassium	450.597	700		*	1300	*
Selenium	0.368	0.571	300	*		*
Vanadium	27.081	51.2		*		*

Table 5-8
Area P4
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P4CD1 P4CD1A 19-May-92 0 feet	P4CD2 P4CD2A 19-May-92 0 feet	P4SO1 P4SO1B 26-Oct-93 0 feet	P4SO2 P4SO2B 26-Oct-93 0 feet	P4SO3 P4SO3B 26-Oct-93 0 feet	P4SO4 P4SO4B 26-Oct-93 0 feet	P4SO4 P4SO4C 15-Nov-93 0 feet
BNAs:								
Benzo(a)anthracene	1			*	*	*	*	1.4
Benzo(a)pyrene	1			*	*	*	*	1.6
Metals:								
Arsenic	4.8	200	16	7.1	7.2	130	210	*

Table 5-9
Area P4
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	P4SW1 P4SW1A 23-Apr-92 0.25 feet
Metals:					
Aluminum	400	87			293
Arsenic	3.15		190	0.14	13.2
Lead	10.3	0.55	0.55		2

Table 5-10
Area P4
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	P4SD1 P4SD1A 23-Apr-92 1 foot
Metals:			
Aluminum	5020		6600 B
Arsenic	2.03	6	9.4
Cadmium	0.5	0.6	0.641
Calcium	562		700 B
Chromium	9.66	26	13.1
Copper	6.33	16	8.46
Iron	7590		14000 B
Lead	4.48	31	4.6 B
Manganese	70.5		180
Nickel	5.92	16	10.8
Zinc	20.8	120	21.6

Table 5-11
Area P7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P7TPA P7TPA1 10-Dec-91 2 feet	P7TPB P7TPB1 10-Dec-91 2 feet
Metals:					
Cadmium	0.563	1.79	30	7.62 @	5.79 @
Potassium	450.597	700		593	478

Table 5-12
Area P7
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-P7-28 P7SB28A 23-Mar-92 4 feet	OHM-P7-30 P7SB30A 20-Mar-92 4 feet	OHM-P7-30 DUPSB02A 20-Mar-92 4 feet	OHM-P7-31 P7SB31A 20-Mar-92 4 feet
Metals:							
Arsenic	8.951	17	30				11
Cobalt	3.472	7.3				3.73 D	3.89
Magnesium	1793.596	5060				2090 D	
Nickel	9.322	23.2	300			10.5 D	
Potassium	450.597	700		522	538	894 D	736

Table 5-13
Area P7
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	OHM-P7-28 P7GW28A 18-Jun-92 Filtered metals	OHM-P7-28 P7GW28B 26-Oct-92 Filtered metals	OHM-P7-30 P7GW30A 18-Jun-92 Filtered metals	OHM-P7-30 P7GW30B 26-Oct-92 Filtered metals	OHM-P7-31 P7GW31A 18-Jun-92 Filtered metals	OHM-P7-31 P7GW31B 26-Oct-92 Filtered metals
Metals:								
Aluminum		50	286	340	383	460	390	321
Manganese		50	103	205	98	103	78	70.5

Table 5-14
Area P17
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P17CD1 P17CD1A 27-May-92 0 feet	P17CD1 DUPCD01A 27-May-92 0 feet	P17SO1 P17SO1B 26-Oct-93 0 feet	P17SO1 P17SO1C 15-Nov-93 0 feet	P17SO2 P17SO2B 26-Oct-93 0 feet	P17SO2 P17SO2C 15-Nov-93 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1	0.0086		*	*	*	*
PCB/Pesticides:									
Benzenehexachloride, beta	0.005	0.004			0.01 D				
ppDDD	0.019	0.063	2	0.107	0.071 D	*	0.09	*	0.13
ppDDE	0.039	0.139	2	0.315	0.274 X	*	0.55	*	0.57
ppDDT	0.066	0.23	2	0.368	0.338 D	*	0.33 2	*	0.32 2
Metals:									
Arsenic	8.951	17	30	220	210 D	260	*	260	*
Barium	21.603	54.7		27.9	28.6 D	27.3	*	29.4	*
Beryllium	0.298	0.638	0.4			0.582	*	0.448	*
Cadmium	0.563	1.79	30			0.694	*	0.712	*
Calcium	554.016	1170					*	1160	*
Cobalt	3.472	7.3					*	3.53 1	*
Copper	9.521	19.5		10.5	11 D		*		*
Lead	51.432	110	300	56 B	57 B		*		*
Potassium	450.597	700					*	467	*
Selenium	0.368	0.571	300			0.44	*	0.37	*
Zinc	33.907	85.8	2500				*	37	*

Table 5-14
Area P17
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P17SO3 P17SO3B 26-Oct-93 0 feet	P17SO3 P17SO3C 15-Nov-93 0 feet	P17SO4 P17SO4B 26-Oct-93 0 feet	P17SO4 P17SO4C 15-Nov-93 0 feet
VOCs:							
Methylene chloride	0.008	0.018	0.1	*	*	*	*
PCB/Pesticides:							
Benzenehexachloride, beta	0.005	0.004					
ppDDD	0.019	0.063	2	*	0.21 JI	*	0.055
ppDDE	0.039	0.139	2	*	1.1 1	*	0.36
ppDDT	0.066	0.23	2	*	0.21 JI2	*	0.239 2
Metals:							
Arsenic	8.951	17	30	250	*	240	*
Barium	21.603	54.7		21.7	*		*
Beryllium	0.298	0.638	0.4	0.436	*	0.507	*
Cadmium	0.563	1.79	30	0.694	*	0.605	*
Calcium	554.016	1170			*		*
Cobalt	3.472	7.3			*		*
Copper	9.521	19.5			*		*
Lead	51.432	110	300		*		*
Potassium	450.597	700			*		*
Selenium	0.368	0.571	300	0.41	*		*
Zinc	33.907	85.8	2500		*		*

Table 5-15
Area P17
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P17CD1 P17CD1A 27-May-92 0 feet	P17CD1 DUPCD01A 27-May-92 0 feet	P17SO1 P17SO1B 26-Oct-93 0 feet	P17SO1 P17SO1C 15-Nov-93 0 feet	P17SO2 P17SO2B 26-Oct-93 0 feet	P17SO2 P17SO2C 15-Nov-93 0 feet	P17SO3 P17SO3B 26-Oct-93 0 feet	P17SO3 P17SO3C 15-Nov-93 0 feet	P17SO4 P17SO4B 26-Oct-93 0 feet
PCB/Pesticides:										
ppDDE	0.5			*	0.55	*	0.57	*	1.1 1	*
Metals:										
Arsenic	4.8	220	210 D	260	*	260	*	250	*	240
Beryllium	0.55			0.582	*		*		*	

Table 5-16
Area P17
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P17TPA P17TPA1 28-Jan-92 2 feet	P17TPB P17TPB1 27-Jan-92 2 feet	P17TPB P17TPB3 27-Jan-92 6 feet	P17TPC P17TPC1 27-Jan-92 2 feet	P17TPD P17TPD1 28-Jan-92 2 feet	P17TPD P17TPD2 28-Jan-92 4 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1			0.0088		0.01	0.0095
BNAs:									
Di-n-butyl phthalate	3.801	9		4.5 S		*			*
PCB/Pesticides:									
Heptachlor epoxide	0.004	0.006	0.06			*		0.0122	*
ppDDE	0.039	0.139	2			*			*
ppDDT	0.066	0.23	2			*			*
Metals:									
Aluminum	10834.976	18000				*			*
Arsenic	8.951	17	30			*	11		*
Cadmium	0.563	1.79	30			*			*
Calcium	554.016	1170				*	695	672	*
Cobalt	3.472	7.3				*			*
Magnesium	1793.596	5060			1890	*			*
Nickel	9.322	23.2	300			*			*
Potassium	450.597	700		517	522	*	725	796	*
Zinc	33.907	85.8	2500			*			*

Table 5-16
Area P17
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P17TPD P17TPD3 28-Jan-92 6 feet	P17TPE P17TPE1 24-Jan-92 2 feet	P17TPF P17TPF1 28-Jan-92 2 feet	P17TPG P17TPG1 28-Jan-92 2 feet	P17TPG P17TPG2 28-Jan-92 4 feet	P17TPG P17TPG3 28-Jan-92 6 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1	0.0091	0.014		0.0098	0.0085	0.009
BNAs:									
Di-n-butyl phthalate	3.801	9		*			5.6 S	*	*
PCB/Pesticides:									
Heptachlor epoxide	0.004	0.006	0.06	*			0.011	*	*
ppDDE	0.039	0.139	2	*				*	*
ppDDT	0.066	0.23	2	*				*	*
Metals:									
Aluminum	10834.976	18000		*				*	*
Arsenic	8.951	17	30	*	9.8		9.2	*	*
Cadmium	0.563	1.79	30	*	0.87			*	*
Calcium	554.016	1170		*	602		946	*	*
Cobalt	3.472	7.3		*				*	*
Magnesium	1793.596	5060		*	1910		1960	*	*
Nickel	9.322	23.2	300	*				*	*
Potassium	450.597	700		*	900	658	967	*	*
Zinc	33.907	85.8	2500	*	36.7			*	*

Table 5-16
Area P17
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P17TPH P17TPH1 24-Jan-92 2 feet	P17TPH P17TPH2 24-Jan-92 4 feet	P17TPH P17TPH3 24-Jan-92 6 feet	P17TPI P17TPI1 24-Jan-92 2 feet	P17TPJ P17TPJ1 27-Jan-92 2 feet	P17TPJ P17TPJ3 27-Jan-92 6 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1				0.011		0.0092
BNAs:									
Di-n-butyl phthalate	3.801	9		4 S				5.5 S	*
PCB/Pesticides:									
Heptachlor epoxide	0.004	0.006	0.06						*
ppDDE	0.039	0.139	2	0.0733					*
ppDDT	0.066	0.23	2	0.103	0.0767				*
Metals:									
Aluminum	10834.976	18000		11000					*
Arsenic	8.951	17	30	22	13		9.2		*
Cadmium	0.563	1.79	30						*
Calcium	554.016	1170				917			*
Cobalt	3.472	7.3			3.52			4.56	*
Magnesium	1793.596	5060			2080			1900	*
Nickel	9.322	23.2	300		11.9				*
Potassium	450.597	700			655	767	612	804	*
Zinc	33.907	85.8	2500		39.4				*

Table 5-17
Area P17
Summary of Compounds Exceeding Ground Water Criteria
Ground Water Samples (ug/L)

Analyte	EPA MCLs	EPA SMCLs	MCP GW-1	OHM-BW-3 BKGGW03A 02-Oct-91 Filtered metals
VOCs:				
Methylene chloride	5		5	11.8

Table 5-18
Area P19
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P19CD1 P19CD1B 27-Oct-93 0 feet
PCB/Pesticides:				
ppDDE	0.039	0.139	2	0.0751
Metals:				
Aluminum	10834.976	18000		11000
Arsenic	8.951	17	30	10
Barium	21.603	54.7		34.8
Beryllium	0.298	0.638	0.4	0.479
Cobalt	3.472	7.3		4.38
Lead	51.432	110	300	80
Potassium	450.597	700		480
Selenium	0.368	0.571	300	0.64
Zinc	33.907	85.8	2500	38.7

Table 5-19
Area P19
Summary of Compounds Exceeding
ESAT Soil Criteria
Surface Soil (ug/g)

Analyte	ESAT Soil	P19CD1 P19CD1B 27-Oct-93 0 feet
Metals:		
Arsenic	4.8	10

Table 5-20
Area P20
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P20CD1 P20CD1A 18-May-92 0 feet	P20SO1 P20SO1A 20-Apr-92 0 feet	P20SO2 P20SO2B 27-Oct-93 0 feet	P20SO3 P20SO3B 27-Oct-93 0 feet	P20SO4 P20SO4B 27-Oct-93 0 feet	P20SO5 P20SO5B 27-Oct-93 0 feet
VOCs:									
Acetone	0.026	0.046	3		0.059 X	*	*	*	*
Metals:									
Aluminum	10834.976	18000			11000				
Beryllium	0.298	0.638	0.4				0.568		
Cadmium	0.563	1.79	30	0.885					
Cobalt	3.472	7.3		3.92			5.24	3.85	3.68
Copper	9.521	19.5			39.8		100		
Iron	12806.693	28000			13000				
Lead	51.432	110	300		780		3000	110	
Magnesium	1793.596	5060		2050	2490	1920	2530		1800
Nickel	9.322	23.2	300	9.67	11.2		12.3		
Potassium	450.597	700		705	758	887	791	474	769
Zinc	33.907	85.8	2500				39.7		

Table 5-21
Area P20
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P20CD1 P20CD1A 18-May-92 0 feet	P20SO1 P20SO1A 20-Apr-92 0 feet	P20SO2 P20SO2B 27-Oct-93 0 feet	P20SO3 P20SO3B 27-Oct-93 0 feet	P20SO5 P20SO5B 27-Oct-93 0 feet
Metals:						
Arsenic	4.8	7.5	7.94	6.6	7.2	7
Beryllium	0.55				0.568	
Copper	100				100	
Lead	200		780		3000	

Table 5-22
Area P25
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P25SO1 P25SO1A 20-Apr-92 0 feet	P25SO2 P25SO2B 28-Oct-93 0 feet	P25SO3 P25SO3B 28-Oct-93 0 feet	P25SO4 P25SO4B 28-Oct-93 0 feet	P25SO5 P25SO5B 28-Oct-93 0 feet
VOCs:								
Methylene chloride	0.008	0.018	0.1	0.01	*	*	*	*
PCB/Pesticides:								
Chlordane, alpha	0.004	0.004			0.0074			
Endrin aldehyde	0.026	0.011			0.0508			0.0606
ppDDD	0.019	0.063	2	0.0415	0.21			
ppDDE	0.039	0.139	2	0.0546	0.178		0.5	
ppDDT	0.066	0.23	2	0.241	0.36		0.0852	0.0901
Metals:								
Barium	21.603	54.7		37.2	28.9	45.7	38.1	38.5
Beryllium	0.298	0.638	0.4			0.401		
Cadmium	0.563	1.79	30	1.24	1.32			0.653
Calcium	554.016	1170		940 B	2220	710	1450	2460
Chromium	18.666	62.5	1000	24.1	26.9			
Cobalt	3.472	7.3		3.82				
Copper	9.521	19.5		55.4	56.5	13.8	14.7	10.5
Iron	12806.693	28000			15000			
Magnesium	1793.596	5060		2480		2840	2390	1930
Manganese	263.698	1100			270			280
Nickel	9.322	23.2	300	9.9	18.4	25		
Potassium	450.597	700		2000	890	2000	1310	1000
Zinc	33.907	85.8	2500	65.4	300		46.6	43.2

Table 5-23
Area P25
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P25SO1 P25SO1A 20-Apr-92 0 feet	P25SO2 P25SO2B 28-Oct-93 0 feet	P25SO3 P25SO3B 28-Oct-93 0 feet	P25SO4 P25SO4B 28-Oct-93 0 feet
PCB/Pesticides:					
ppDDE	0.5				0.5
Metals:					
Arsenic	4.8	4.9	6.3	8.4	
Silver	10	52.3			

Table 5-24
Area P35
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P35SO1 P35SO1A 20-Apr-92 0 feet	P35SO1 DUPSO03A 20-Apr-92 0 feet	P35SO2 P35SO2B 28-Oct-93 0 feet	P35SO3 P35SO3B 28-Oct-93 0 feet	P35SO4 P35SO4B 28-Oct-93 0 feet	P35SO5 P35SO5B 28-Oct-93 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1	0.0085		*	*	*	*
BNAs:									
2-Methylnaphthalene			0.7	2 1	2 1	*	*	*	*
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004		0.0834	0.109 D	2.8	0.00813	0.0265	0.23
Chlordane, gamma	0.019	0.005		0.11	0.16 D	4.1			0.34 X
Chlordane, total	0.023	0.009	1	0.1934	0.269 D	6.9		0.0265	0.57 X
Endrin	0.011	0.008	0.6	0.0471	0.0436 D				
Endrin aldehyde	0.026	0.011					0.0548	0.0748	0.129
Heptachlor epoxide	0.004	0.006	0.06	0.0133	0.0377 D				0.0174
ppDDD	0.019	0.063	2	0.85	0.88 D	2.6	0.0917	1.2	0.43
ppDDE	0.039	0.139	2	0.46	0.49 D	1.5 1	0.44	2.4	0.188
ppDDT	0.066	0.23	2	3	3.4 D		0.26	1.3	0.48
Metals:									
Arsenic	8.951	17	30				32		
Barium	21.603	54.7		30.5		163	31.5	34.4	35.5
Beryllium	0.298	0.638	0.4			0.448			
Cadmium	0.563	1.79	30	0.901	0.832 D	1.99			1.62
Calcium	554.016	1170		1480	1010 B	1460	1230	990	1430
Chromium	18.666	62.5	1000			19.1		25.6	
Cobalt	3.472	7.3				4.24			
Copper	9.521	19.5		13.8	11.9 D	22.3	10.4	14.7	74
Lead	51.432	110	300	130	120 B	360	110	100	170
Magnesium	1793.596	5060				2080		2240	2210
Mercury	0.101	0.318	10	0.353	0.415 D	0.36			
Nickel	9.322	23.2	300			11.5			14.3
Potassium	450.597	700		694	484 D	720	615	591	597
Selenium	0.368	0.571	300				0.37		
Zinc	33.907	85.8	2500	93.2	76.8 D	453	71.6	81.1	378

Table 5-25
Area P35
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P35SO1 P35SO1A 20-Apr-92 0 feet	P35SO1 DUPSO03A 20-Apr-92 0 feet	P35SO2 P35SO2B 28-Oct-93 0 feet	P35SO3 P35SO3B 28-Oct-93 0 feet	P35SO4 P35SO4B 28-Oct-93 0 feet	P35SO5 P35SO5B 28-Oct-93 0 feet
PCB/Pesticides:							
Chlordane, total	0.5			6.9			0.57 X
ppDDD	0.5	0.85	0.88 D	2.6		1.2	
ppDDE	0.5			1.5 1		2.4	
ppDDT	0.5	3	3.4 D			1.3	
Metals:							
Arsenic	4.8	7.3	5.43 D	7.8	32	5	
Lead	200			360			
Zinc	350			453			378

Table 5-26
Area P49
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P49CD1 P49CD1A 19-May-92 0 feet	P49SO1 P49SO1B 28-Oct-93 0 feet	P49SO2 P49SO2B 28-Oct-93 0 feet	P49SO3 P49SO3B 28-Oct-93 0 feet
PCB/Pesticides:							
Dieldrin	0.010	0.023	0.03	0.0124			
Heptachlor epoxide	0.004	0.006	0.06				0.00497 1
ppDDD	0.019	0.063	2	0.0711	0.0319	0.0256	
ppDDE	0.039	0.139	2	0.124	0.128	0.0546	0.0801
ppDDT	0.066	0.23	2	0.23	0.193	0.142	0.171

Table 5-27
Area P49
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P49CD1 P49CD1A 19-May-92 0 feet
Metals:		
Arsenic	4.8	6.4

Table 5-28
Area P51
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	P51CD1 P51CD1A 19-May-92 0 feet	P51SO1 P51SO1B 01-Nov-93 0	P51SO2 P51SO2B 01-Nov-93 0	P51SO3 P51SO3B 01-Nov-93 0	P51SO4 P51SO4B 01-Nov-93 0
PCB/Pesticides:								
Chlordane, alpha	0.004	0.004			0.0443		0.00648 1	
Chlordane, total	0.023	0.009	1		0.0443			
Dieldrin	0.010	0.023	0.03	0.117				
ppDDD	0.019	0.063	2	0.18	0.11	0.039	0.152	0.0474
ppDDE	0.039	0.139	2	0.512	0.244	0.139	0.314	0.355
ppDDT	0.066	0.23	2	0.283	0.418	0.107	0.365	0.238
Metals:								
Aluminum	10834.976	18000						13000
Arsenic	8.951	17	30					12
Beryllium	0.298	0.638	0.4					0.734
Copper	9.521	19.5		14.4		11.8	12.4	26
Iron	12806.693	28000						15000
Lead	51.432	110	300	77	58	56	70	
Mercury	0.101	0.318	10	0.367				
Potassium	450.597	700		751				
Selenium	0.368	0.571	300		0.49	0.58	1.1	0.99

Table 5-29
Area P51
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	P51CD1 P51CD1A 19-May-92 0 feet	P51SO4 P51SO4B 01-Nov-93 0 feet
PCB/Pesticides:			
ppDDE	0.5	0.512	
Metals:			
Arsenic	4.8		12
Beryllium	0.55		0.734

Table 5-30
Area P59
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	FWISD21 FWISD21B 16-Nov-93 0 feet	FWISD22 FWISD22B 16-Nov-93 0.5 feet	FWISD23 FWISD23B 16-Nov-93 0 feet	FWISD24 FWISD24B 16-Nov-93 0 feet	FWISD25 FWISD25B 16-Nov-93 0.5 feet
BNAs:							
Benzo(a)anthracene		0.23			0.58		
Benzo(a)pyrene		0.4	0.48		0.78		
Benzo[def]phenanthrene		0.35			1.4 1		
Chrysene		0.4			1		
Phenanthrene		0.225			0.4		
PCB/Pesticides:							
Benzene hexachloride, total		0.003					0.108
Lindane	0.001						0.108
ppDDD		0.002	0.335	0.418	4.7	0.92	0.255
ppDDE		0.002	0.279	0.374	0.372	0.114	0.124
ppDDT		0.001	0.129 2	0.0744 2	5.4 2	0.424 2	
Metals:							
Aluminum	5020					10800	10100
Arsenic	2.03	6	22	27	36	15	
Barium	23.9	20				26.2	25.7
Beryllium	0.18						1.53
Calcium	562			898		711	1760
Chromium	9.66	26	14.7	24.4	13.1	18.1	
Copper	6.33	16	48.6	155	152	187	28.7
Iron	7590		110000	150000	130000	110000	
Lead	4.48	31	120	110	110	86	19
Manganese	70.5		262	279	264	250	
Nickel	5.92	16			45.2	37.7	
Selenium	0.2	1	1.2	1.4	0.68	1.9	1.4
Vanadium	17			18.8			
Zinc	20.8	120	49.1	75.4	50.3	58.8	27.1

Table 5-31
Area P60
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	FWICD1 FWICD1B 16-Nov-93 0 feet	FWICD2 FWICD2B 16-Nov-93 0 feet
PCB/Pesticides:					
ppDDD	0.019	0.063	2	0.0329	0.0702
ppDDE	0.039	0.139	2	0.0916	0.199
ppDDT	0.066	0.23	2	0.14 2	0.231 2
Metals:					
Aluminum	10834.976	18000		12000	14000
Arsenic	8.951	17	30	260	460
Beryllium	0.298	0.638	0.4		0.41
Cadmium	0.563	1.79	30	1.27	2.74
Potassium	450.597	700			502
Selenium	0.368	0.571	300	0.55	0.5
Zinc	33.907	85.8	2500		38.6

Table 5-32
Area P60
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	FWICD1 FWICD1B 16-Nov-93 0 feet	FWICD2 FWICD2B 16-Nov-93 0 feet
Metals:			
Arsenic	4.8	260	460

DRAWING NUMBER 14316-A1

APPROVED BY

CHECKED BY DWP 8-9-94

DRAWN B.O'Connor 1-27-94

OHM CORPORATION PITTSBURGH, PA

PLOT SCALE: 1" = 1'

EXPLANATION

- TREE
- TREELINE
- SWAMP
- STONES
- STONE WALL
- BRUSH
- WATER
- MOUND
- PAVED ROAD
- UNPAVED ROAD
- 192 ⌀ POWER POLE
- DRUM ON SURFACE
- CHAIN LINK FENCE (UNLESS OTHERWISE NOTED)
- EXISTING WELL LOCATION
- ABANDONED WELL
- WELL LOCATION
- BORING LOCATION
- SURFACE WATER AND/OR SEDIMENT SAMPLE LOCATION
- TEST PIT LOCATION
- SOIL SAMPLE LOCATION
- HAND AUGER BORING LOCATION
- STAFF GAGE LOCATION

NOTE:
SHADED SAMPLE SYMBOLS DENOTE LOCATIONS OF SAMPLES FROM PREVIOUS OHM INVESTIGATION.

FIGURE 1-7

STUDY AREA MAP SYMBOLS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 14316-B1
APPROVED BY
CHECKED BY 4-2-95
DRAWN BY B.O'Connor 1-27-94
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1 = 100

OLD MARLBORO ROAD
PATROL ROAD
PATROL ROAD
ROAD

AREA A4

OHM-A4-4
OHM-A4-5
OHM-A4-50
A4TPC
DEPRESSION
A4TPA
A4TPB
A4TPF
A4B2
A4TPG
A4TPE
A4B1
A4TPD
A4S01
A4S02
A4S03
A4S04
A4S05
A4AT1
A4TTA
A4TTB
DM4
DM5
EHA7
VOSE TAVERN FOUNDATION
EAST GATE
STONE WELL
A4CD1
A4CD2
A4SD1
A4SW1
A4SD2
A4SW2
A4SD4
A4SW4
A4SD5
A4SW5
A4SD6
A4SW6
A4SD7
A4SW7
SG-13
~490'
~150'
FEMA
N 2,974,500
E 670,000
E 669,500
N 2,973,500
E 669,000
E 668,500
200
205
195
190
185

KEY MAP
A4

NOTE:
FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

SCALE
0 100 200 FEET

FIGURE 2-1

AREA A4
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

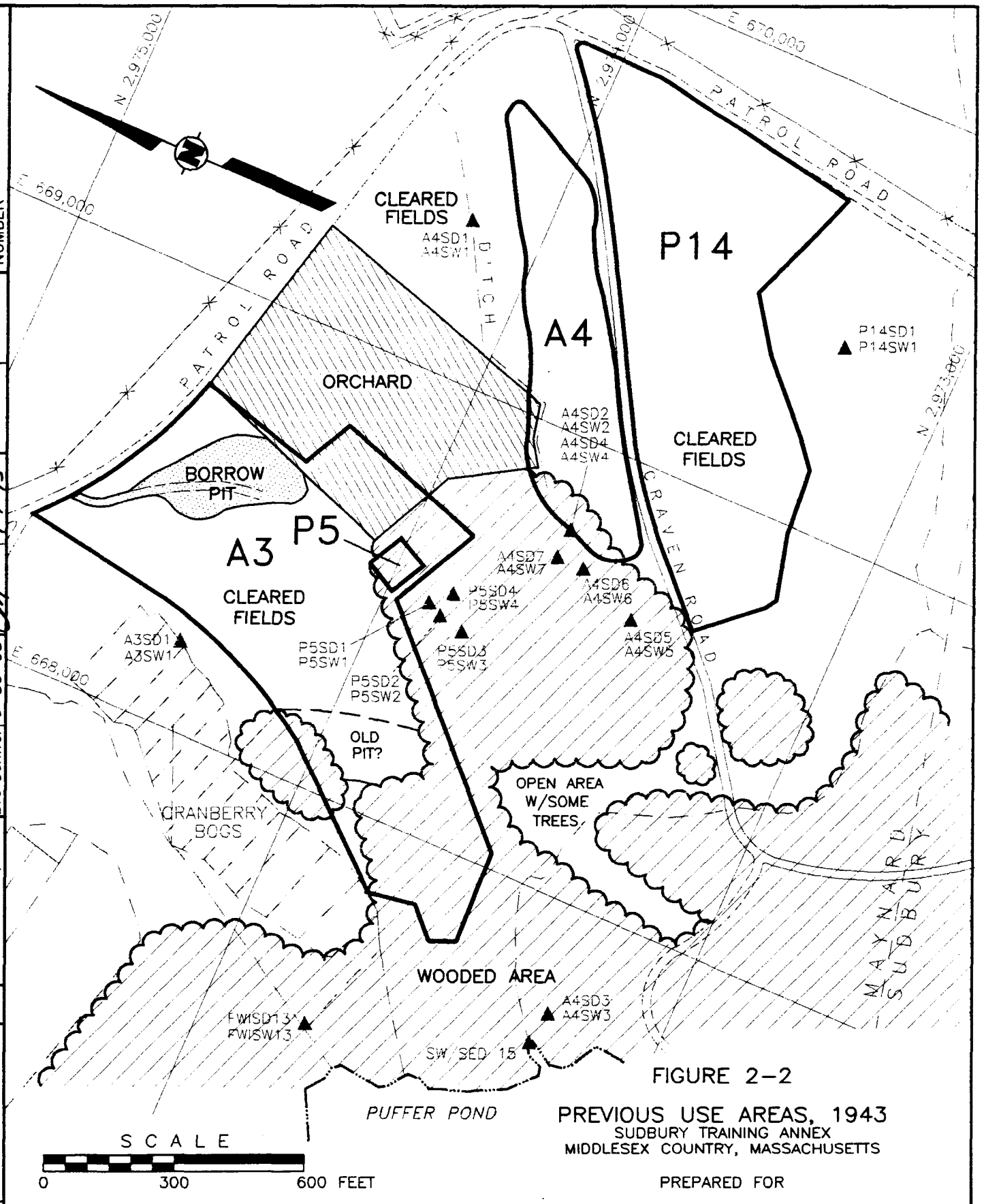

FIGURE 2-2

PREVIOUS USE AREAS, 1943
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTRY, MASSACHUSETTS

PREPARED FOR

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ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIR US16DPU, 23 JUN 43
208-1-253, 209-1-253

	DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY	PLOT SCALE: 1" = 300'
OHM CORPORATION PITTSBURGH, PA	14316-A91		4-2-95	B.O'Connor 3-30-95	

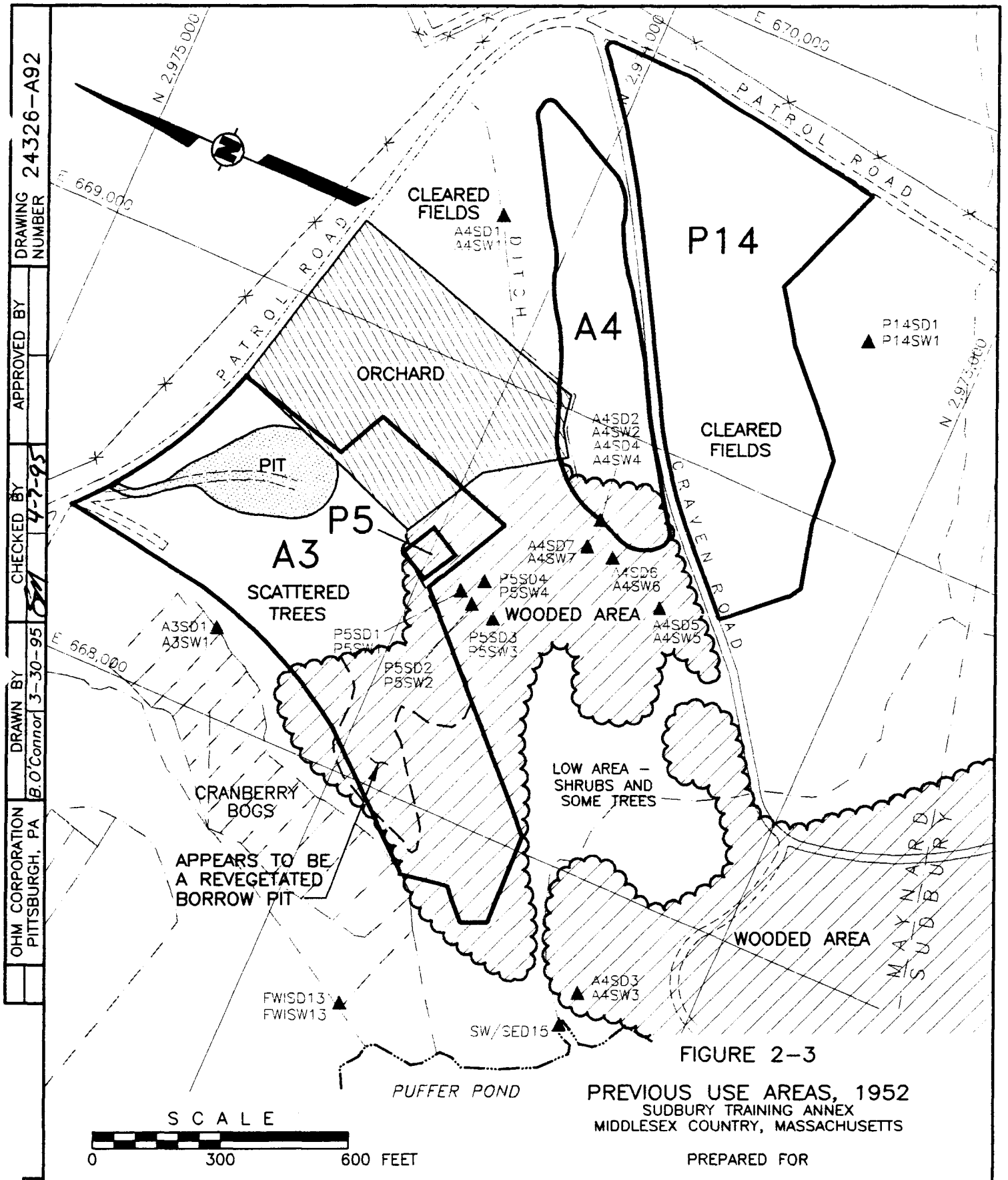


FIGURE 2–3

PREVIOUS USE AREAS, 1952
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTRY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1–7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIR DPQ–12K–104/105
5 SEP 52, EPIC NO'S. 9277/9278

OHM CORPORATION PITTSBURGH, PA	DRAWN BY	B.O'Connor 3-30-95
	CHECKED BY	4-7-95
	APPROVED BY	
	DRAWING NUMBER	24326-A92

PLOT SCALE: 1" = 300'

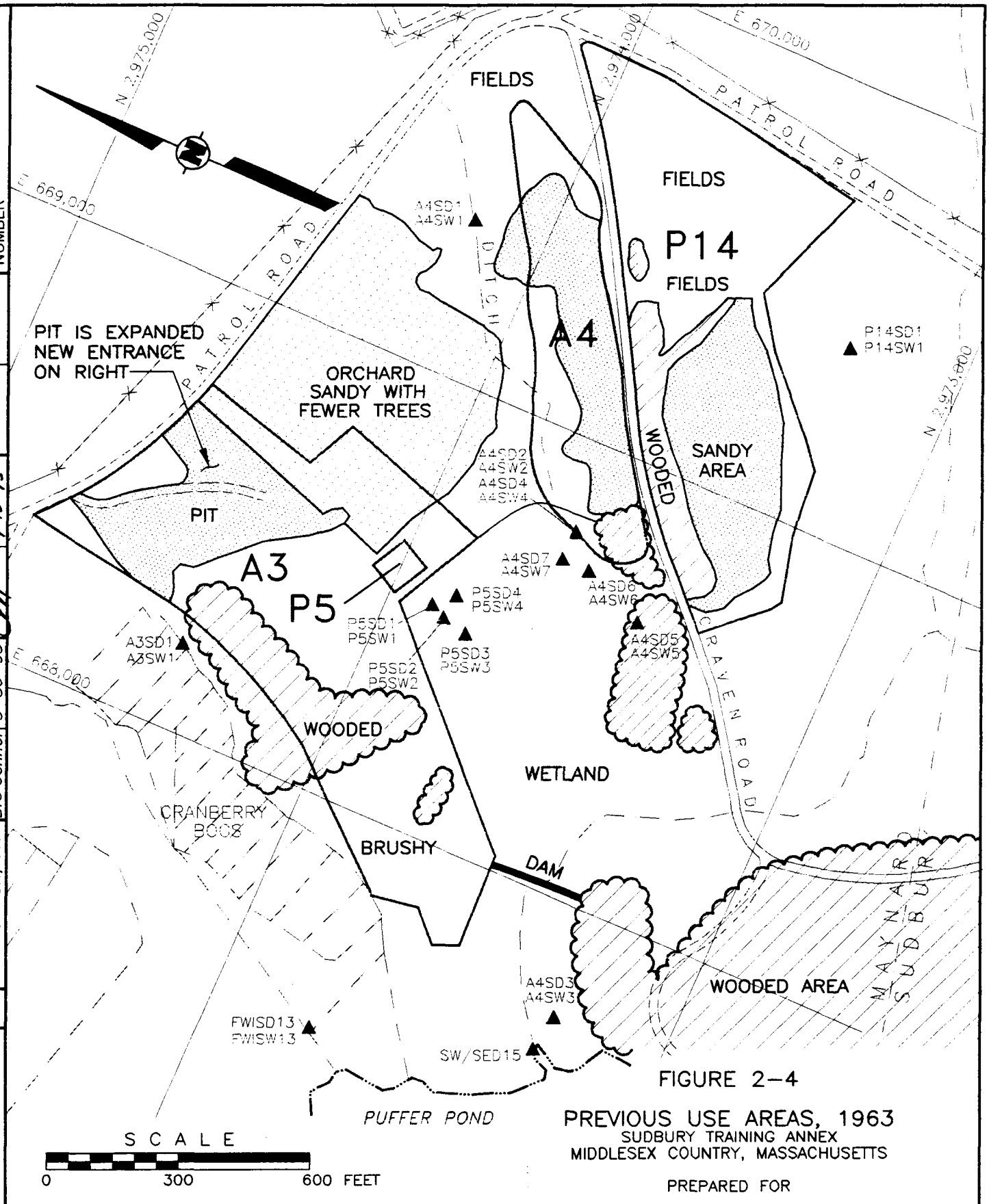


FIGURE 2-4

PREVIOUS USE AREAS, 1963
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTRY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIR GS-VAQZ-122/1-44
29 APR 63, EPIC NO'S. 9223/9229

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY B.O'Connor 3-30-95

CHECKED BY 4-10-95

APPROVED BY

DRAWING NUMBER 24326-A93

PLOT SCALE: 1" = 300'

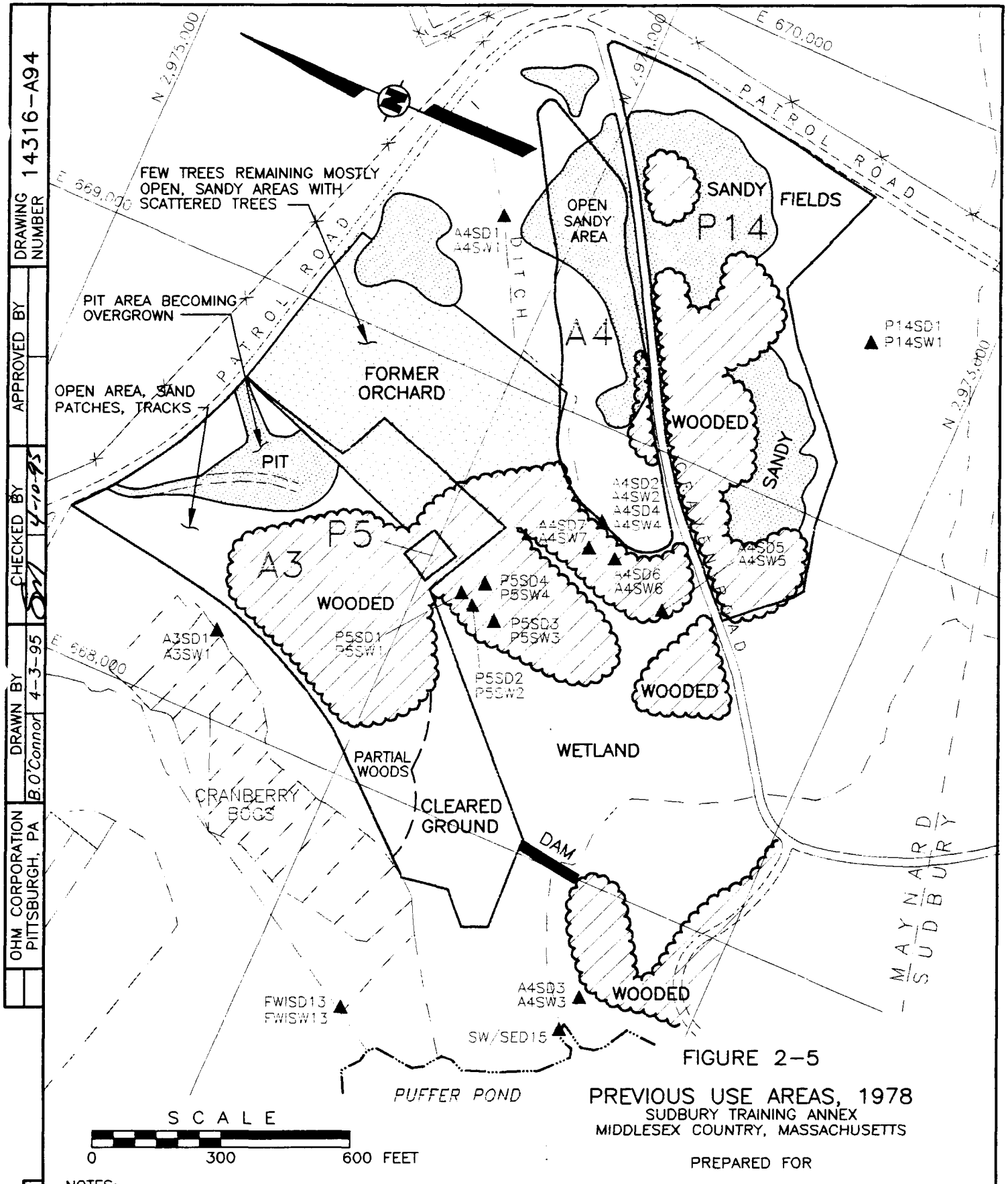


FIGURE 2-5

PREVIOUS USE AREAS, 1978
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTRY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIR GS-SWJS, 12 MAY 78
4-118/119, EPA EPIC 9220/9221

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY: B.O'Connor 4-3-95
CHECKED BY: 4-10-95
APPROVED BY:
DRAWING NUMBER: 14316-A94

PLOT SCALE: 1" = 300'

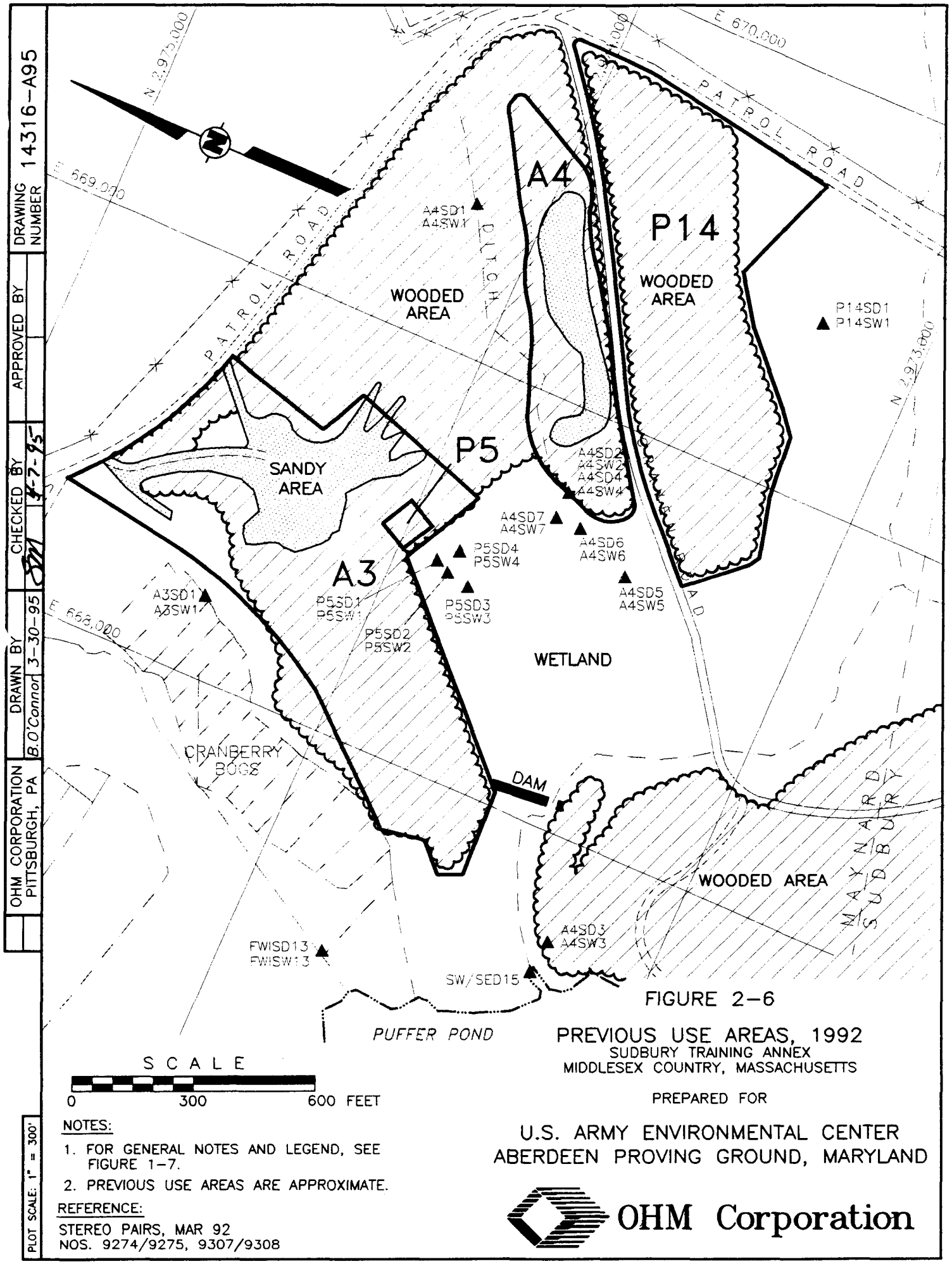


FIGURE 2-6

PREVIOUS USE AREAS, 1992
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTRY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIRS, MAR 92
NOS. 9274/9275, 9307/9308

	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
OHM CORPORATION PITTSBURGH, PA	B.O'Connor 3-30-95	BM 4-7-95		14316-A95

PLOT SCALE: 1" = 300'

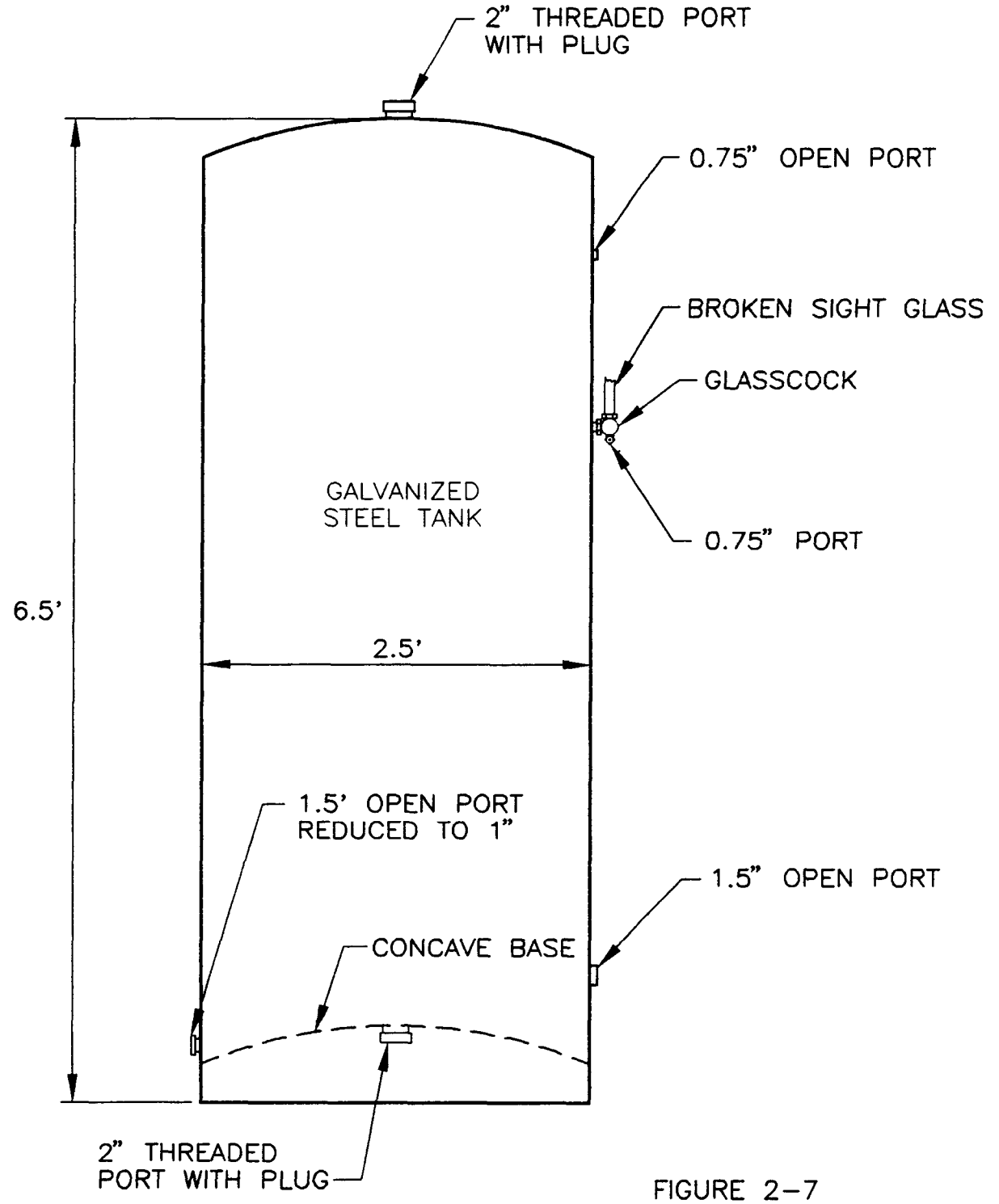


FIGURE 2-7

AREA A4 TANK
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

SCALE
0 1 2 FEET

NOTE:
PRESSURIZED STEEL WATER TANK REMOVED FROM BASEMENT OF VOSE TAVERN, APPROXIMATE VOLUME 235. GALLONS.

OHM Corporation

OHM CORPORATION PITTSBURGH, PA
DRAWN BY B.O'Connor 6-1-94
CHECKED BY 8-2-95
APPROVED BY
DRAWING NUMBER 14316-A64
PLOT SCALE: 1" = 1'

DRAWING NUMBER 14316-B27

APPROVED BY

CHECKED BY 4-7-93

DRAWN BY B.O'Connor 8-1-94

OHM CORPORATION PITTSBURGH, PA

PLOT SCALE: 1 = 100

OLD MARLBORO ROAD

PATROL ROAD

PATROL ROAD

GROUND WATER FLOW

DEPRESSION

A R E A A 4

VOSE TAVERN FOUNDATION

EAST GATE

STONE WELL

FEMA

OHM-A4-4 (196.37)

OHM-A4-5 (184.04)

OHM-A4-50 (185.03)

DM4 (189.00)

DM5 (195.66)

EHA7 (197.59)

SG-13 (182.25)

~490'

197 196 194 192 190 188 186 184

200 205 195 185

KEY MAP

A4

SCALE

0 100 200 FEET

NOTE:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 2 FOOT.

LEGEND:

196 ~ 196 GROUND WATER ELEVATION (MSL)

FIGURE 2-8

AREA A4
OVERBURDEN GROUND WATER ELEVATION AND FLOW DIRECTION
APRIL 27, 1994
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 14316-B3
APPROVED BY
CHECKED BY 4-2-95
DRAWN BY B.O'Connor 1-27-94
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1" = 100'

ASSABET RIVER

FWISW15
FWISD15

N 2,977,500
N 2,978,000
E 661,000
E 661,500

INSTALLATION BOUNDARY
TRACK ROAD
PATROL ROAD

OHM-A7-9
OHM-A7-52
OHM-A7-51
OHM-A7-11
OHM-A7-10
OHM-A7-12
OHM-A7-46
OHM-A7-45
OHM-A7-8
OHM-A7-13
OHM-A7-7A
OHM-A7-7

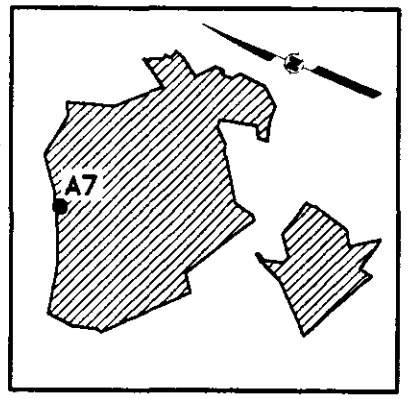
A7TPN
A7TPM
A7TPO
A7B6
A7TPP
A7HA2
A7S04
A7B5
A7S05
A7TPH
A7B7
A7TPD
A7TPE
A7HA3
A7TPF
A7TPG
A7TPK
A7TPI
A7S06
A7S013
A7TPC
A7B16
A7B15
A7B4
A7B17 AND A7TPK
A7TTB
A7TTA
A7B2
A7S02
A7TPL
A7S01
A7TPR
A7B3
A7B13
A7B14
A7CD1
A7TPJ
A7S03
A7HA2
A7TPB
A7S07
A7S010
A7B10
A7B9
A7TPQ
A7HA1
A7S08
A7B8
A7B19
A7HA4
A7B20
A7CD2
A7B18
A7S09
DM12
A7B12
A7S011
A7S012
A7B1
A7TPT
A7TPS
A7B11

A7-E
A7-C
A7-B
A7-A
A7-F
AREA P8
AREA P9

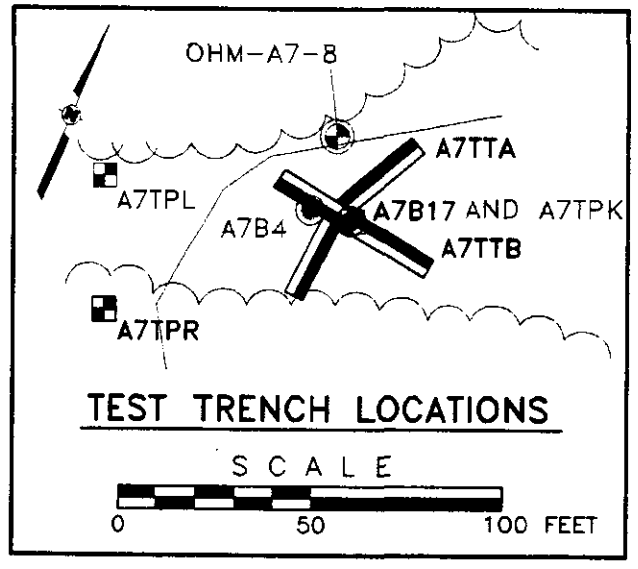
SW/SED8
E3-BCK-D03
A7SD2
A7SW2
SG-06
A7SD1
A7SW1
A7SD3
A7SW3
P9SD1
P9WD1
P9SD2
P9SW2
P9SD4
P9SW4
SW/SED7
P9SD3
P9SW3

LIMITS OF GEOPHYSICAL STUDY (TYP)

SCALE
0 100 200 FEET



KEY MAP



TEST TRENCH LOCATIONS

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. LOCATION OF DAMES & MOORE SAMPLE (SW/SED8) IS APPROXIMATE.
3. A7HA3 COLLECTED FROM SAME LOCATION AS A7TPE.
4. A7HA4 COLLECTED FROM SAME LOCATION AS A7CD2.
5. A7S013 COLLECTED FROM SAME LOCATION AS A7S06.

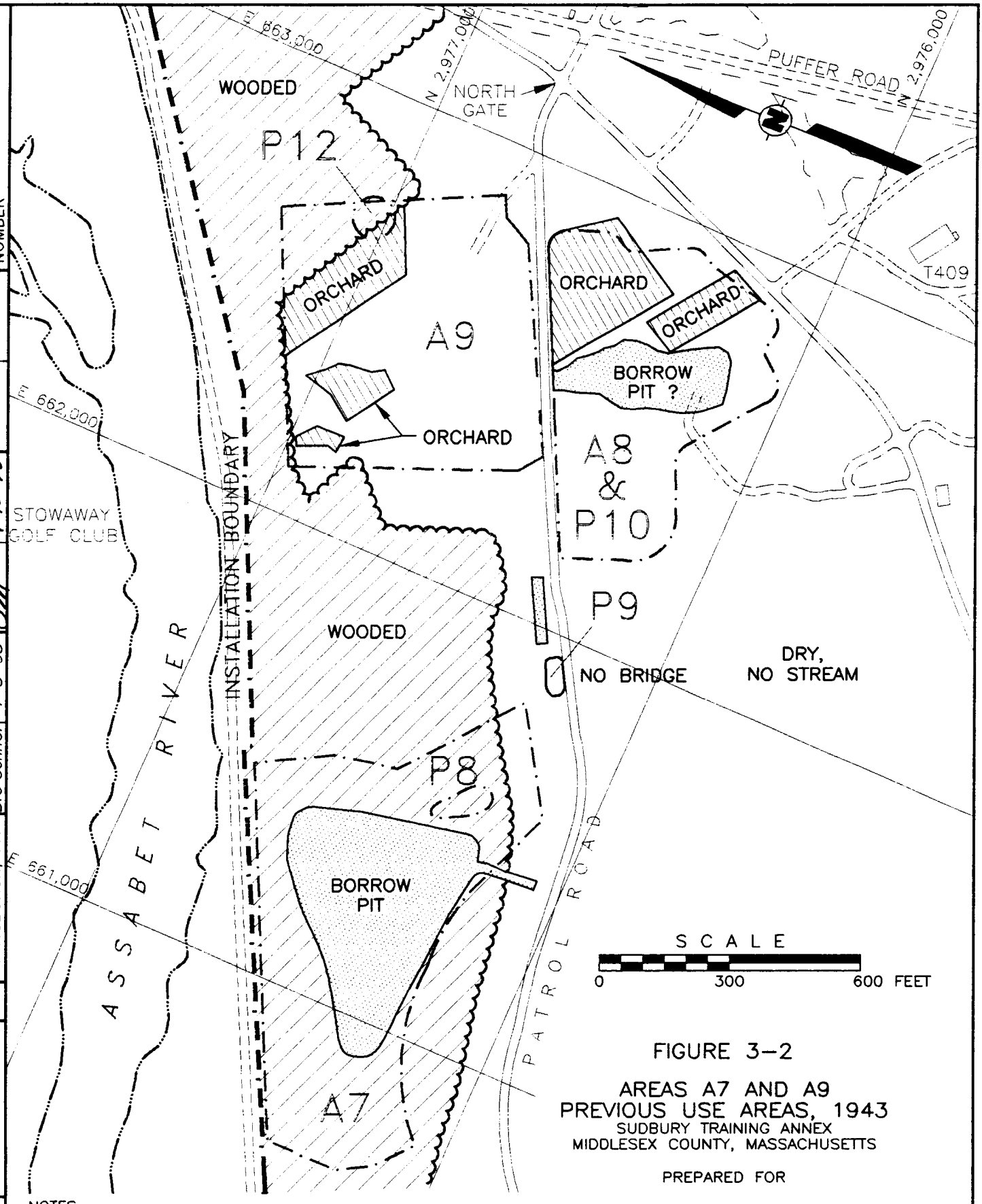
FIGURE 3-1

AREA A7
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
OHM CORPORATION PITTSBURGH, PA	B.O'Connor 4-5-95	4-10-95		14316-A97

PLOT SCALE: 1" = 300'

FIGURE 3-2

AREAS A7 AND A9
PREVIOUS USE AREAS, 1943
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIRS, 06 JUN 43
207-1-253, 208-1-253

OHM Corporation

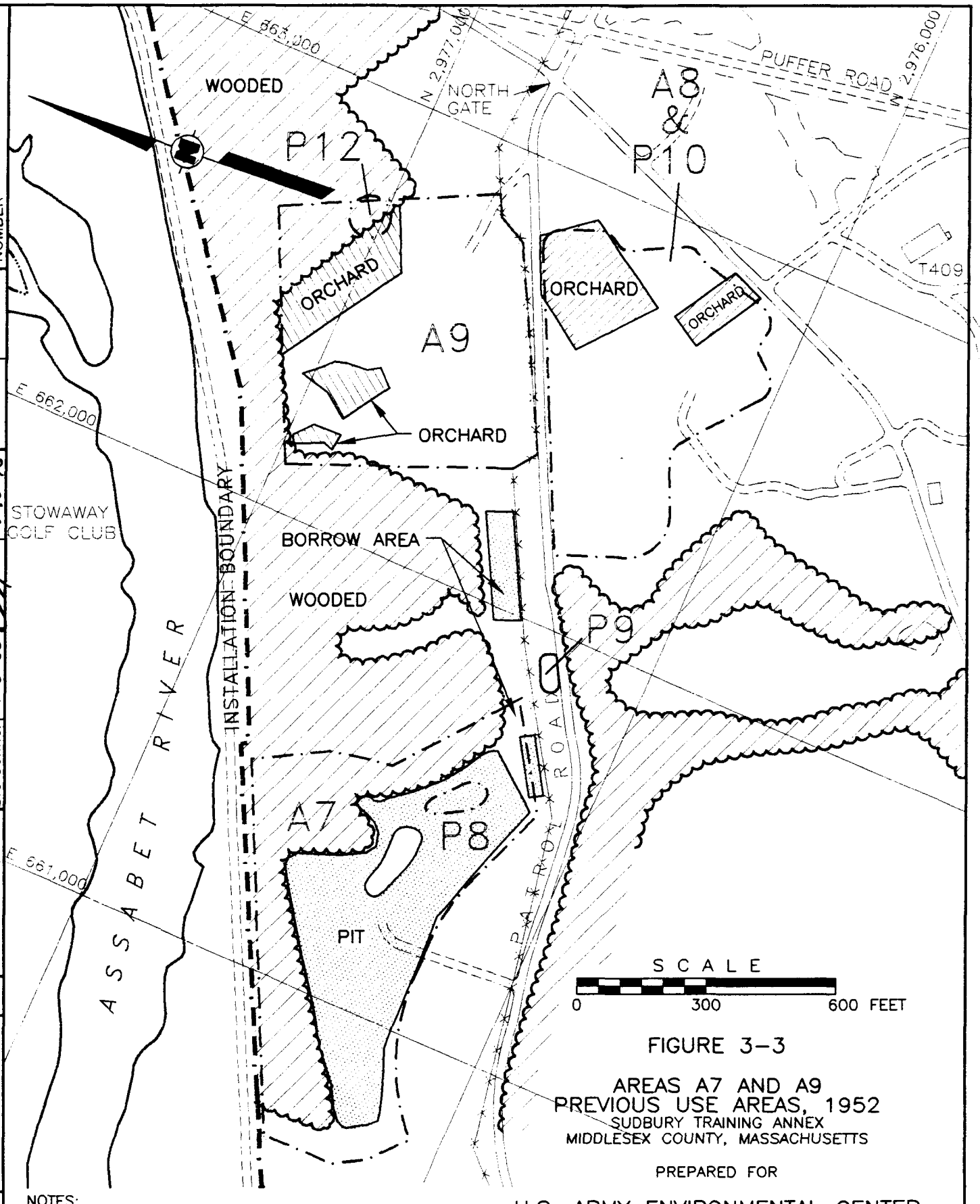


FIGURE 3-3

AREAS A7 AND A9
PREVIOUS USE AREAS, 1952
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIRS, 05 SEP 52
104,105

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY: B.O'Connor 4-5-95
CHECKED BY: 4-10-95
APPROVED BY:
DRAWING NUMBER: 14316-A98

PLOT SCALE: 1" = 1'

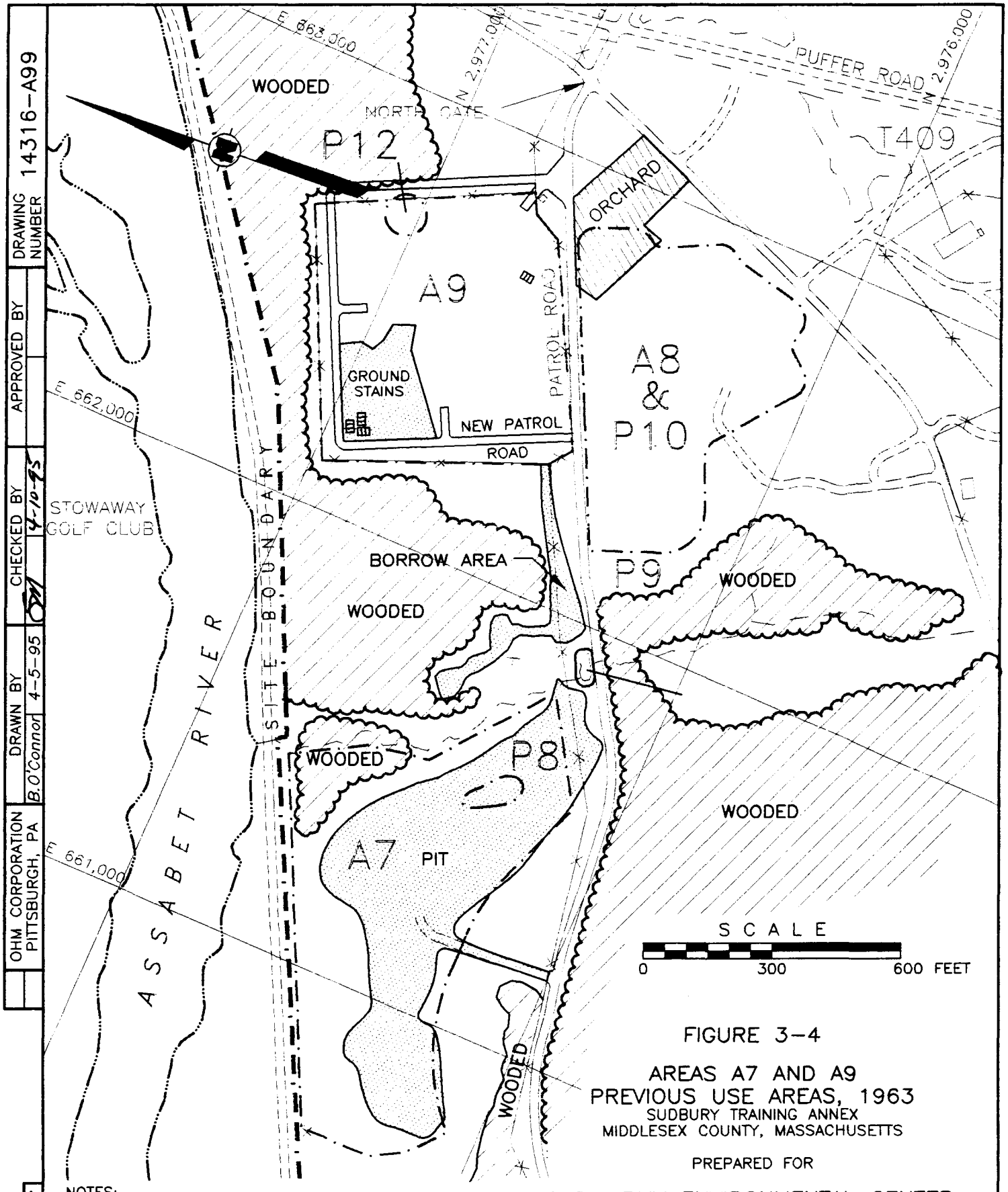


FIGURE 3-4

AREAS A7 AND A9
PREVIOUS USE AREAS, 1963
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. PREVIOUS USE AREAS ARE APPROXIMATE.

REFERENCE:

STEREO PAIRS, 29 APR 63
1-44, 1-45

	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
OHM CORPORATION PITTSBURGH, PA	B.O'Connor 4-5-95	4-10-95		14316-A99

PLOT SCALE: 1" = 300'

DRAWING NUMBER 142816-B28

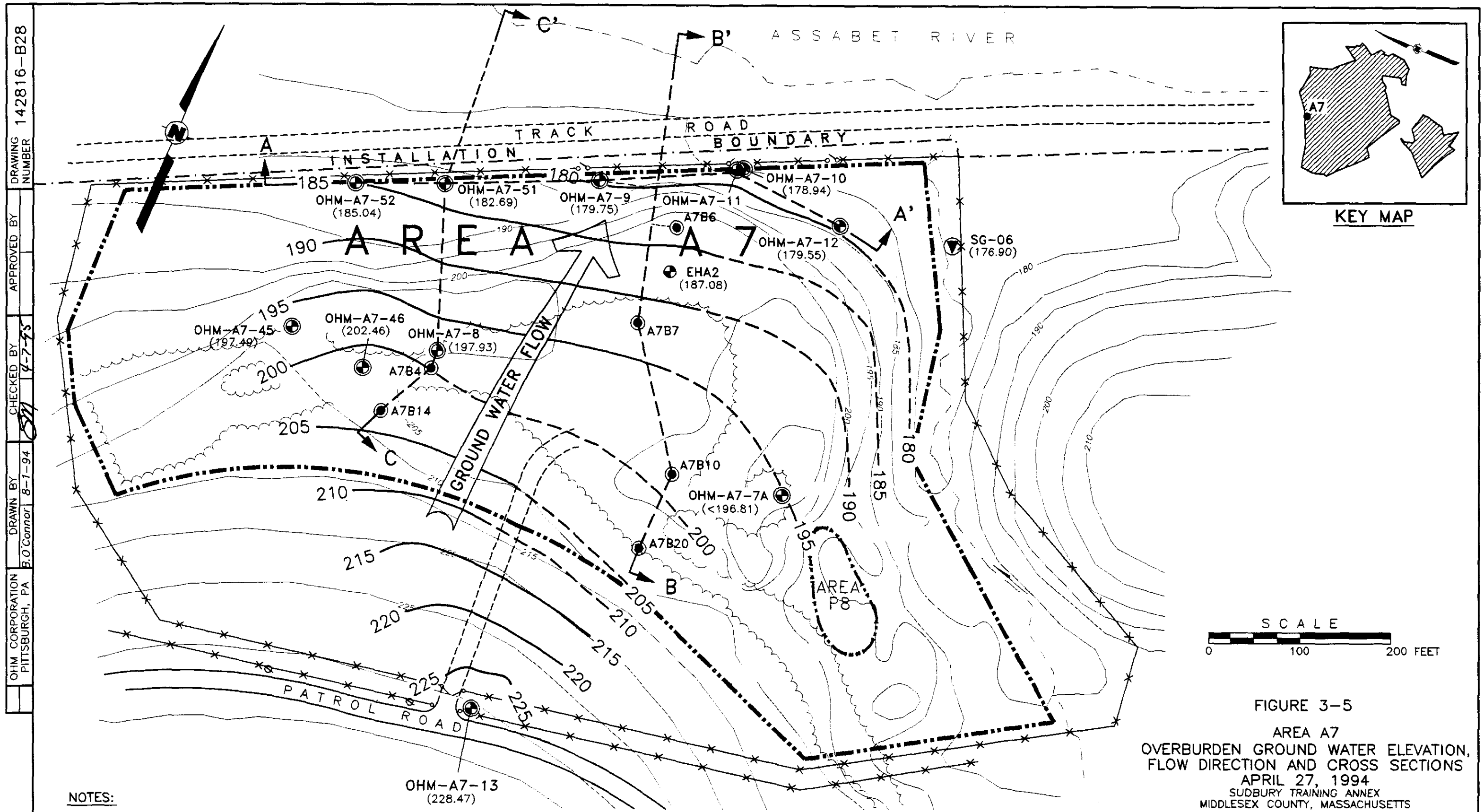
APPROVED BY

CHECKED BY 8-7-94

DRAWN BY B.O'Connor 8-1-94

OHM CORPORATION PITTSBURGH, PA

PLOT SCALE: 1" = 100'



NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 5 FOOT.

LEGEND:

220 ~ 220 GROUND WATER ELEVATION (MSL)

FIGURE 3-5

AREA A7
OVERBURDEN GROUND WATER ELEVATION, FLOW DIRECTION AND CROSS SECTIONS
APRIL 27, 1994
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY B.O'Connor 12-15-95

CHECKED BY 4-7-95

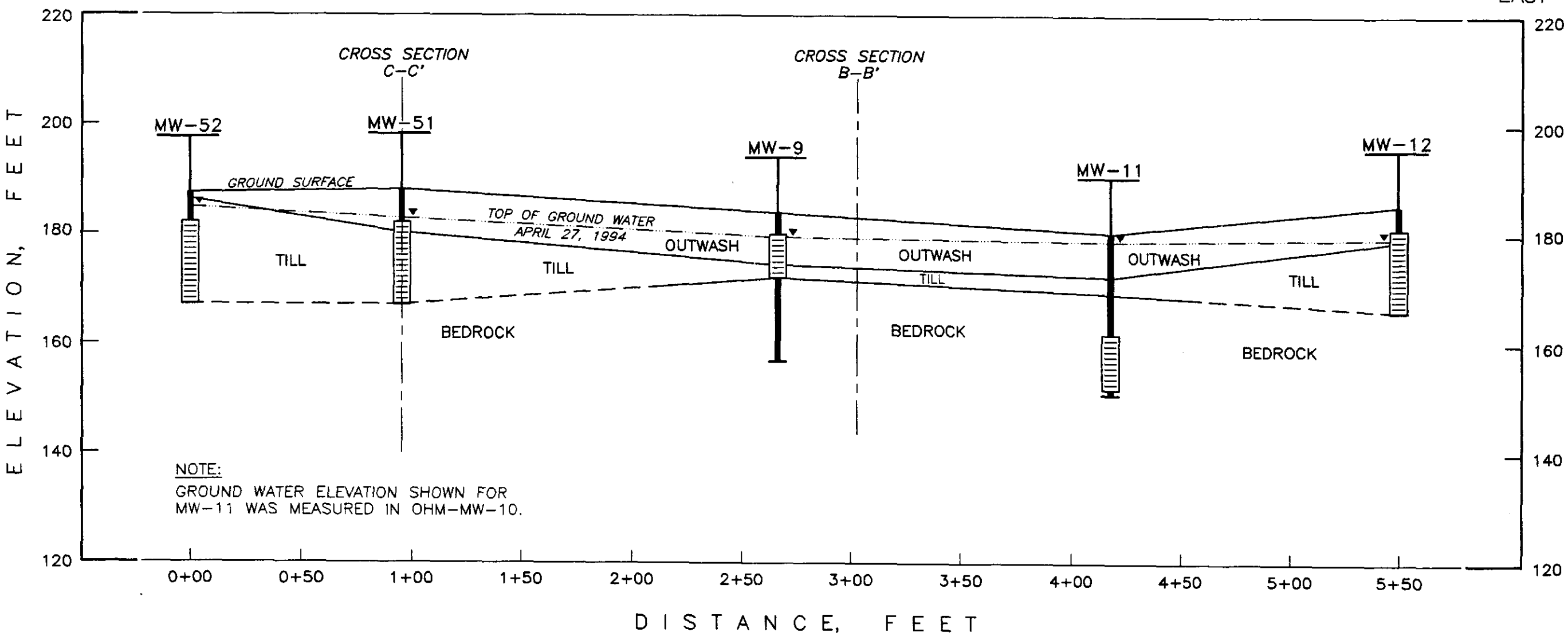
APPROVED BY

DRAWING NUMBER 14316-B36

PLOT SCALE: 1" = 1'

A
WEST

A'
EAST



NOTE:
GROUND WATER ELEVATION SHOWN FOR MW–11 WAS MEASURED IN OHM–MW–10.

LEGEND:

MW — MONITORING WELL
CASED
SCREENED
85 — PID READING ON SOIL SAMPLE
TOP OF GROUND WATER

HORIZONTAL SCALE
0 50 100 FEET

VERTICAL SCALE
0 20 40 FEET

FIGURE 3–6

AREA A7
DOWN GRADIENT STRIKE
CROSS SECTION A–A'
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

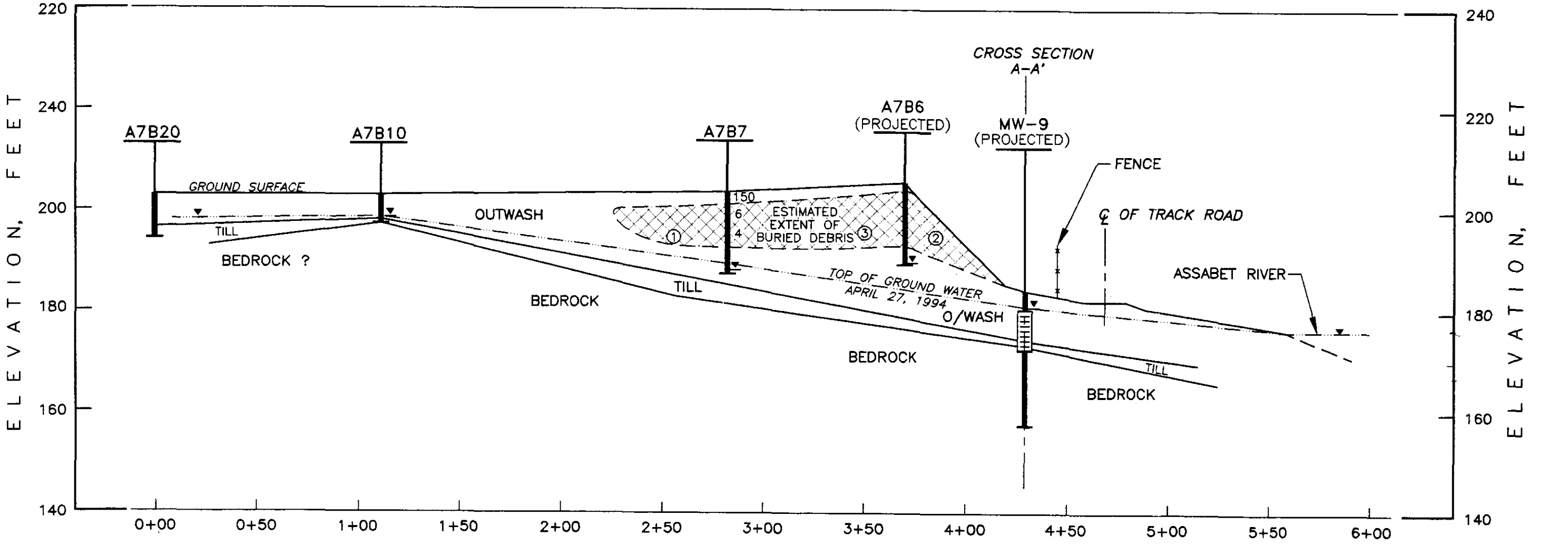
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 14316-B37
APPROVED BY
CHECKED BY 4-7-95
DRAWN BY B.O'Connor 12-15-95
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1" = 1'

B
SOUTH

B'
NORTH



LEGEND:

- MW — MONITORING WELL
- CASED
- SCREENED
- 85 — PID READING ON SOIL SAMPLE
- ▼ TOP OF GROUND WATER

NOTES:

① TEST PITS IN SB-7 AREA SHOW BURIED DEBRIS TO AT LEAST 6' BGS. HAVE ASSUMED DEPTH OF DEBRIS TO BE ~10' BASED ON BORING SB-6 RESULTS (CONSERVATIVE CHOICE).

② DEPTH OF DEBRIS AT FACE OF SLOPE ESTIMATED BASED ON TEST PITS M, N, AND P (4' EACH) AND TESTPIT O (6'+). SEE FIGURE ? FOR LOCATIONS.

③ EXTENT SHOWN WAS USED FOR CONSERVATIVE VOLUME ESTIMATION. THE ACTUAL LATERAL AND VERTICAL DISTRIBUTION OF BURIED DEBRIS IS NOT UNIFORM.

HORIZONTAL SCALE
0 50 100 FEET

VERTICAL SCALE
0 20 40 FEET

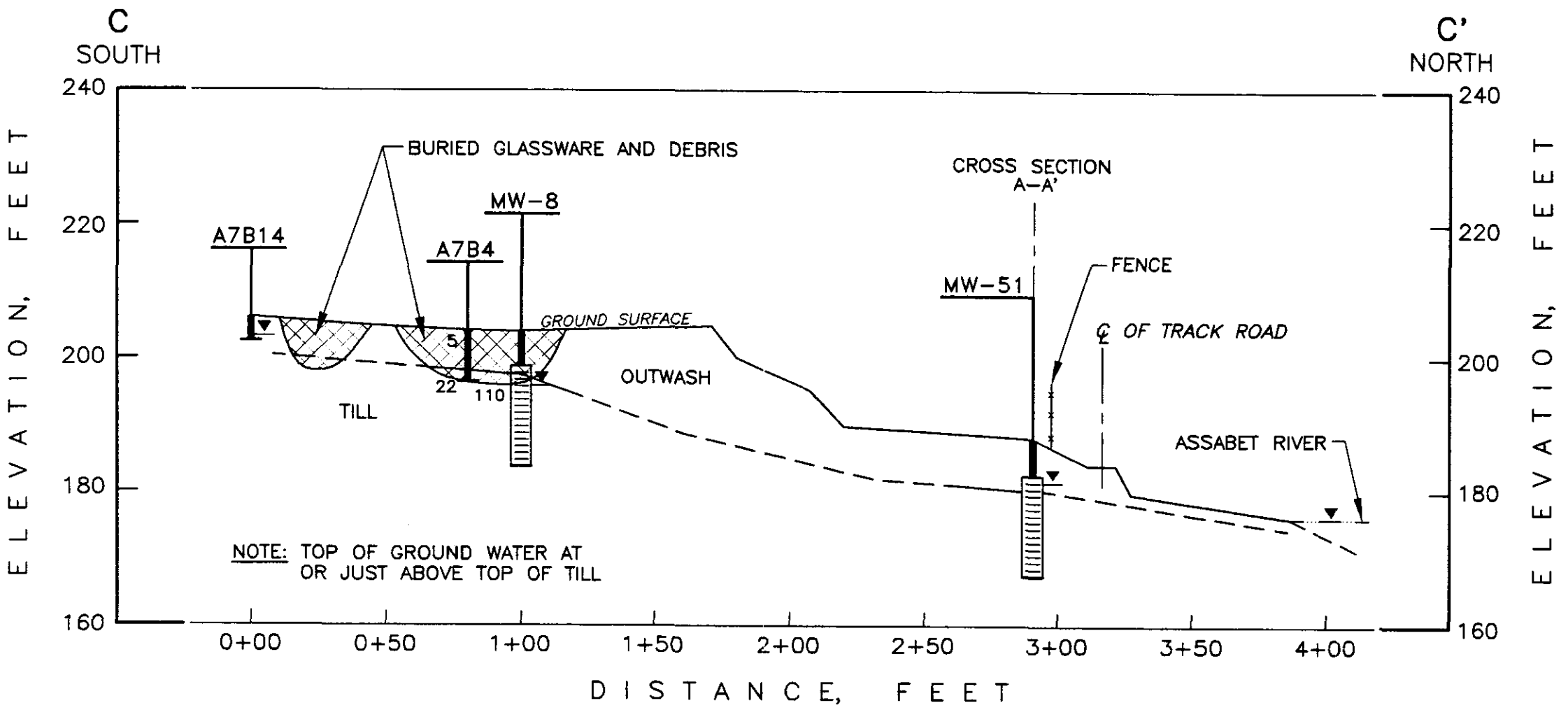
FIGURE 3-7

AREA A7
DIP CROSS SECTION B-B'
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



LEGEND:

MW — MONITORING WELL
CASED
SCREENED
85 — PID READING ON SOIL SAMPLE
TOP OF GROUND WATER

HORIZONTAL SCALE
0 50 100 FEET

VERTICAL SCALE
0 20 40 FEET

FIGURE 3-8

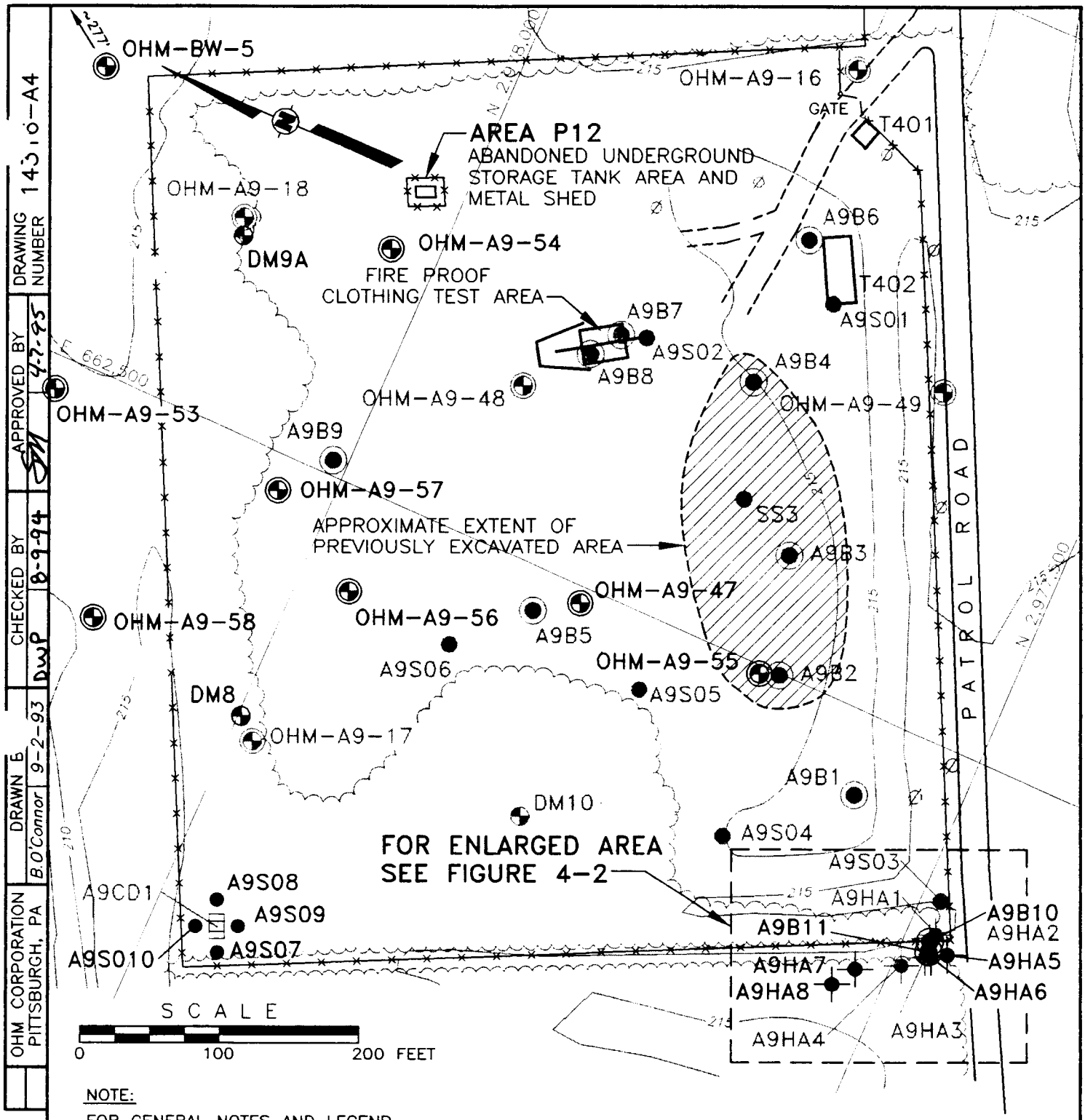
AREA A7
DIP CROSS SECTION C-C'
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 14316-B38
APPROVED BY
CHECKED BY 12-7-95
DRAWN BY B.O'Connor 12-16-94
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1" = 1'



NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

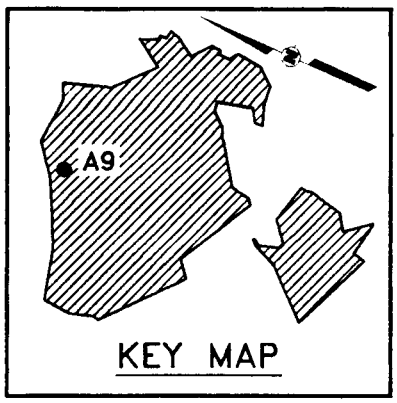


FIGURE 4-1

AREA A9
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

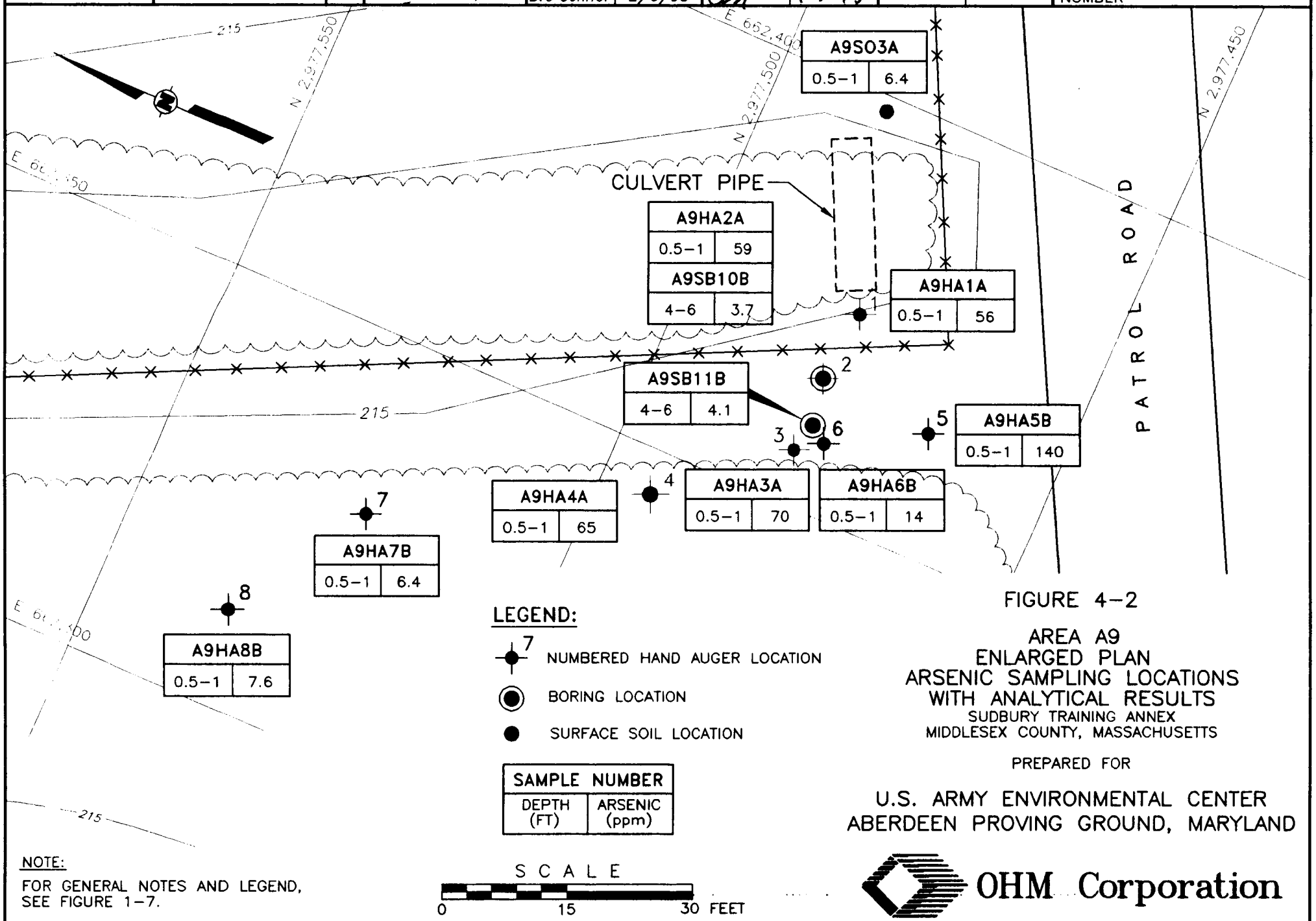
PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 143,0-A4
APPROVED BY 4-7-95
CHECKED BY 8-9-94 DWP
DRAWN B. O'Connor 9-2-93
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1 = 100

PLOT SCALE: 1" = 15'	OHM CORPORATION PITTSBURGH, PA	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
		B.O'Connor 2/6/95	SM 4-7-95		14316-A65



LEGEND:

- 7 — NUMBERED HAND AUGER LOCATION
- BORING LOCATION
- SURFACE SOIL LOCATION

SAMPLE NUMBER	
DEPTH (FT)	ARSENIC (ppm)

SCALE

0 15 30 FEET

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1–7.

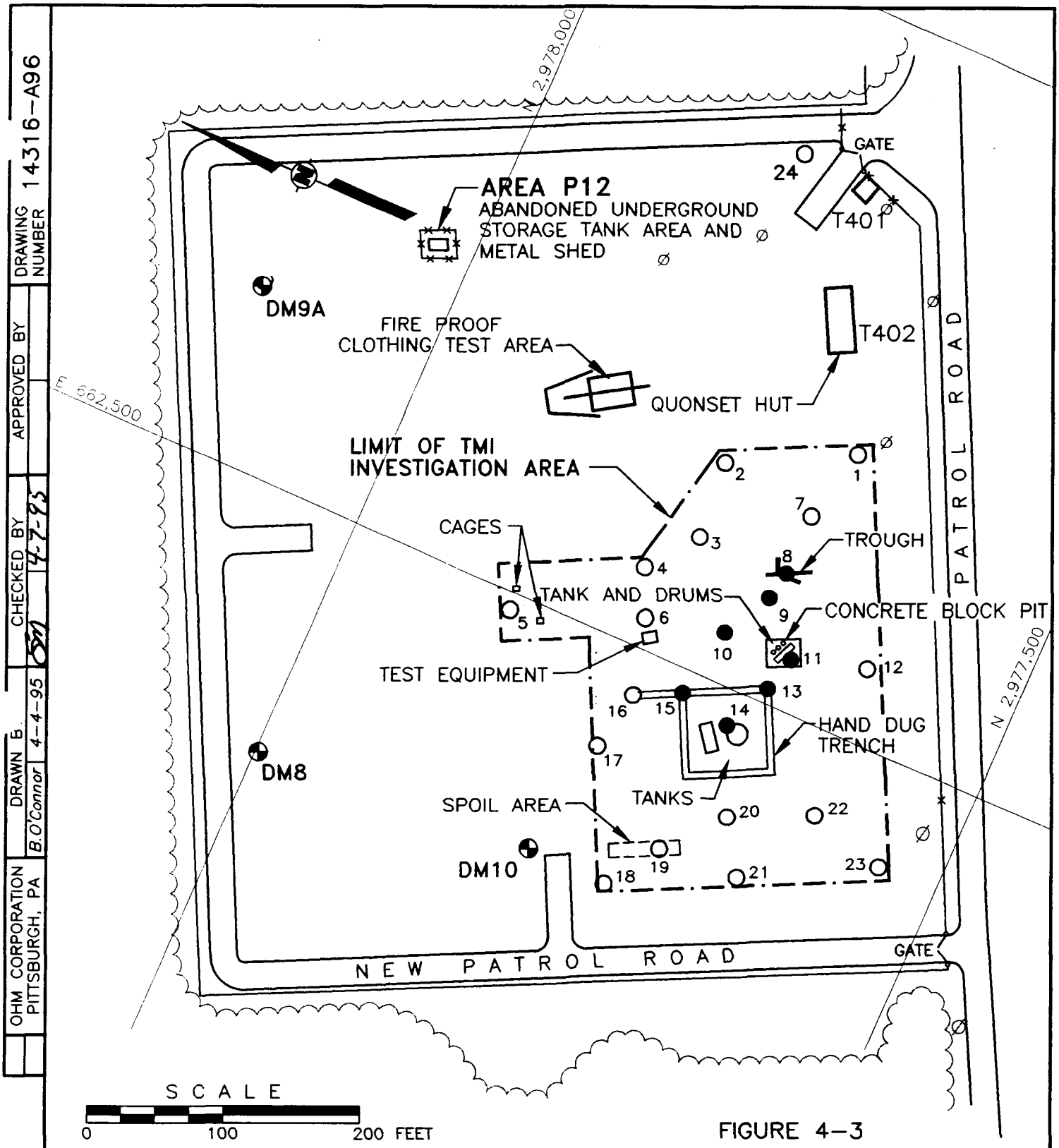
FIGURE 4–2

AREA A9
ENLARGED PLAN
ARSENIC SAMPLING LOCATIONS
WITH ANALYTICAL RESULTS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



NOTE:
FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

LEGEND:

21 ○ SURFACE SOIL SAMPLE

10 ● SURFACE SOIL SAMPLE AND ADDITIONAL SOIL SAMPLE TAKEN BELOW SURFACE

REFERENCE:
TMI INVESTIGATION AREA PREPARED FROM DRAWING BY QUARTERMASTER RESEARCH AND ENGINEERING COMMAND, DWG. NO. FE-86-10, DATED: 9, MAY, 1986.

FIGURE 4-3

AREA A9
PRIOR USE AREAS - 1986
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN B: B.O'Connor 4-4-95

CHECKED BY: 4-7-95

APPROVED BY:

DRAWING NUMBER 14316-A96

PLOT SCALE: 1 = 100

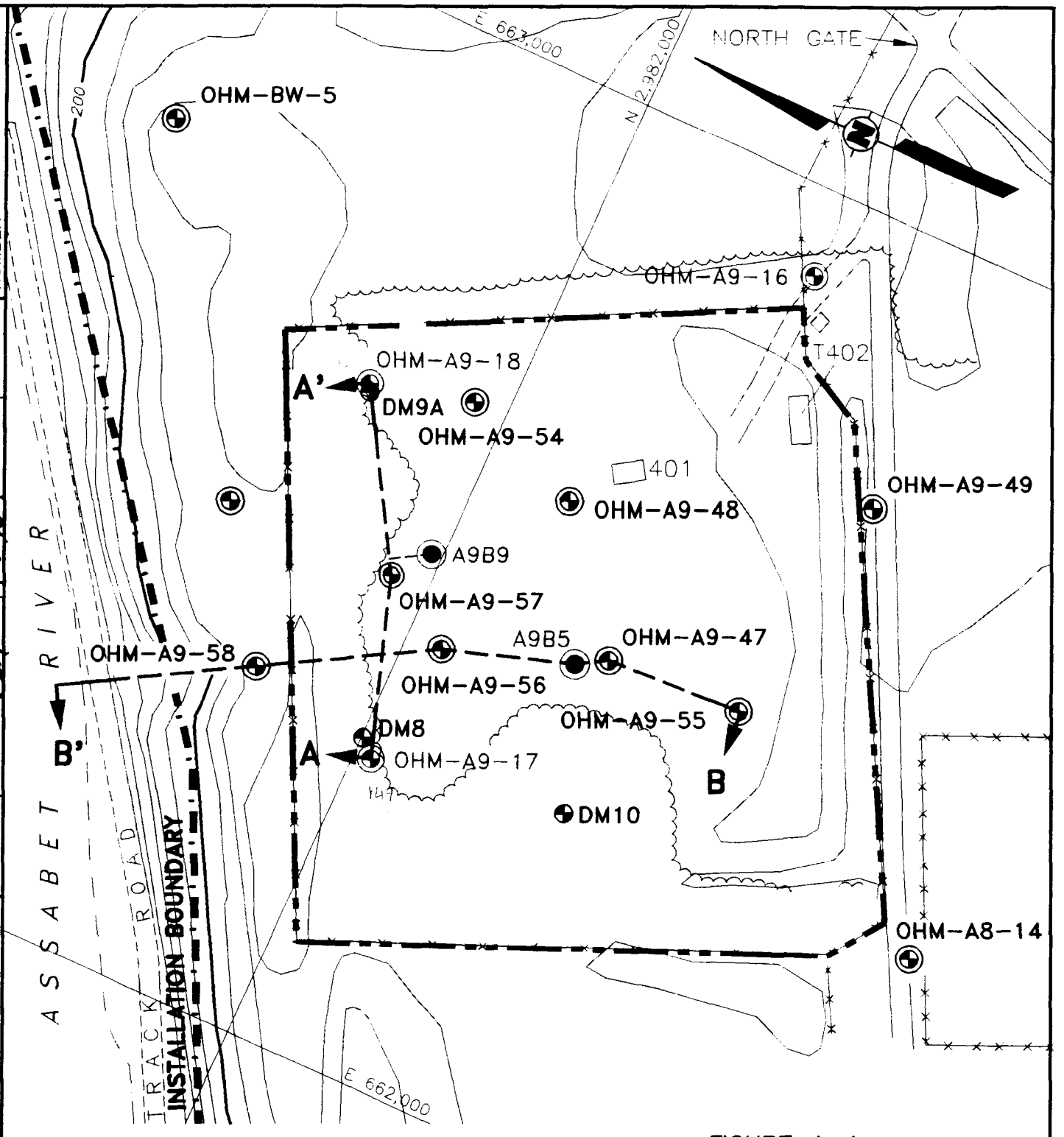


FIGURE 4-4

AREA A9
CROSS SECTION LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

SCALE
0 140 280 FEET

NOTES:

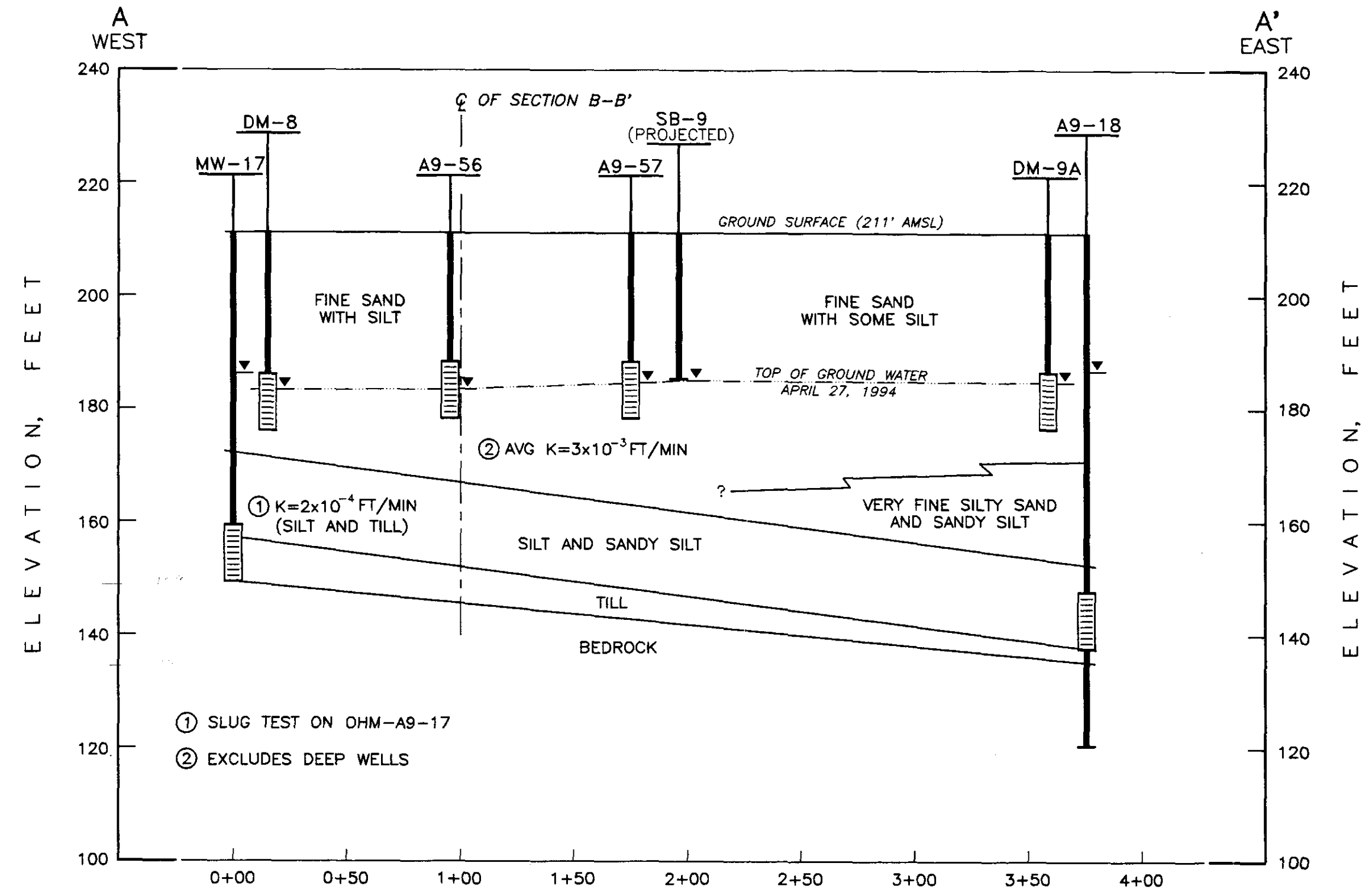
1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY: B.O'Connor 4-6-95
CHECKED BY: 4-7-95
APPROVED BY:
DRAWING NUMBER: 14316-A100
PLOT SCALE: 1" = 140'

DRAWING NUMBER 14316-B33
APPROVED BY
CHECKED BY 12-7-93
DRAWN BY B.O'Connor 12-14-94
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1" = 1'



LEGEND:

MW — MONITORING WELL
CASED
SCREENED
85 — PID READING ON SOIL SAMPLE
TOP OF GROUND WATER

HORIZONTAL SCALE
0 50 100 FEET

VERTICAL SCALE
0 20 40 FEET

FIGURE 4-5

AREA A9
DOWNGRADIENT STRIKE
CROSS SECTION A-A'
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

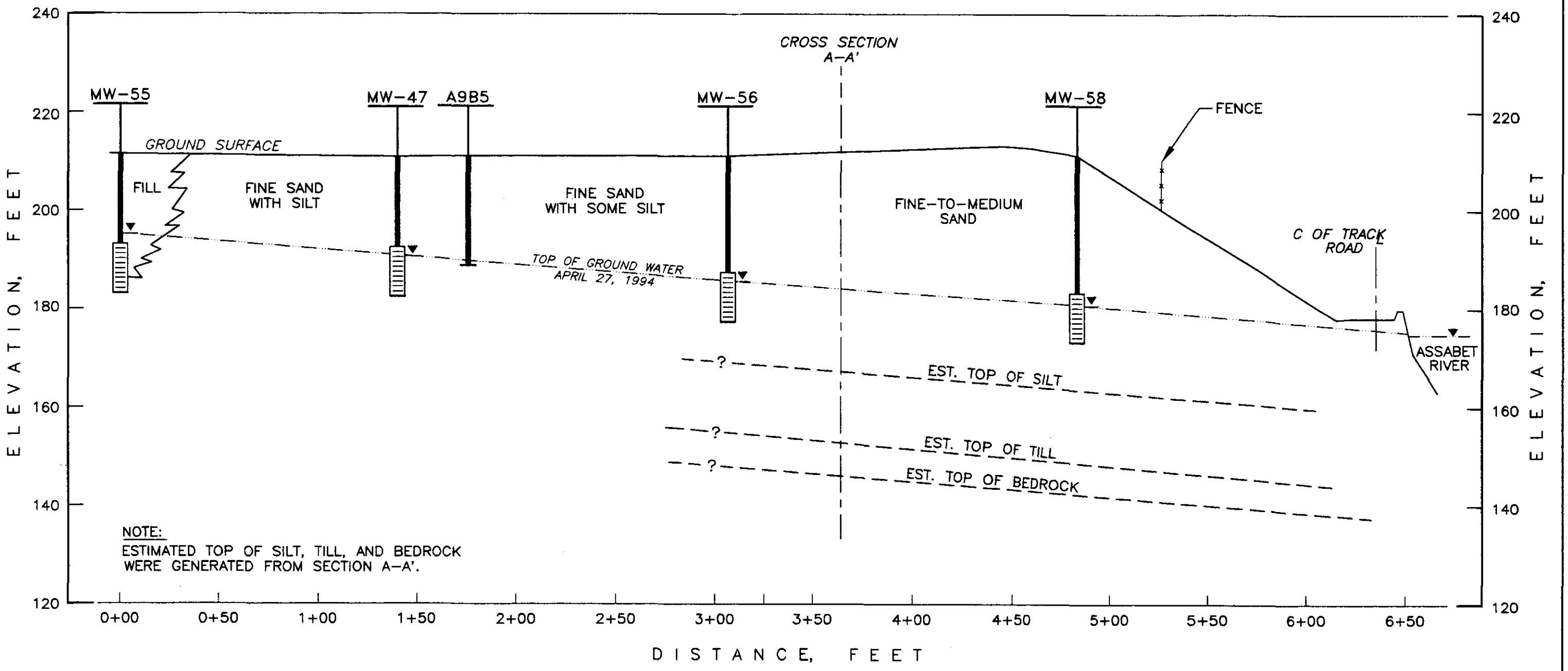
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

DRAWING NUMBER 14316-B34
APPROVED BY
CHECKED BY 7-7-95
DRAWN BY B.O'Connor 12-14-94
OHM CORPORATION PITTSBURGH, PA
PLOT SCALE: 1" = 1'

B
SOUTH

B'
NORTH



NOTE:
ESTIMATED TOP OF SILT, TILL, AND BEDROCK WERE GENERATED FROM SECTION A–A'.

LEGEND:

- MW — MONITORING WELL
- CASED
- SCREENED
- 85 — PID READING ON SOIL SAMPLE
- TOP OF GROUND WATER

HORIZONTAL SCALE
0 50 100 FEET

VERTICAL SCALE
0 20 40 FEET

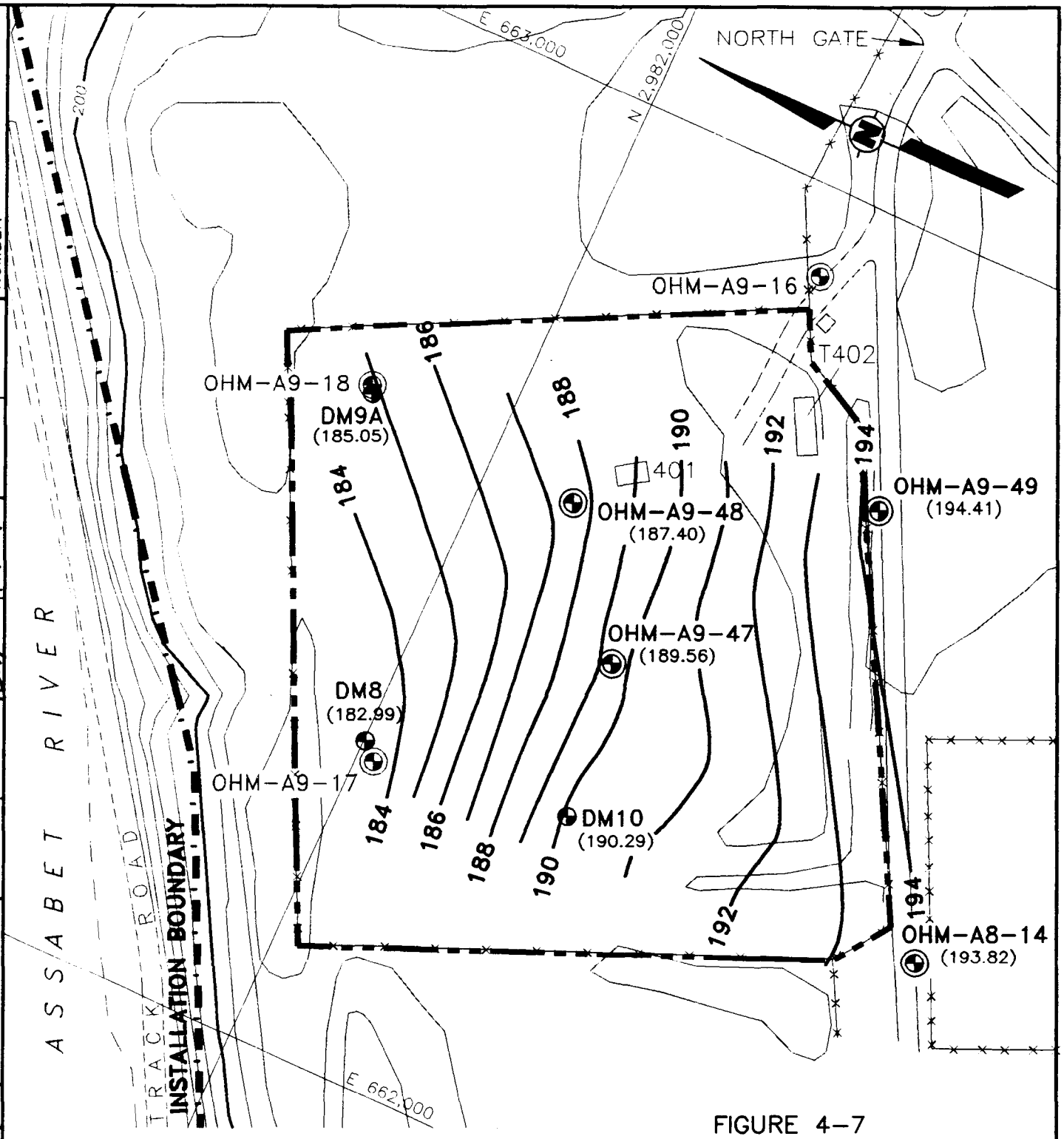
FIGURE 4–6

AREA A9
DIP CROSS SECTION B–B'
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



SCALE

0 140 280 FEET

FIGURE 4-7

AREA A9
OVERBURDEN GROUND WATER ELEVATION
JUNE 15, 1992
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTES:

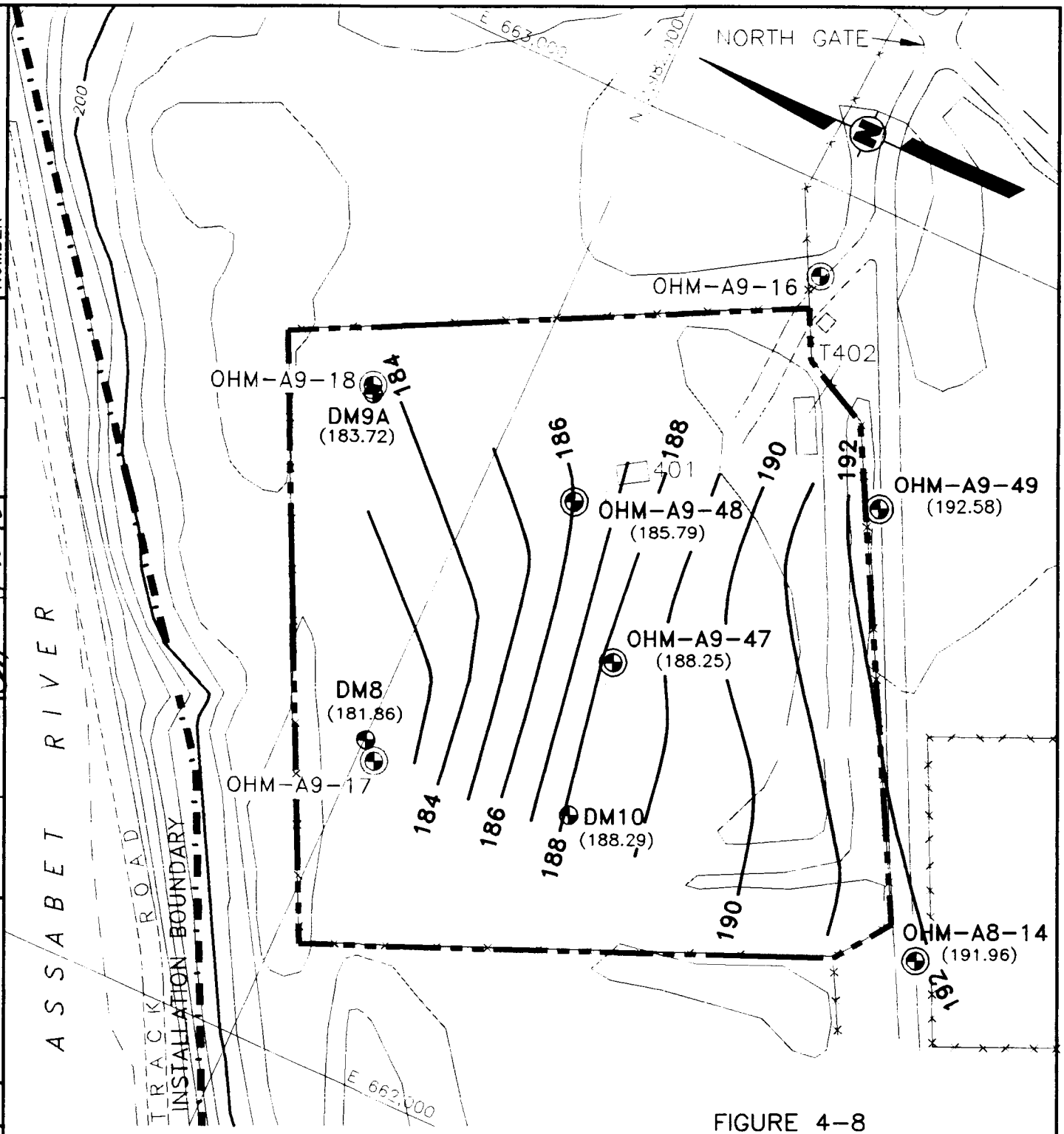
1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 1 FOOT.

LEGEND:

192 ~ 192 GROUND WATER ELEVATION (MSL)

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY: B.O'Connor 2-9-95
CHECKED BY: 4-10-95
APPROVED BY:
DRAWING NUMBER: 14316-A84
PLOT SCALE: 1" = 140'



SCALE

0 140 280 FEET

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 1 FOOT.

LEGEND:

230 ~ 230 GROUND WATER ELEVATION (MSL)

FIGURE 4-8

AREA A9
OVERBURDEN GROUND WATER ELEVATION
OCTOBER 23, 1992
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

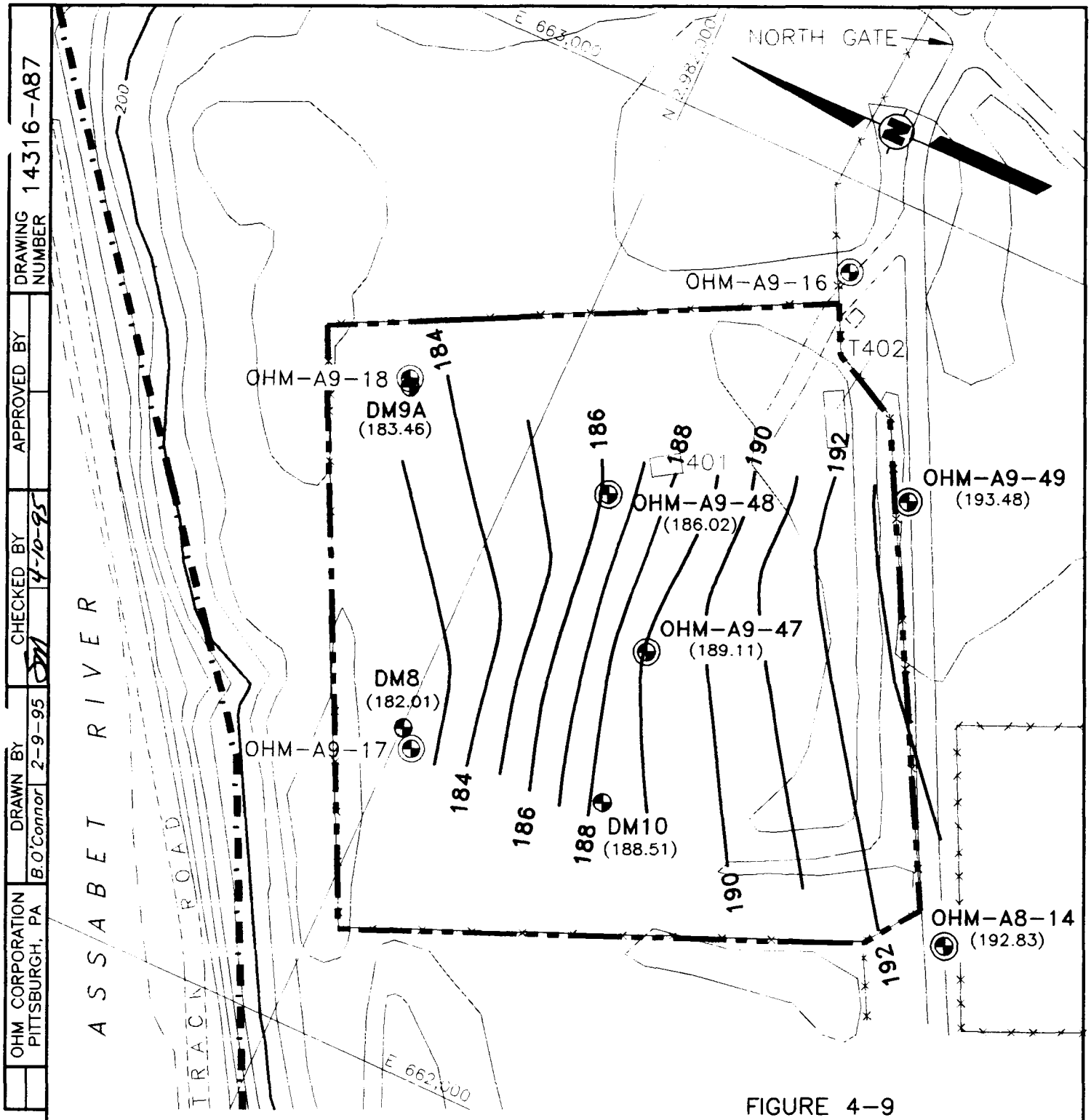
DRAWN B. B.O'Connor 2-9-95

CHECKED BY SM 4-10-95

APPROVED BY

DRAWING NUMBER 14316-A86

PLOT SCALE: 1" = 140'



SCALE

0 140 280 FEET

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 1 FOOT.

LEGEND:

230 ~ 230 GROUND WATER ELEVATION (MSL)

FIGURE 4-9

AREA A9
OVERBURDEN GROUND WATER ELEVATION
JANUARY 8, 1993
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

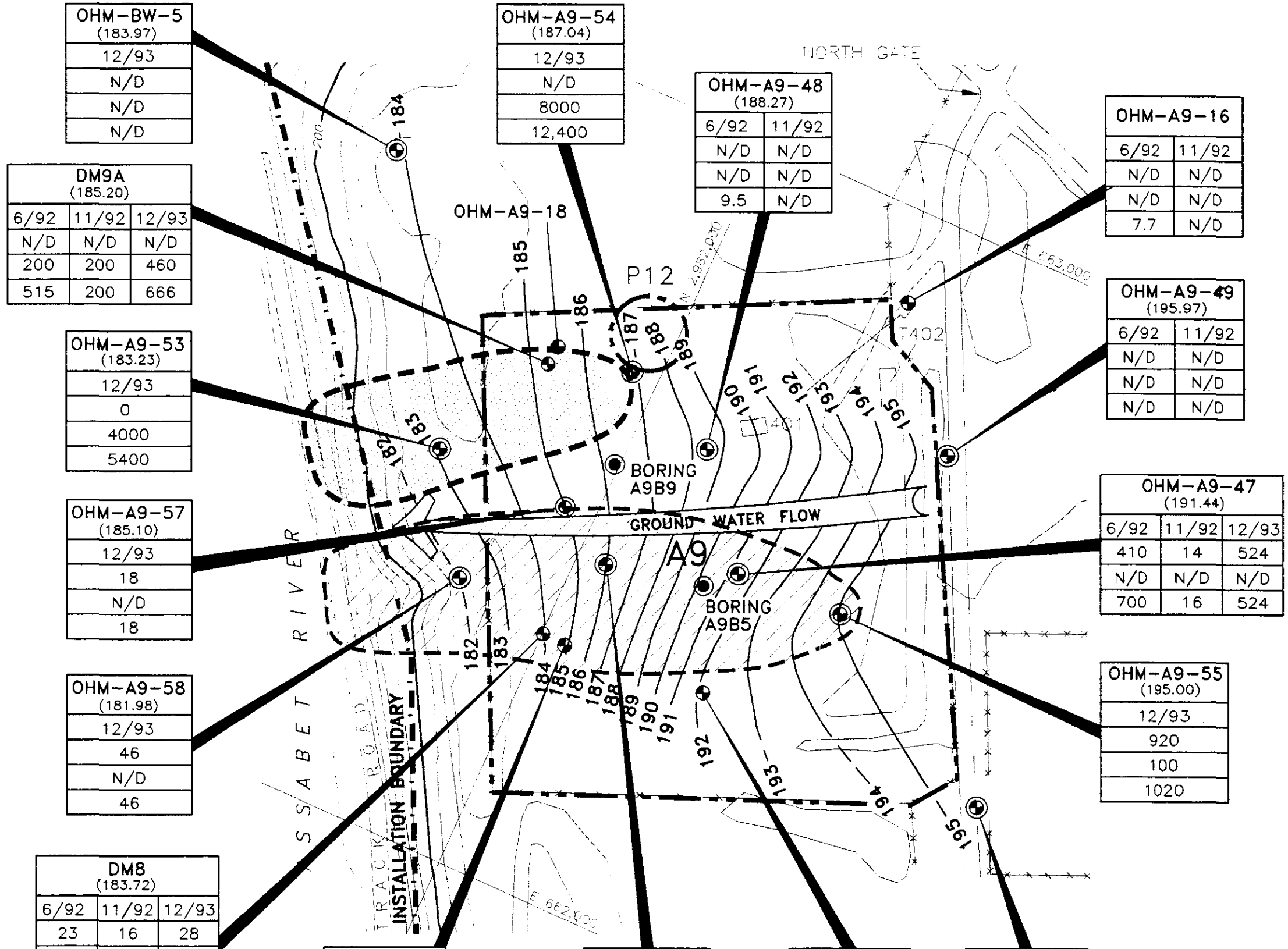
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
OHM CORPORATION PITTSBURGH, PA	B.O'Connor 2-9-95	4-10-95		14316-A87

PLOT SCALE: 1" = 140'

DRAWING NUMBER	14316-B32
APPROVED BY	
CHECKED BY	4-10-95
DRAWN BY	B.O'Connor 12-29-94
OHM CORPORATION PITTSBURGH, PA	
PLOT SCALE: 1" = 140'	



OHM-BW-5 (183.97)
12/93
N/D
N/D
N/D

OHM-A9-54 (187.04)
12/93
N/D
8000
12,400

OHM-A9-48 (188.27)	
6/92	11/92
N/D	N/D
N/D	N/D
9.5	N/D

OHM-A9-16	
6/92	11/92
N/D	N/D
N/D	N/D
7.7	N/D

DM9A (185.20)		
6/92	11/92	12/93
N/D	N/D	N/D
200	200	460
515	200	666

OHM-A9-49 (195.97)	
6/92	11/92
N/D	N/D
N/D	N/D
N/D	N/D

OHM-A9-53 (183.23)
12/93
0
4000
5400

OHM-A9-47 (191.44)		
6/92	11/92	12/93
410	14	524
N/D	N/D	N/D
700	16	524

OHM-A9-57 (185.10)
12/93
18
N/D
18

OHM-A9-58 (181.98)
12/93
46
N/D
46

OHM-A9-55 (195.00)
12/93
920
100
1020

DM8 (183.72)		
6/92	11/92	12/93
23	16	28
0	0	0
23	16	28

OHM-A9-17	
6/92	11/92
N/D	N/D
N/D	N/D
N/D	N/D

OHM-A9-56 (185.71)
12/93
2070
N/D
2070

DM10 (192.35)	
6/92	11/92
N/D	N/D
N/D	N/D
N/D	N/D

OHM-A8-14 (195.56)	
6/92	11/92
N/D	N/D
N/D	N/D
7.6	N/D

NOTES:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
2. GROUND WATER ELEVATION CONTOUR INTERVAL = 1 FOOT.

LEGEND:

185 ~ 185 — GROUND WATER ELEVATION (MSL)

N/D — NONDETECTION

OHM-A9-54 (187.04)	WELL IDENTIFICATION GROUND WATER ELEVATION
12/92	DATE SAMPLES TAKEN
N/D	CHLORINATED VOCs (µg/l)
8000	TOTAL XYLENES (µg/l)
12,400	TOTAL VOCs (µg/l)

XYLENES PLUME

CHLORINATED VOC PLUME

CHLOR VOCs = SUM OF 11DCE, 111TCA, TCE

SCALE
0 140 280 FEET

FIGURE 4-12

AREA A9
AREAL EXTENT OF CHLORINATED VOC AND XYLENES PLUME
APRIL 27, 1994
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

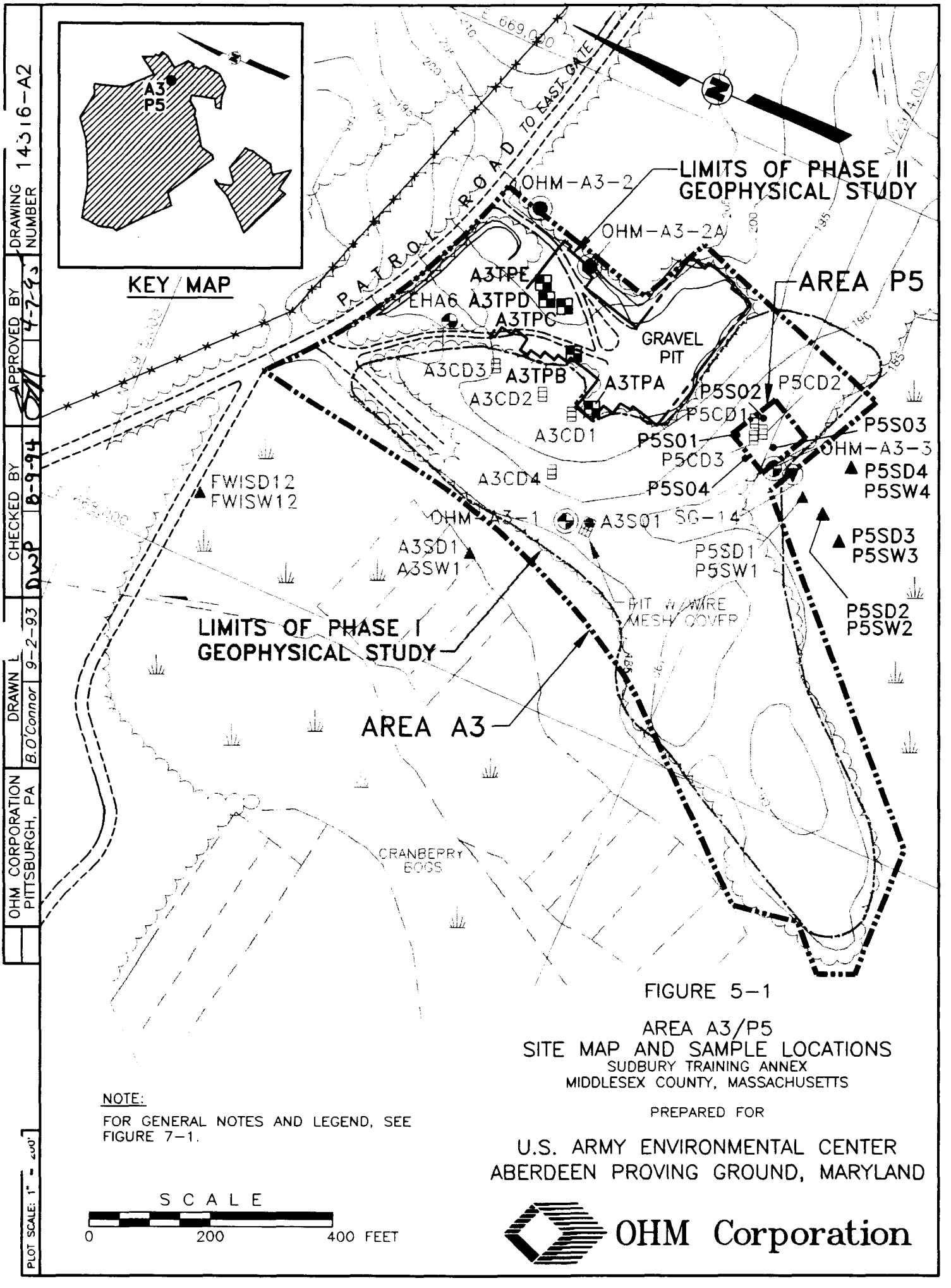


FIGURE 5-1

AREA A3/P5
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

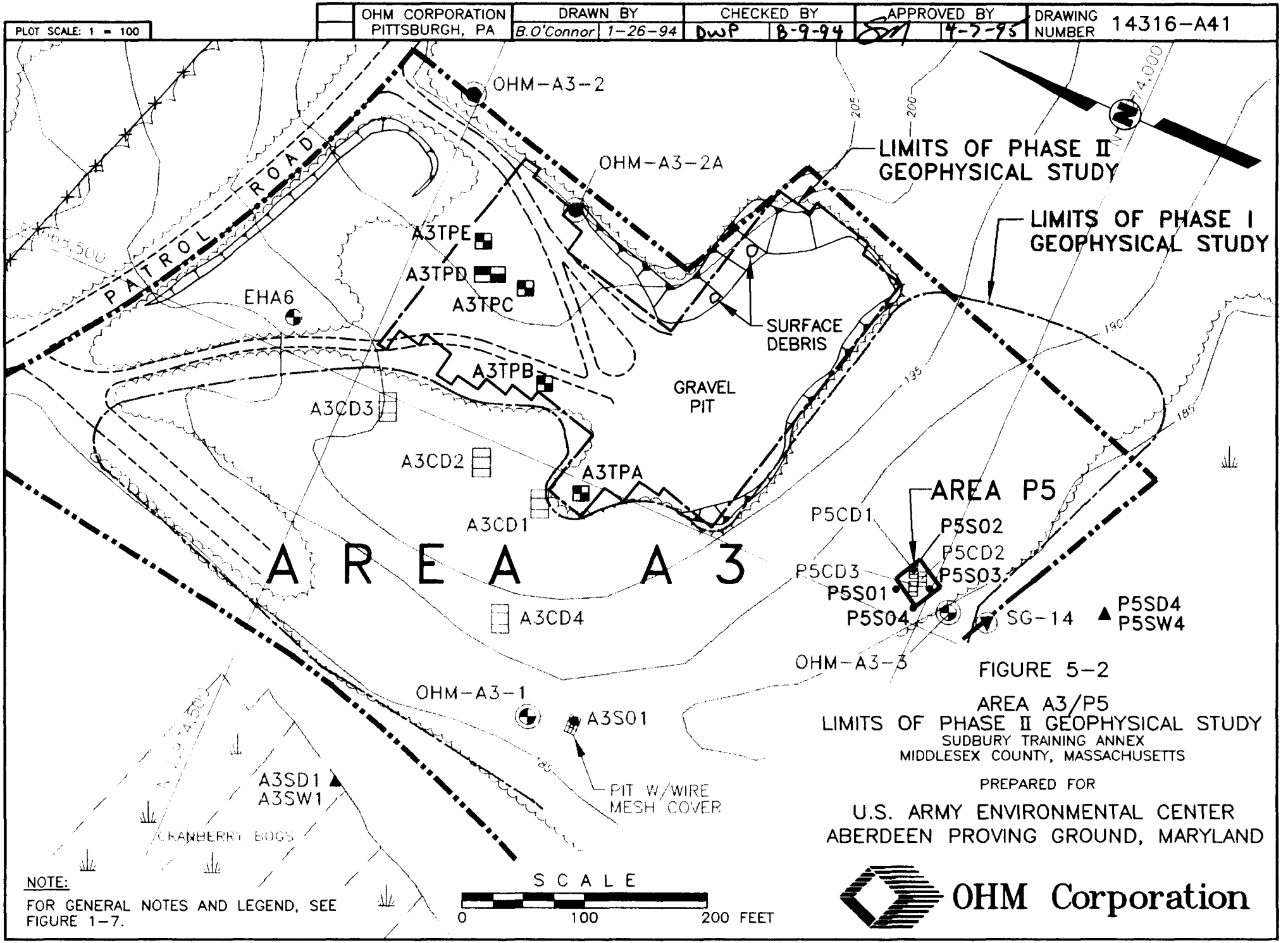
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

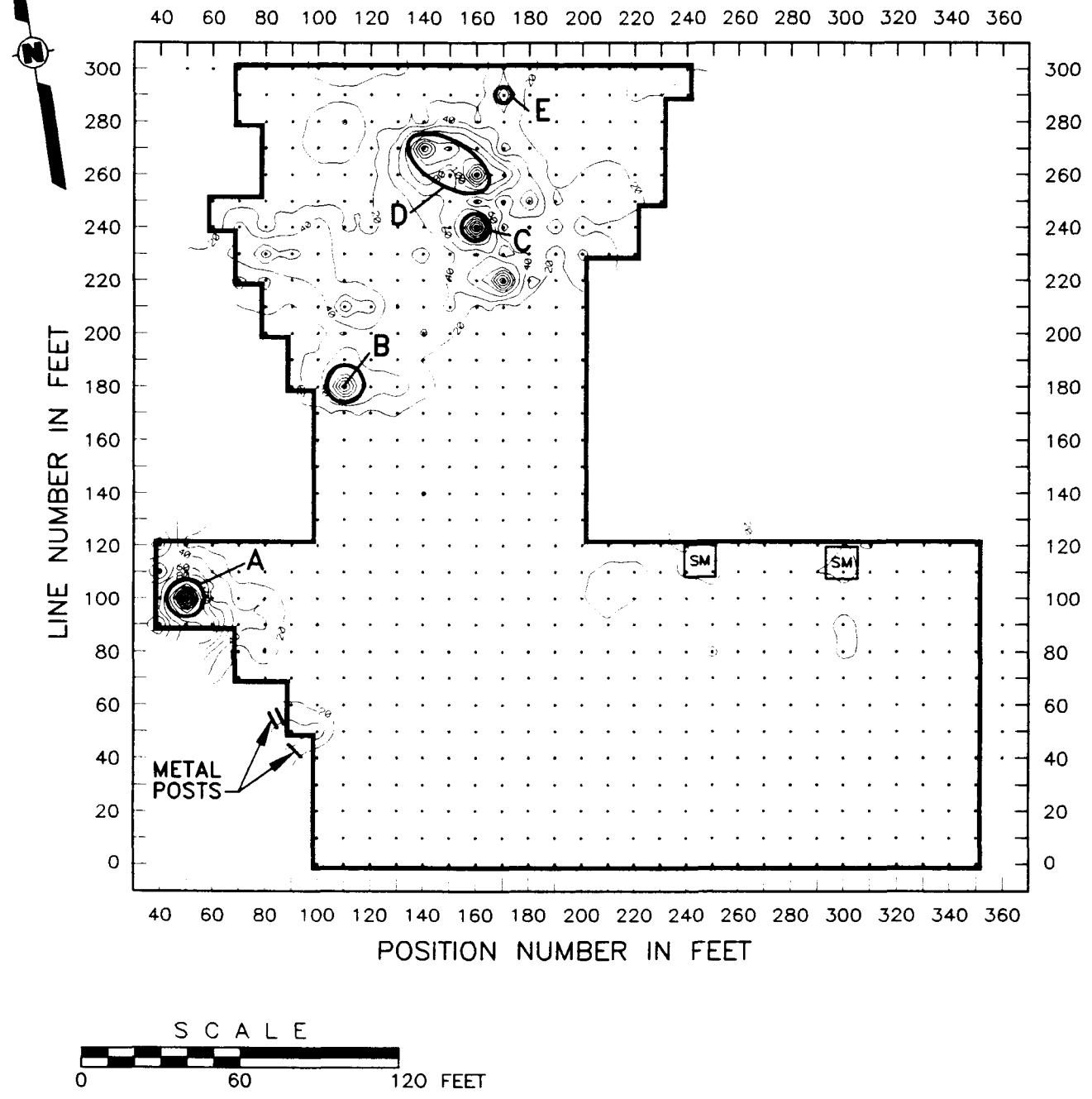
NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 7-1.

SCALE
0 200 400 FEET

OHM Corporation


PLOT SCALE: 1 = 100
OHM CORPORATION PITTSBURGH, PA
DRAWN BY B.O'Connor 1-26-94
CHECKED BY DwP 8-9-94
APPROVED BY 4-7-95
DRAWING NUMBER 14316-A41
OHM-A3-2
OHM-A3-2A
OHM-A3-1
OHM-A3-3
PATROL ROAD
LIMITS OF PHASE II GEOPHYSICAL STUDY
LIMITS OF PHASE I GEOPHYSICAL STUDY
A3TPE
A3TPD
A3TPC
A3TPB
A3TPA
EHA6
SURFACE DEBRIS
GRAVEL PIT
A3CD3
A3CD2
A3CD1
A3CD4
A3S01
PIT W/WIRE MESH COVER
AREA A3
AREA P5
P5CD1
P5CD2
P5CD3
P5S01
P5S02
P5S03
P5S04
SG-14
P5SD4
P5SW4
A3SD1
A3SW1
CRANBERRY BOGS
205
200
195
190
185
180
N 74,000
N 73,500
N 73,000
SCALE
0
100
200 FEET
NOTE:
FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.
FIGURE 5-2
AREA A3/P5
LIMITS OF PHASE II GEOPHYSICAL STUDY
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS
PREPARED FOR
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND
OHM Corporation



SCALE

0 60 120 FEET

LEGEND:

- MAGNETIC GRADIENT CONTOUR IN GAMMAS PER METER
- MAGNETIC GRADIENT DATA POINT
- (A) APPROXIMATE LOCATION OF MAGNETIC ANOMALY
- [SM] SCRAP METAL

NOTES:

1. MAGNETIC GRADIENT CONTOUR INTERVAL VARIES
2. FOR SITE MAP OF AREA, SEE FIGURE 5-1.
3. LOCATION OF THE OBJECTS OUTSIDE OF THE GEOPHYSICAL STUDY AREA ARE RELATIVE ONLY AND ARE NOT TO SCALE.

FIGURE 5-3

AREA A3
PHASE II GEOPHYSICAL STUDY
MAGNETIC ISO-GRADIENT
CONTOUR MAP
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY: B.O'Connor 1-28-94
CHECKED BY: DWP 8-9-94
APPROVED BY: [signature] 9-7-94
DRAWING NUMBER: 14316-A42

PLOT SCALE: 1" = 1'

OHM CORPORATION PITTSBURGH, PA	DRAWN B.O'Connor 6-10-94	CHECKED BY DwP 8-9-94	APPROVED BY [signature] 9-7-95	DRAWING NUMBER 14-, 6-A63

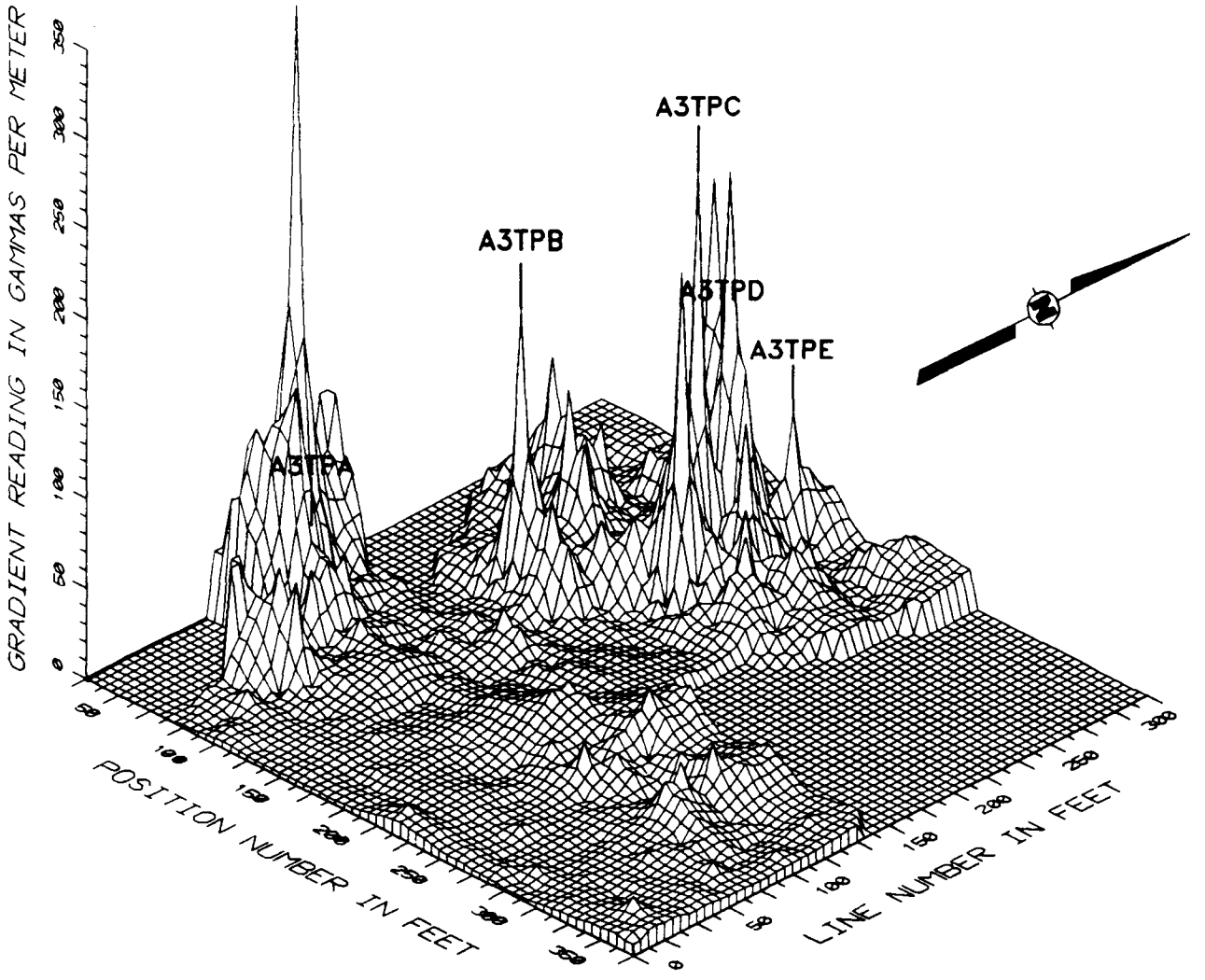


FIGURE 5-4

AREA A3
MAGNETIC GRADIENT CONTOUR MAP
AND TEST PIT LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

SCALE
0 100 200 FEET

NOTE: FOR PLAN LOCATION OF GEOPHYSICAL STUDY AREA, SEE FIGURE 5-2.

OHM Corporation

PLOT SCALE: 1" =

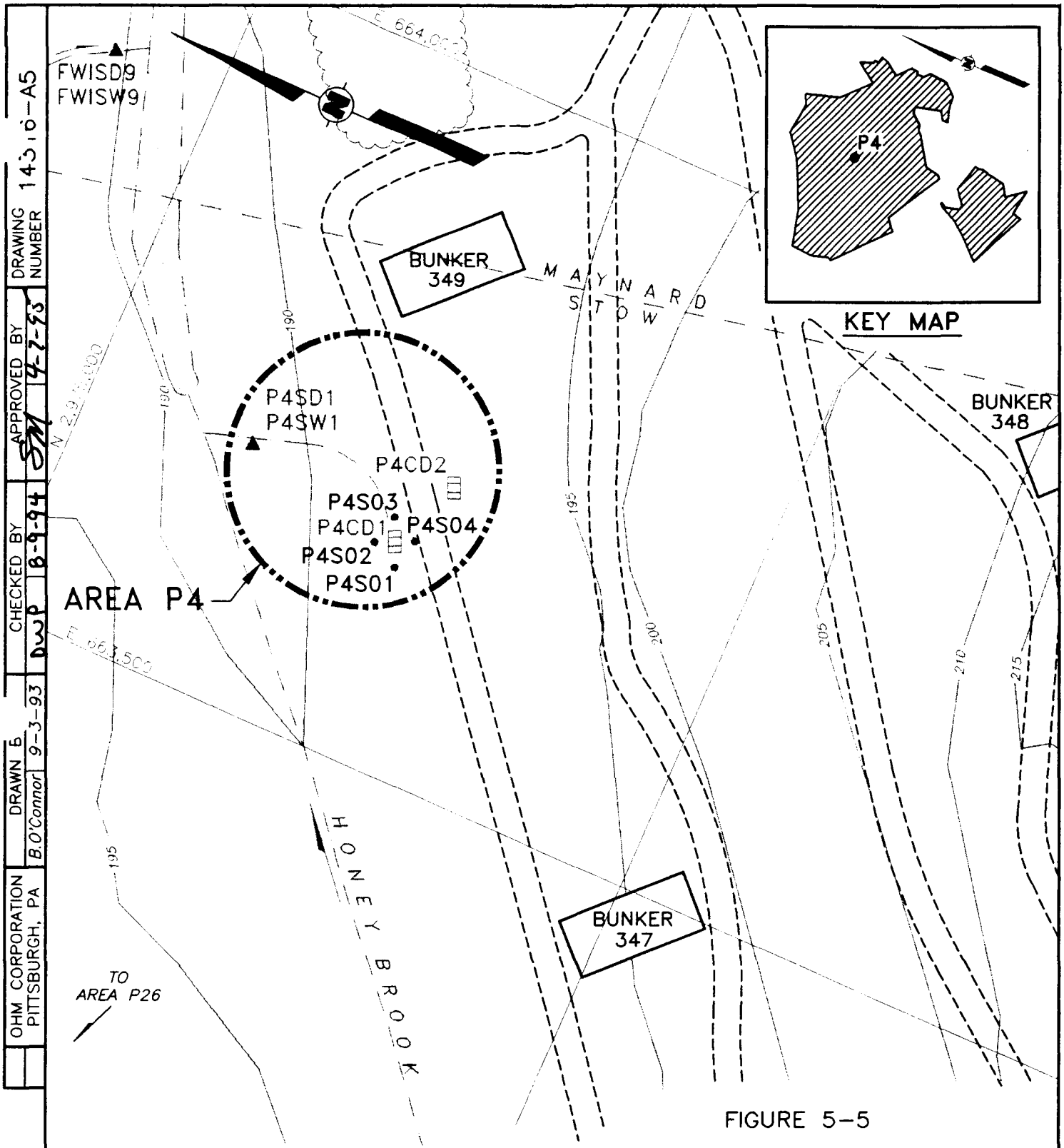


FIGURE 5-5

AREA P4
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

SCALE
0 100 200 FEET

OHM Corporation

OHM CORPORATION PITTSBURGH, PA | DRAWN B. O'Connor 9-3-93 | CHECKED DWP 8-9-94 | APPROVED SM 4-7-95 | DRAWING NUMBER 14316-A5 | PLOT SCALE: 1" = 100'

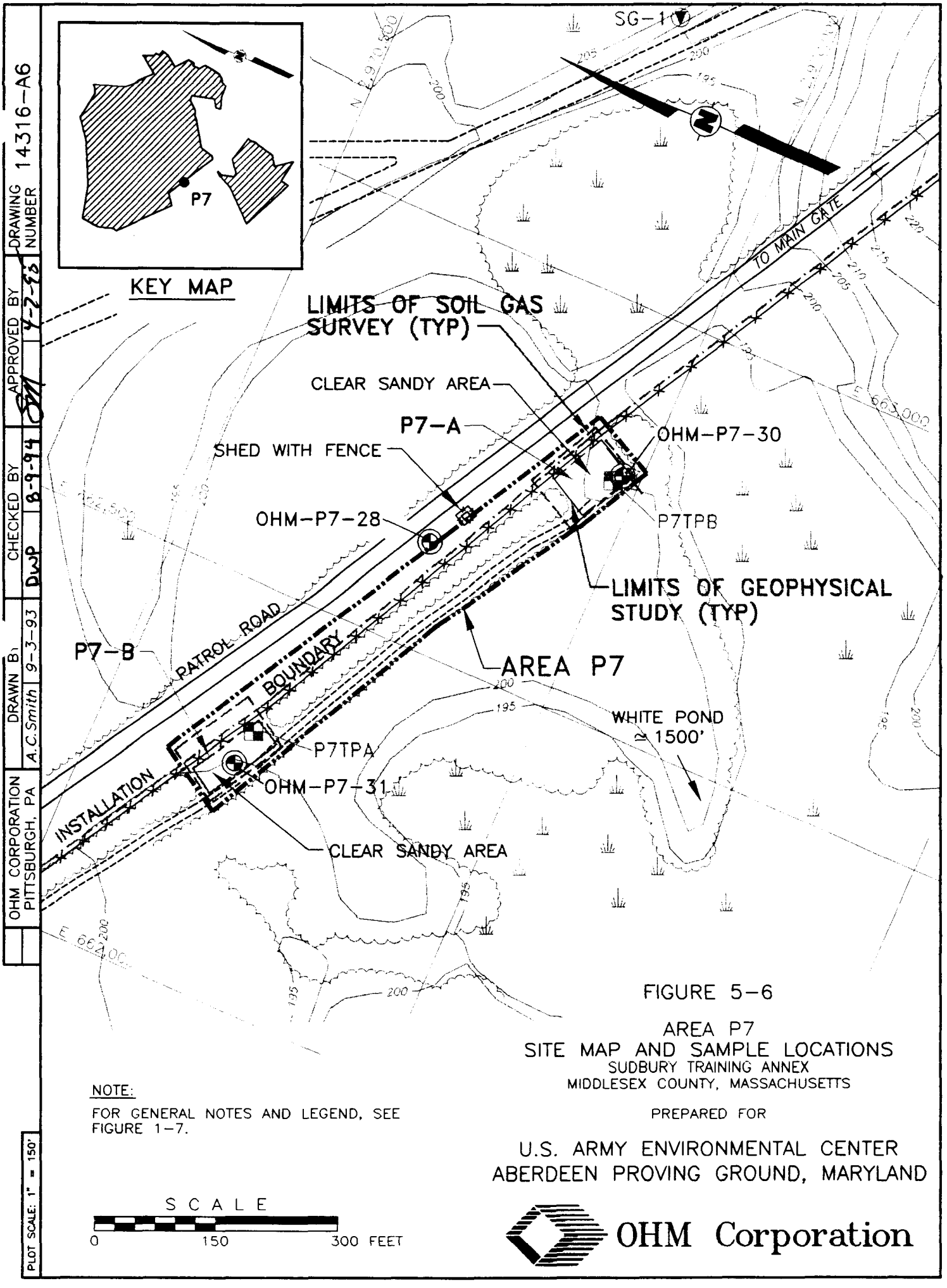


FIGURE 5-6

AREA P7
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTE:
FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

SCALE
0 150 300 FEET

OHM Corporation

OHM CORPORATION
PITTSBURGH, PA

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
A.C. Smith 9-3-93	DWP 8-9-94	4-2-95	14316-A6

PLOT SCALE: 1" = 150'

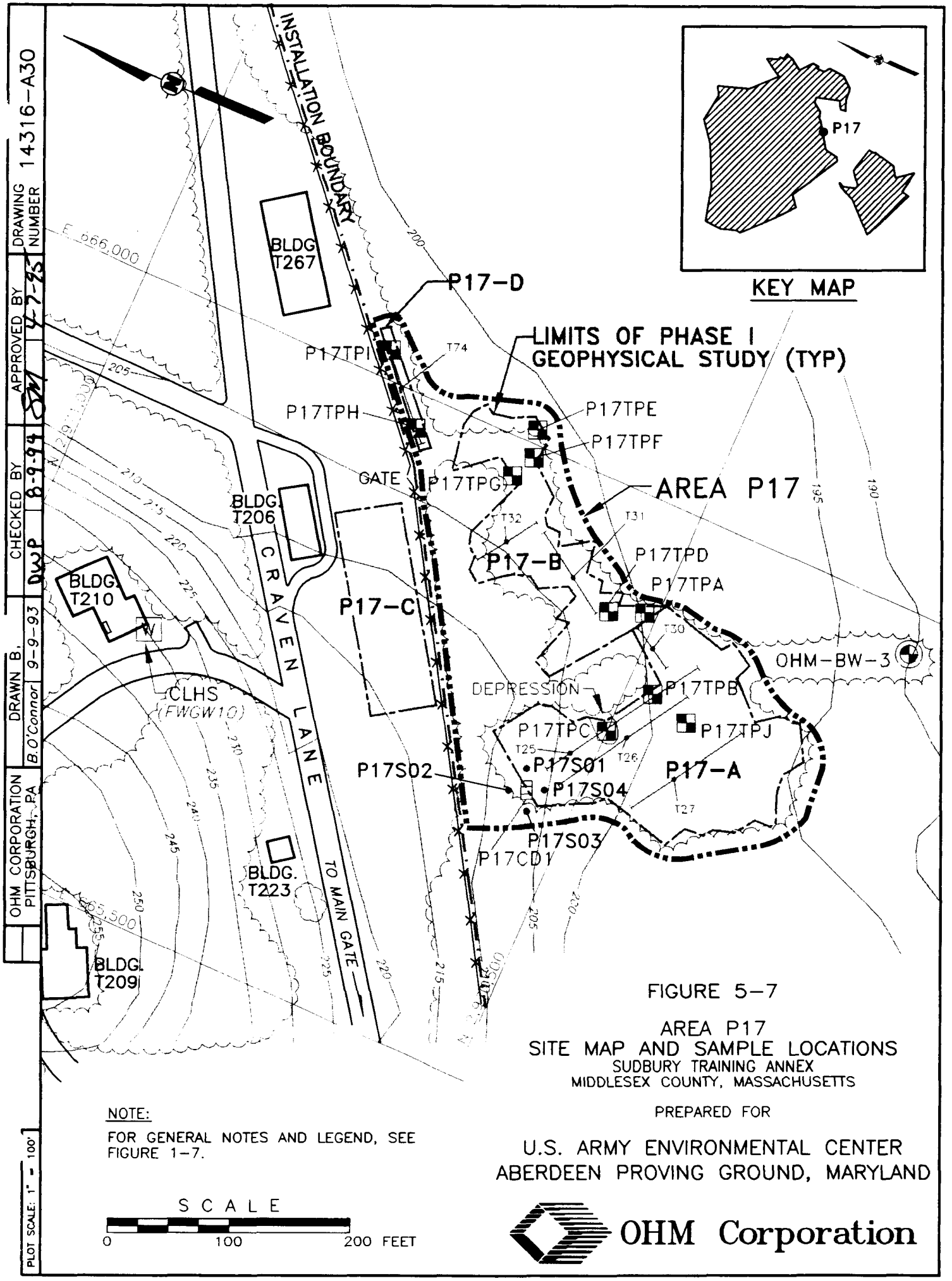


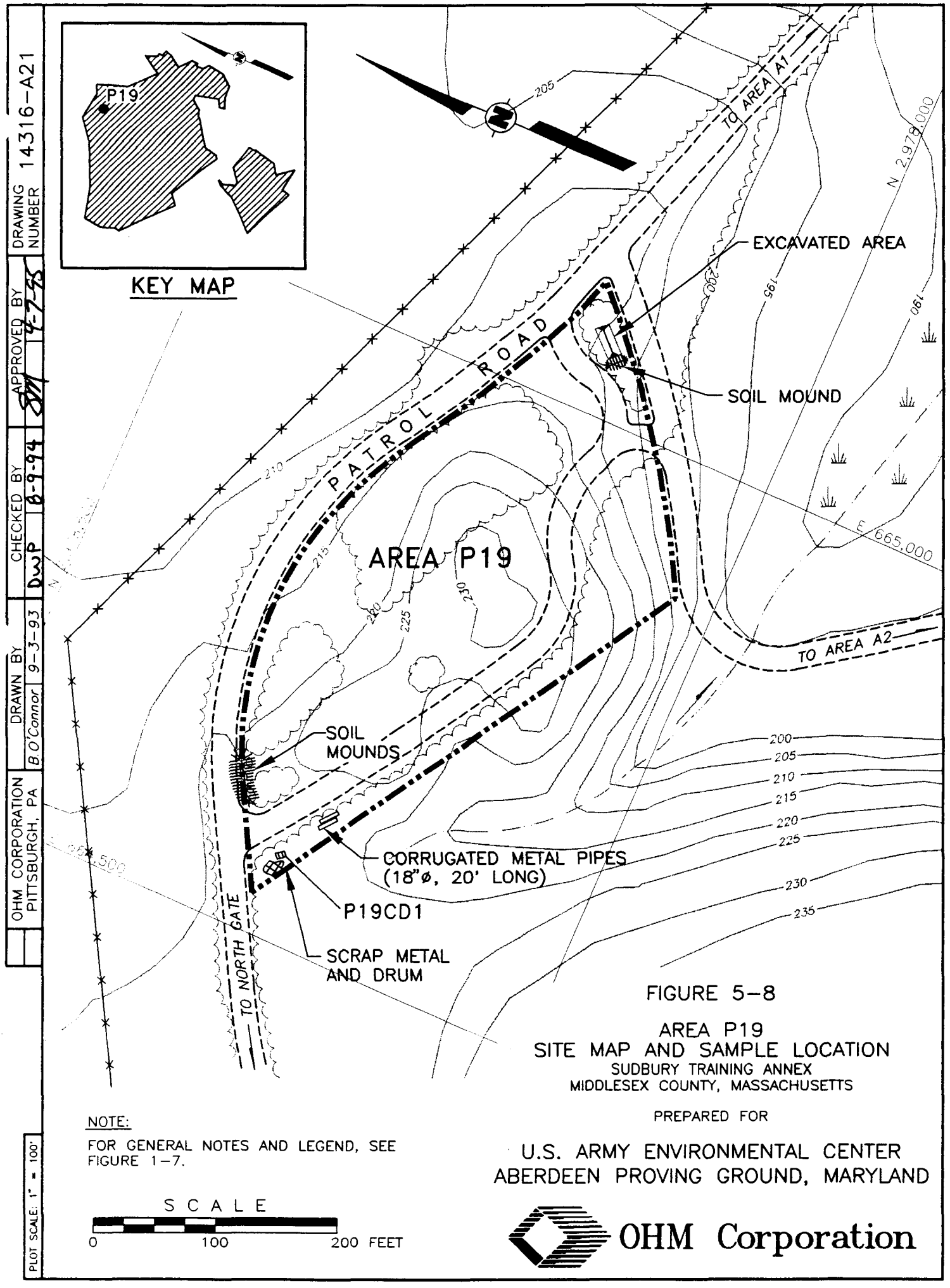
FIGURE 5-7

AREA P17
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



OHM CORPORATION
PITTSBURGH, PA

	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
	B.O'Connor 9-3-93	DwP 8-9-94	8-7-95	14316-A21

PLOT SCALE: 1" = 100'

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

SCALE

0 100 200 FEET

FIGURE 5-8

AREA P19
SITE MAP AND SAMPLE LOCATION
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

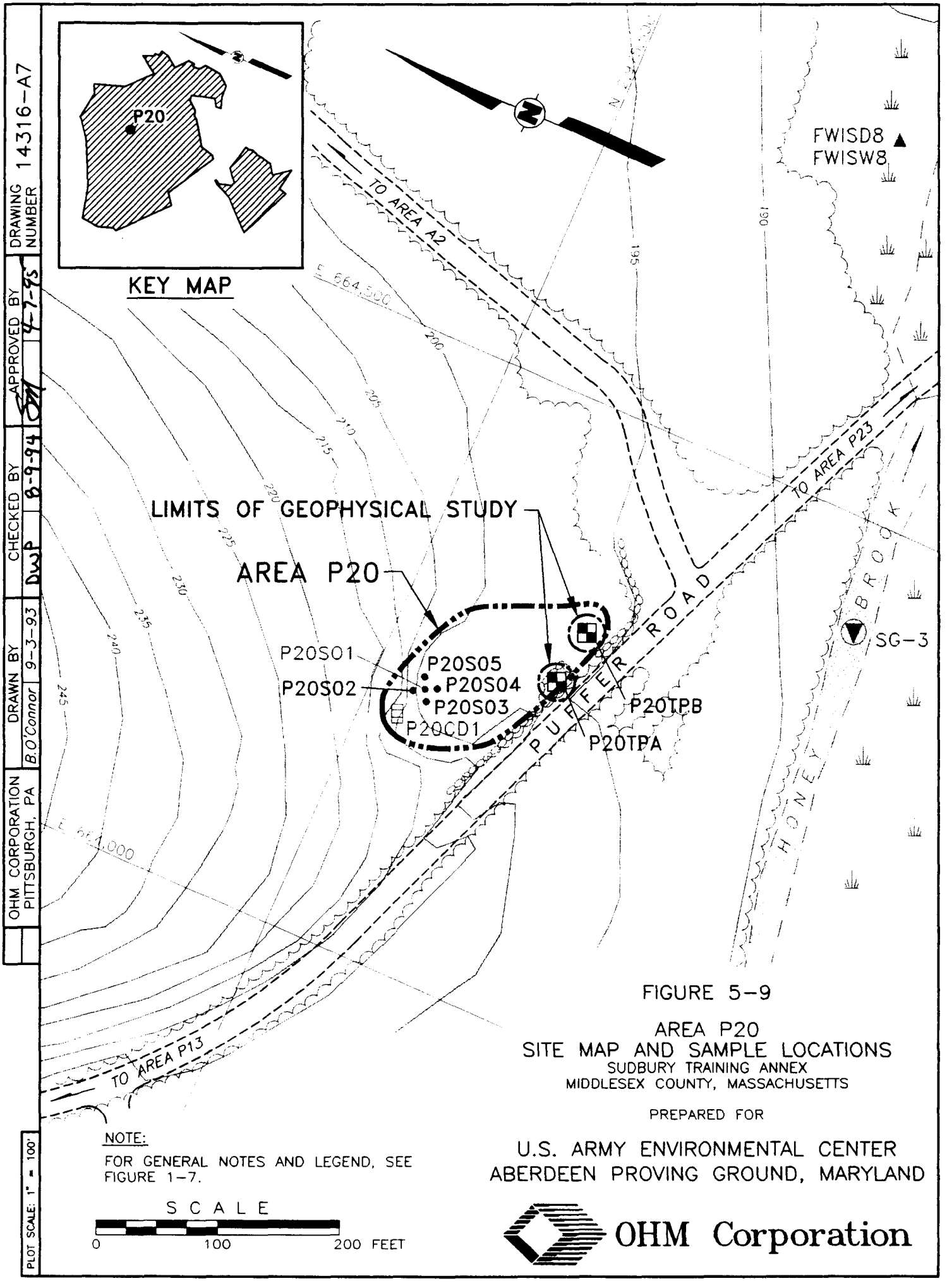


FIGURE 5-9

AREA P20
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

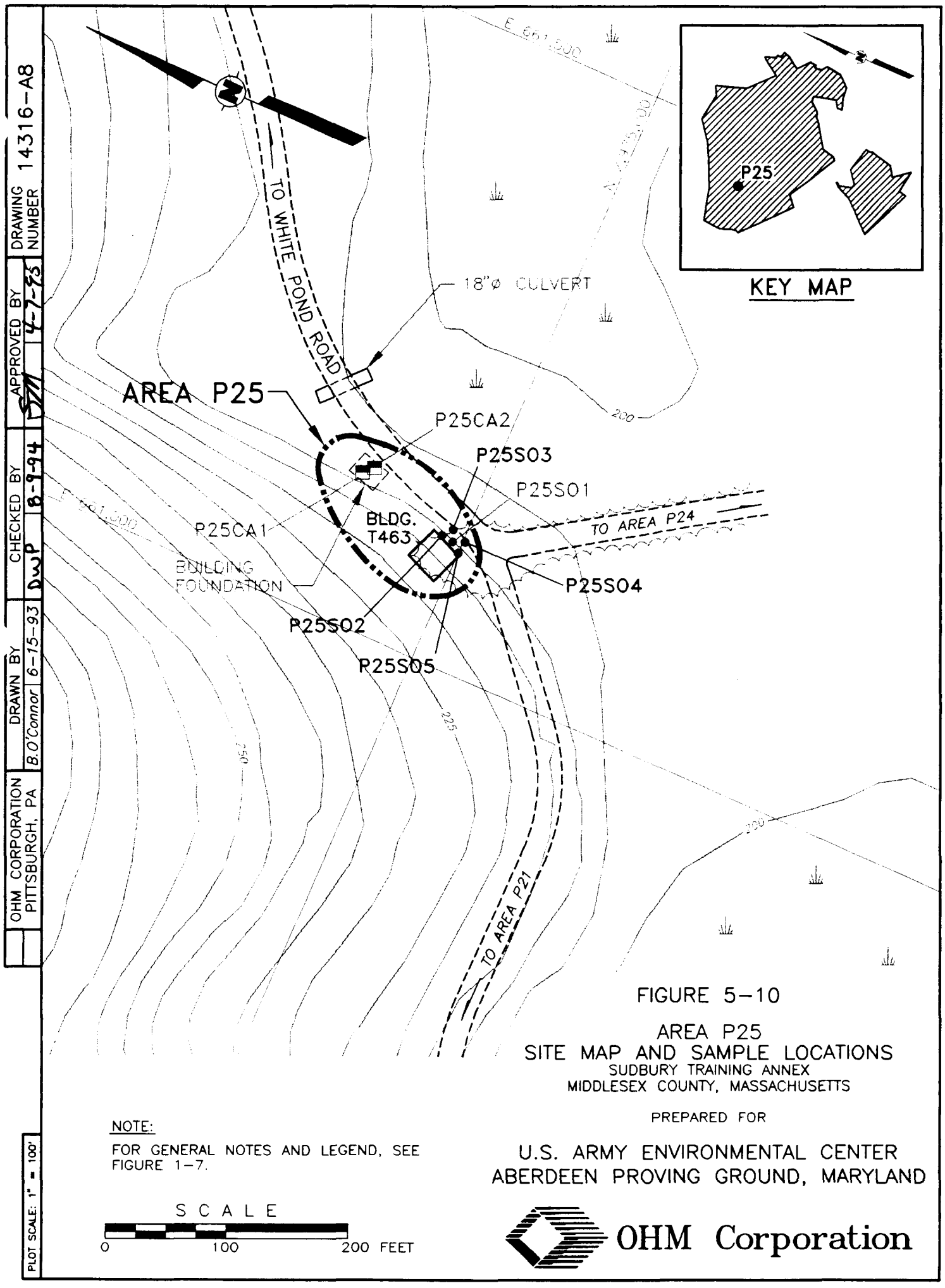


FIGURE 5-10

AREA P25
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
OHM CORPORATION PITTSBURGH, PA	B.O'Connor 6-15-93	DWP 8-9-94	4-7-95	14316-A8

PLOT SCALE: 1" = 100'

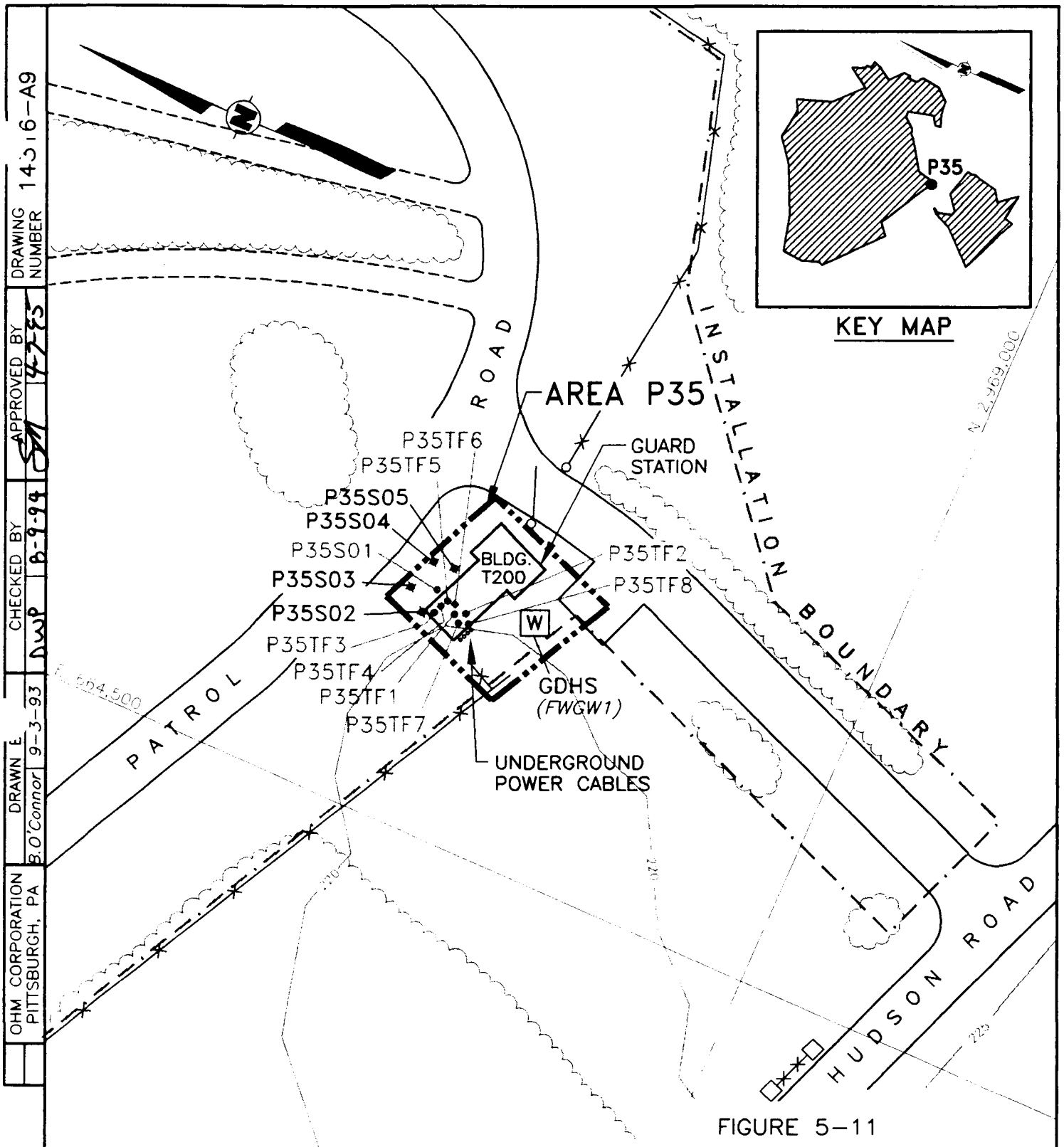


FIGURE 5–11

AREA P35
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1–7.

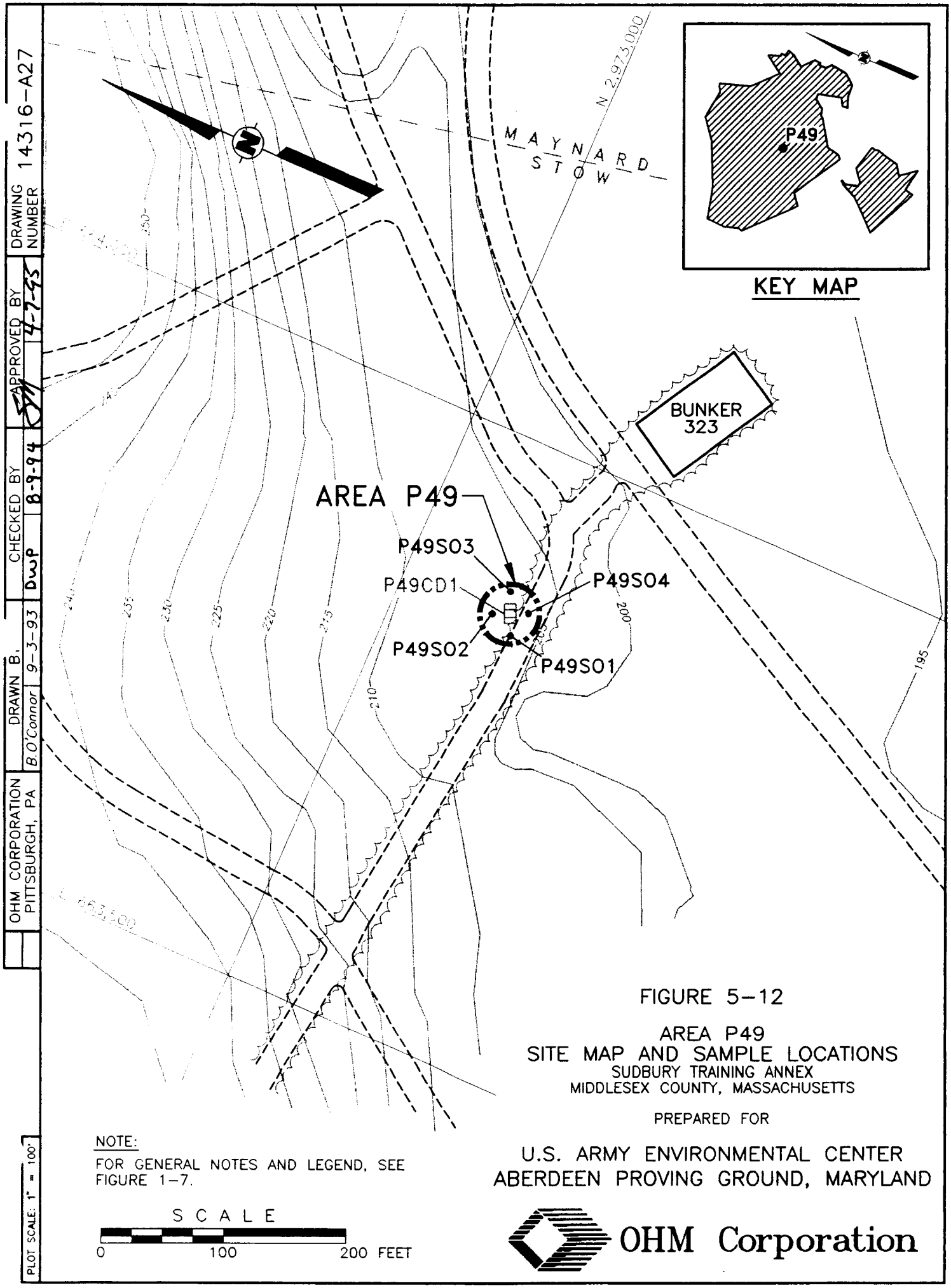


FIGURE 5-12

AREA P49
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

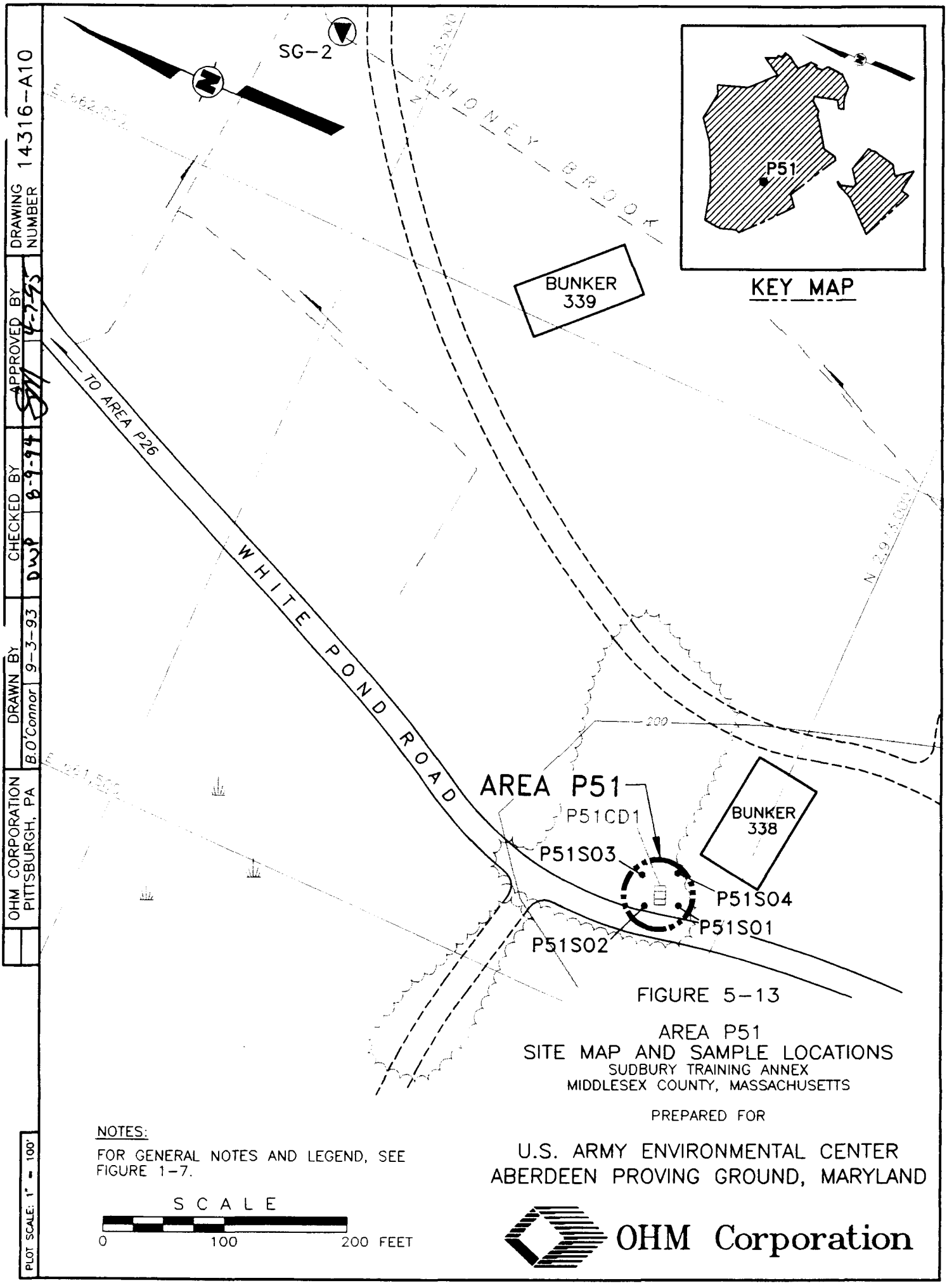


FIGURE 5-13

AREA P51
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

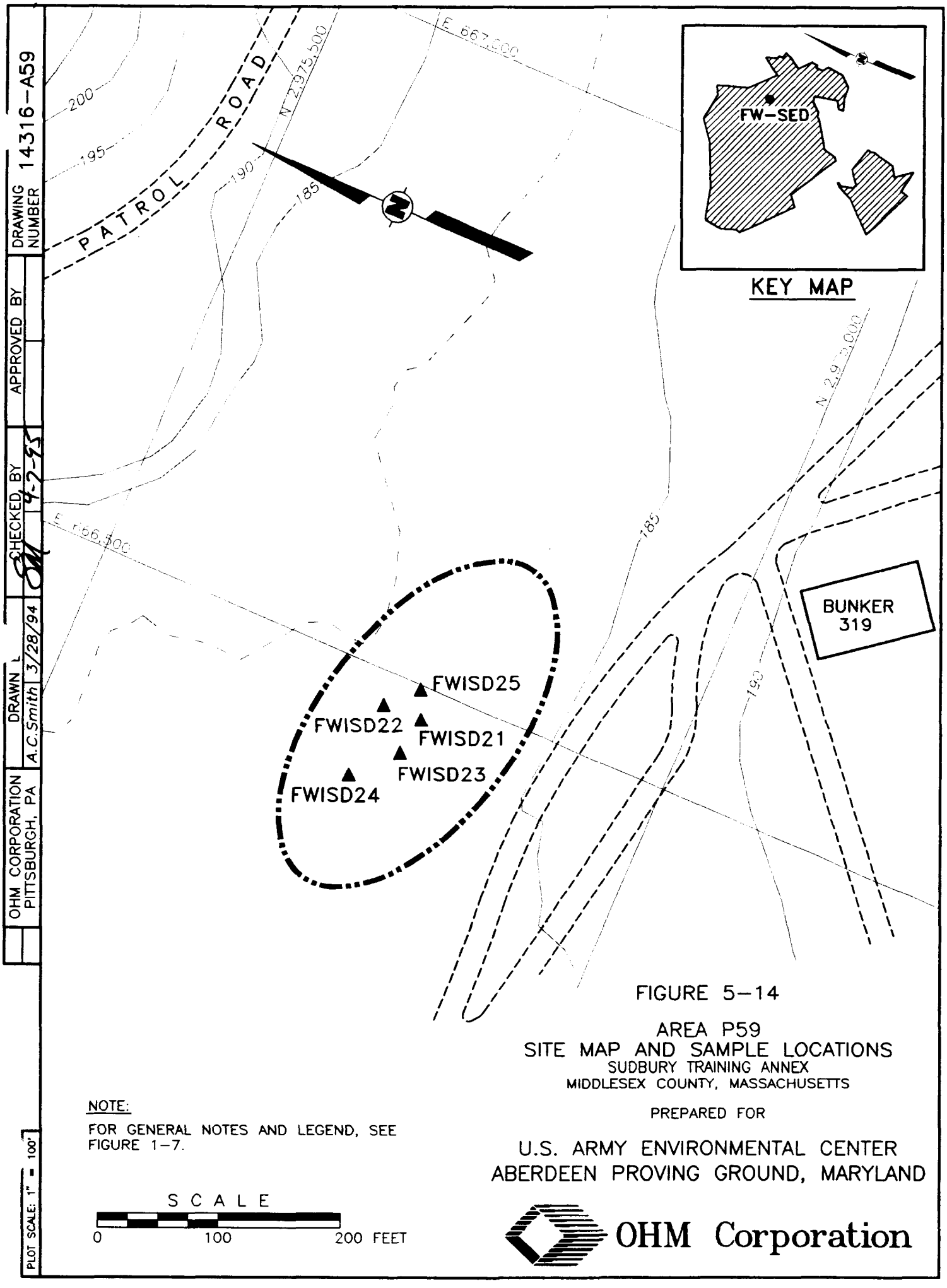


FIGURE 5-14

AREA P59
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

OHM Corporation

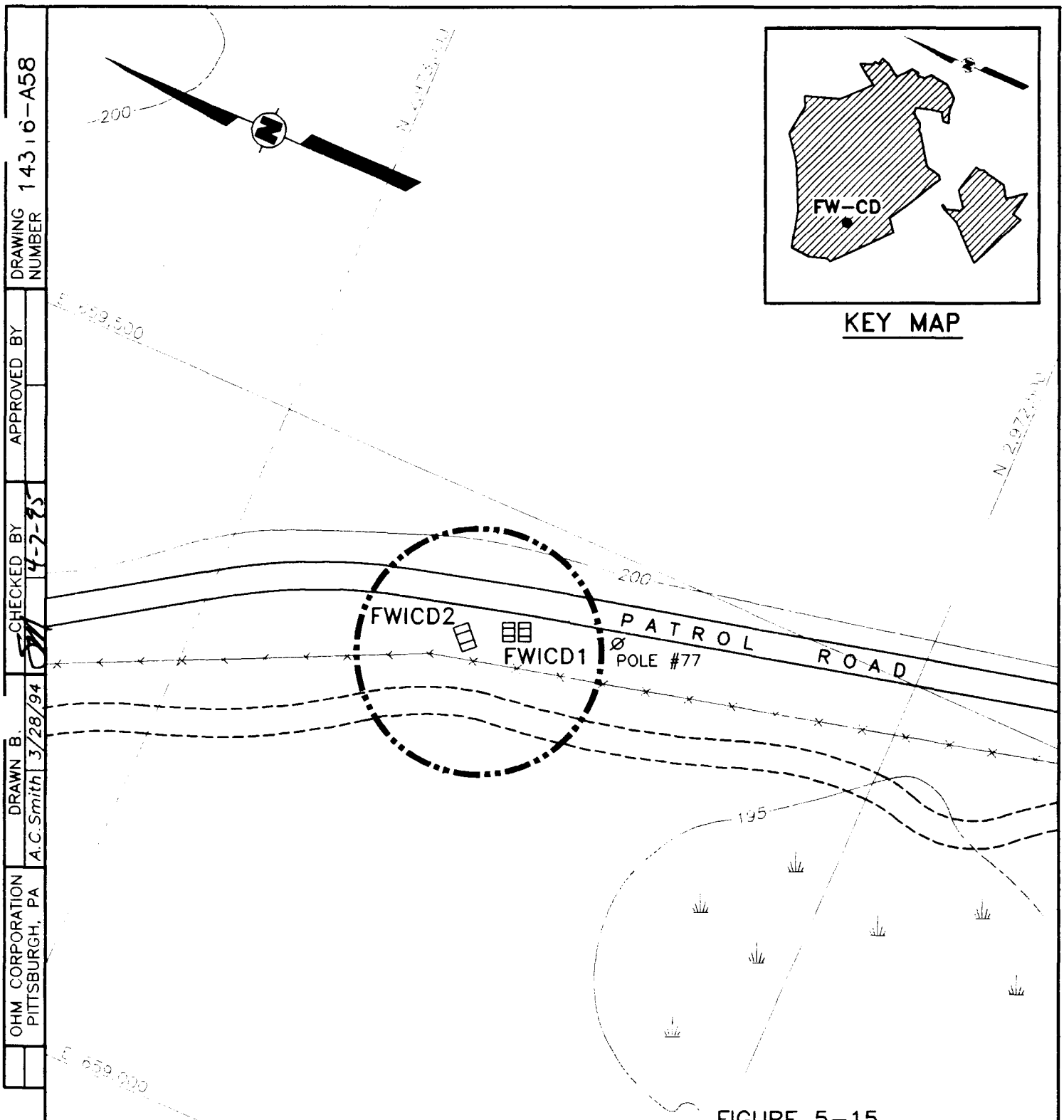


FIGURE 5-15

AREA P60
SITE MAP AND SAMPLE LOCATIONS
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

NOTE:

FOR GENERAL NOTES AND LEGEND, SEE FIGURE 1-7.

SCALE
0 100 200 FEET

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APPENDIX B

- AREAS A7/A9 GRAIN-SIZE DATA AND PHASE II SI/RI AREAS CONDUCTIVITY DATA
- TEST PIT LOGS
- BORING LOGS AND MONITORING WELL COMPLETION DIAGRAMS
- MONITORING WELL COMPLETION DETAILS
- FIELD SURVEY DATA
- SUMMARY OF PHASE II WATER LEVEL DATA
- GEOTECHNICAL GRAIN-SIZE ANALYSIS
- ASBESTOS AIR MONITORING RESULTS

APPENDIX B
AREA A7
GRAIN SIZE ANALYSIS SUMMARY

WELL OR BORING	SAMPLE NO.	DEPTH (ft)	UPPER OR LOWER AQUIFER (U or L)	PER CENT GRAVEL	PER CENT SAND, SILT, AND CLAY		
					MEDIUM AND COARSE	FINE	SILT AND CLAY
OHM-A7-7	S-03	04-06	U	17	29	42	12
OHM-A7-7A	S-05	08-10	L	10	56	32	2
OHM-A7-8	S-04	06-08	U/L	28	18	35	19
OHM-A7-13	S-03	04-06	L	15	28	27	30
OHM-A5-45	S-04	06-08	U	3	62	33	2
	S-07	15-17	L	13	24	31	32
OHM-A7-46	S-03	04-06	L	0	24	73	3
OHM-A7-51	S-06	15-16	U	6	31	18	45
OHM-A7-52	S-05	09-11	L	5	23	32	40
A7B1	S-04	06-08	L	11	29	29	31
A7B2	S-03	04-06	U	1	22	48	29
A7B4	S-04	06-08	L	25	26	24	25
A7B5	S-02	02-04	U	1	35	34	30
	S-05	08-10	U	20	30	45	5
A7B7	S-08	14-16	U	0	2	11	87
A7B9	S-07	12-13	U/L	26	28	25	21
A7B10	S-03	04-05	L	8	26	27	39
A7B11	S-01	00-02	U	61	13	20	6
A7B16	S-05	08-10	U	22	26	47	5
A7B17	S-03	04-06	L	21	30	22	27
A7B18	S-01	00-02	U	55	28	11	6
A7B19	S-02	02-04	U	49	25	12	14
A7B20	S-04	06-08	L	3	18	22	57

APPENDIX B
AREA A9
GRAIN SIZE ANALYSIS SUMMARY

WELL OR BORING	SAMPLE NO.	DEPTH (ft)	UPPER OR LOWER AQUIFER (U or L)	PER CENT GRAVEL	PER CENT SAND, SILT, AND CLAY		
					MEDIUM AND COARSE	FINE	SILT AND CLAY
OHM-A9-16	S-04	06-08	U	1	36	60	3
	S-06	10-12	U	0	1	85	14
	S-12	25-27	U	0	0	81	19
	S-17	49-51	L	0	5	75	20
	S-19	59-61	L	0	2	22	76
OHM-A9-17	S-04	06-08	U	0	1	82	17
	S-19	49-51	L	0	2	5	93
OHM-A9-18	S-05	08-10	U	0	3	95	2
	S-22	64-66	L	0	1	6	93
OHM-A9-47	S-10	18-20	U	0	1	94	5
	S-12	22-24	U	0	1	27	72
OHM-A9-48	S-05	08-10	U	0	1	43	56
	S-10	18-20	U	0	0	89	11
OHM-A9-53	S-16	30-32	U	0	1	79	20
OHM-A9-54	--	26-28	U	0	1	85	14
OHM-A9-55	S-11	25-27	U	0	1	35	64
OHM-A9-56	S-14	30-32	U	0	0	92	8
OHM-A9-57	S-14	30-32	U	0	2	93	5
OHM-A9-58	S-17	34-36	U	1	38	60	1
OHM-BW-5	S-15	35-37	U	0	1	22	77
A9B1	S-05	08-10	U	0	17	60	23
	S-10	18-20	U	0	1	79	20
A9B2	S-02	02-04	U	3	8	58	31
	S-05	08-10	U	13	22	43	22
A9B3	S-07	12-14	U	0	13	85	2
	S-10	16-18	U	0	20	54	26
A9B4	S-06	10-12	U	0	10	84	6
	S-10	18-20	U	0	0	34	66
A9B5	S-03	04-06	U	9	9	56	26
	S-11	20-22	U	0	2	60	38
A9B6	S-06	08-10	U	0	1	92	7
A9B7	S-07	12-14	U	0	1	73	26
A9B8	S-07	12-14	U	0	1	95	4

APPENDIX B
ALL PHASE II SI/RI AREAS
HYDRAULIC CONDUCTIVITIES

Site Area	Site ID	Hydraulic Conductivity (K)	Natural Log of K		Arithmetic Mean of Natural log	Geom Mean of K (ft/min)	Geom Mean of K (ft/day)
A03	OHM-A3-1	0.002	-6.2146		-6.5612	0.0014	2.0
A03	OHM-A3-3	0.001	-6.9078				
A04	DM4	0.0003	-8.1117		-7.5401	0.0005	0.8
A04	DM5	0.0005	-7.6009				
A04	OHM-A4-5	0.001	-6.9078				
A07	OHM-A7-8	6E-05	-9.7212	(1)	-5.3855	0.0046	6.6
A07	OHM-A7-9	0.0007	-7.2644	(2)	-9.0888	0.0001	0.2
A07	OHM-A7-10	0.03	-3.5066				
A07	OHM-A7-11	2E-05	-10.8198				
A07	OHM-A7-12	0.0003	-8.1117				
A07	OHM-A7-45	8E-05	-9.4335				
A08	OHM-A8-14	0.002	-6.2146		-7.3659	0.0006	0.9
A08	OHM-A8-15	0.0002	-8.5172				
A09	DM10	0.004	-5.5215	(3)	-6.0354	0.0024	3.4
A09	DM8	0.007	-4.9618	(4)	-8.5172	0.0002	0.3
A09	DM9A	0.002	-6.2146				
A09	OHM-A9-16	0.02	-3.9120				
A09	OHM-A9-17	0.0002	-8.5172				
A09	OHM-A9-47	0.0007	-7.2644				
A09	OHM-A9-48	0.002	-6.2146				
P07	OHM-P7-28	0.03	-3.5066		-3.3593	0.0348	50.1
P07	OHM-P7-30	0.07	-2.6593				
P07	OHM-P7-31	0.02	-3.9120				
FW	OHM-BW-3	0.002	-6.2146	(5)	NA	0.0016	2.3

NOTES:

(1) Glacial outwash values - OHM-A7-9 and -10
(2) Glacial till values - OHM-A7-8, -12, and -45
(3) Glacial outwash value
(4) Glacial till value - OHM-A9-17
(5) One slug test only

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OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

FINAL ADDENDUM TO THE HUMAN HEALTH RISK ASSESSMENT FOR THE FORT DEVENS SUDBURY TRAINING ANNEX MIDDLESEX COUNTY, MASSACHUSETTS

Prepared for:

United States Army Environmental Center
Aberdeen Proving Ground, Maryland
Contract No. DAAA15-90-D-0019
Task Order No. 0001

Prepared by:

OHM Remediation Services Corp.
Pittsburgh, Pennsylvania
A Subsidiary of OHM Corporation

September 22, 1995
OHM Project No. 14316

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Note: All figures are contained in the main figures portion of this report.

EXECUTIVE SUMMARY

This addendum to the human health risk assessment was prepared to evaluate data collected during the Phase II investigation at the Annex to determine whether or not findings from this investigation modify the risk estimates reported in the January 1994 risk assessment. The purpose of the original risk assessment, described in the January report, was to establish whether or not any contamination that might be present at the Fort Devens Sudbury Training Annex (Annex) posed a potential threat to human health.

The Annex is located in Middlesex County, Massachusetts, covers approximately 4.3 square miles (2,750 acres), and includes portions of the towns of Maynard, Hudson, Stow, and Sudbury. The facility was acquired by the government in the early 1940s and was initially used for holding munitions. After World War II, the principle use of the reservation was troop training, although some equipment testing and experiments were also conducted at the Annex. The Annex was also utilized by other agencies or operators for a variety of purposes including testing, training, and waste disposal. The installation is currently used by a number of local groups, including the Massachusetts Fire Fighting Academy (MFFA), the National Guard, and permitted recreational users. Because of its easy accessibility, the site is also used by unauthorized persons.

The site investigation/remedial investigation (SI/RI) conducted by OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, for the U.S. Army Environmental Center (USAEC) at the Annex focused on three areas of contamination (AOCs), where full remedial investigations (RIs) were conducted: AOCs A4, A7, and A9. Studies were also conducted in numerous other areas of the facility to attempt to define the facility-wide nature and extent of any residual chemicals. The Baseline Risk Assessment (BRA), finalized in January 1994, was primarily prepared to evaluate the risk to individuals who may use any of the three RI areas. The risk assessment also included a preliminary assessment of the potential for risks associated with exposure on the base as a whole.

The risk assessment addressed risks that could occur on the site as it currently exists (current use scenario) and under a scenario that assumes use may change in the future. Currently, use of the site is somewhat restricted, although unauthorized entry is not difficult. The greatest potential exposure is likely to be associated with unauthorized use by school-age children. Exposure under a current use scenario is most likely to occur via direct contact with, and subsequent ingestion or dermal absorption of site soils.

Although it is unlikely that future use of the Annex would include building houses on large portions of the facility, such use cannot be precluded if sections of the facility are excessed (sold by the military). Because this scenario posed the highest potential for exposure, residential use of the facility in the future was evaluated to estimate maximum likely risks. Under this scenario, it was assumed that exposure could occur via direct contact with soils and sediment (ingestion or dermal absorption), use of on-site ground water or surface water, and via consumption of fish.

Following U. S. Environmental Protection Agency (USEPA) Region I guidance, risks were assessed using both average and maximum concentrations of the chemicals in the different environmental media at the site. The maximum concentration represents exposure that would be associated with repeated contact with the most highly contaminated area on the site. The average concentration assumes that an individual receives an exposure from a wider distribution of sources. USEPA uses a target cancer risk goal of one in one million (10^{-6}) and typically regulates within a range of 10^{-4} to 10^{-6}. For noncarcinogens, USEPA assumes that adverse health effects are unlikely if the estimated exposure dose is lower than the reference

toxicity criteria (called the reference dose or RfD). The ratio of exposure dose to RfD is termed the Hazard Quotient (HQ) and the sum of these ratios for exposure to multiple chemicals is called the Hazard Index (HI). An HI less than one is considered unlikely to be of concern.

In order to ensure that public health is adequately protected, conservative (unlikely to underestimate risk) assumptions were used in deriving both the exposure estimate and the toxicity values. Because of the use of these conservative (although not necessarily worst case) assumptions, it is likely that actual risks are considerably lower than risks estimated in the January 1994 BRA.

AOC A4

In the BRA, chemicals posing risks were identified as lead in ground water and soil, bis 2-ethylhexyl phthalate (DEHP) in ground water and arsenic in ground water and soil. The Phase II investigation was focused on further evaluation of these chemicals at AOC A4 as well as on a continued search for buried materials in the area. Lead levels were elevated in an October 1992 ground water sample but not in the June 1992 sample from the same well. The Phase II sampling confirmed that the high value was anomalous and that lead is not a concern in ground water in AOC A4. A single high lead concentration in soils (570 mg/kg) was confirmed in the Phase II sampling, but elevated lead levels do not appear to be widespread in this study area (SA). DEHP was not detected in Phase II sampling, suggesting that the previous single detected concentration was not site related. Arsenic continues to be detected infrequently at levels above site-specific background. It is suspected that these occasional hits are indicative of both naturally elevated arsenic and the use of arsenical herbicides for weed control.

During the Phase II sampling, beryllium was detected in test pit soils and in sediments at levels somewhat higher than previously reported for the area. Risks posed by beryllium in soils under the residential scenario in the BRA were 2×10^{-6} at a maximum concentration of 0.35 mg/kg. Assuming that contact with test pit soils was possible, risks posed by beryllium (maximum concentration of 0.64 mg/kg) would be approximately 4×10^{-6}, above the target risk level of 10^{6} but within the target risk range for remediation of 10^{-4} to 10^{-6}. However, concentrations are fairly uniform, no source is apparent, and these beryllium concentrations appear to be indicative of background levels for the area. Beryllium was detected in two sediment samples at levels substantially higher than levels reported elsewhere on the site. Risk associated with the maximum concentration detected (6.6 mg/kg) under the exposure scenario for residential contact with sediments would be 1×10^{-5}.

As noted in the BRA, the primary purpose of the investigations in this area was to locate drums that had allegedly been buried in the area. No evidence of such disposal was found and overall, this area appears unlikely to pose significant health risks.

AOC A7

As noted in the BRA, AOC A7 had allegedly been used as a dump for laboratory wastes, trash, and general debris, and evidence of such use was clear during the investigation. Numerous points of contamination were noted in soils. Elevated levels of several chemicals were detected in ground water and the water is currently unsuitable for potable water supply. Elevated risks were associated with a suite of chemicals, including metals, organochlorine pesticides, and chlorinated solvents.

The Phase II results generally confirm the findings of the Phase I investigation as to the type and concentrations of contaminants but provide a clearer definition of the extent of contamination. Both higher

and lower levels of the contaminants detected in Phase I were detected in the Phase II investigation and risks remain clearly above target risk levels. Based on the Phase II sampling, two distinct areas of contamination were identified. The solid waste disposal area covering the central and eastern portion of the site contains several hotspots of contamination with elevated levels of metals and organochloric pesticides. The laboratory waste area, located in the west-central portion of the site consists of laboratory glassware, glass bottles and metal cans (some partially full) and discarded drums. Soils in this area and groundwater in the area and downgradient are contaminated with chlorinated pesticides (specifically lindane) and chlorinated solvents. In addition to known risks associated with these detected chemicals, the unknown materials in laboratory bottles may pose other, unknown hazards and suggest that remediation is warranted.

AOC A9

In the BRA, elevated risks were associated with arsenic, several chlorinated solvents, and chlorinated pesticides in ground water. Elevated arsenic was also reported in a ditch at the southwestern corner of the site. The Phase II investigation was focused on better defining ground water contamination and on confirming and delineating the arsenic levels.

In Phase II, several volatile compounds were detected in ground water at levels well above concentrations reported in the SI/RI Report. The presence of these higher levels warranted additional quantitative evaluation of potential risks associated with these chemicals. Consequently, risks were estimated under the future residential use scenario described in the BRA, namely the use of the water for domestic purposes.

Estimated cancer risks under this scenario (maximum of 1×10^{-3}) are somewhat higher than reported in the BRA, primarily as a result of the higher 1,1-dichloroethene (1,1-DCE) concentrations. Noncancer risks are in the same range as the previous risk assessment (HI=30 as compared with the previous value of HI=20). However, the ground water in AOC A9 is considered inadequate for domestic use based on MADEP criteria and consequently, it is unlikely that exposure would occur via this pathway. The presence of solvents and petroleum-derived compounds in ground water confirms that the previous clean up was somewhat incomplete, but fairly low levels of petroleum-based compounds and solvents [1,1-DCE and 1,1,1-trichloroethane (1,1,1-TCA)] are present. Considering that natural attenuation, dilution, and probably degradation are likely to reduce concentrations of these constituents and that ground water is unlikely to be used, further action may or may not be warranted.

Arsenic was present at elevated concentrations in soils in the southwest corner of this area and lead and thallium were detected at elevated concentrations in the northwest corner of the site. Use of the site for residential purposes would pose risks above target risk levels. However, such use is probably unlikely to occur and if it did occur, a layer of topsoils would almost certainly be required which would act to preclude contact with this material.

1.0 INTRODUCTION

A human health risk assessment evaluates whether or not contamination present at a site poses a risk to human health. As required by USEPA guidance for sites being addressed under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), a baseline risk assessment (BRA) was conducted for the Annex located in Middlesex County, Massachusetts [OHM 1994; Fort Devens Sudbury Training Annex (Annex); Middlesex County, Massachusetts: Final Report, Site/Remedial Investigation, Appendix G - Human Health Risk Assessment and Appendix H - Ecological Risk Assessment]. The risk assessment was prepared by OHM for the USAEC.

The site-specific risk assessment finalized in January 1994 evaluates the risks posed by three RI sites on the Annex (AOCs A4, A7, and A9) if no remedial action is taken, (i.e., it is a BRA) and provides the basis for determining if any site remediation is necessary. The risk assessment also provides an indication of the potential for risks on the entire facility. Since completion of the BRA, additional field sampling and analysis has been completed by OHM at the Annex (the Phase II investigation). Findings of this investigation are described in detail in the main body of the Addendum to the SI/RI Report.

Although the BRA adequately characterized risks on the site based on the information available from the Phase I investigation, several data gaps were identified during the site/remedial investigation and additional sampling and analysis were performed to address these shortcomings. The purpose of this risk assessment addendum is to describe the effect, if any, that the findings of this additional investigation have on the estimate of risks posed by the site. Because the purpose is only to update the existing risk assessment, only findings that significantly affect risk estimates are discussed in detail in the Addendum. In addition, the detailed discussion of exposure scenarios and assumptions, toxicity criteria, and approaches to risk characterization are not repeated in this document. A more thorough discussion of these issues is provided in the BRA (January 1994). More detailed information on chemical concentrations detected at the site is provided in the SI/RI Report (January 1994) and in the main body of the SI/RI Addendum.

Section 2.0 of the risk assessment addendum provides background information related to site history, local demographics, site features (climate, topography, geology, etc.), drinking water supply and previous investigations, and characterizes the nature and extent of contamination. Information on non-site-related levels (background levels) of metals and organics in off-site areas are also discussed in this section. The key toxicity criteria for site chemicals are presented in Table 1-1 and are the same values used in preparing the January 1994 BRA. Further information on chemical toxicology and on site characteristics are provided in the BRA.

Sections 3.0 through 6.0 contain information on risks in AOCs A4, A7, and A9, and facility-wide, respectively. Each section summarizes the results of the previous risk assessment, describes current findings, and summarizes the effect of the new findings on site risks. The conclusions of the risk assessment are presented in Section 7.0, and Section 8.0 contains the list of references.

2.0 SITE CHARACTERIZATION

This section of the risk assessment contains a brief discussion of site history and local demographics. Site and area features including climate, topography, geology, hydrogeology, surface water hydrology, and domestic water use are also summarized. In addition, findings from previous investigations, a discussion of the nature and extent of contamination, and selected chemicals of potential concern are presented. Information on background levels of chemicals in off-site areas is also provided. Off-site background concentrations include both naturally-occurring and anthropogenic concentrations of metals and organics.

2.1 SITE HISTORY AND LOCAL DEMOGRAPHICS

The Annex, originally known as the Maynard Ammunition Depot, was acquired by the government in the early 1940s. During World War II, the Annex was used for holding munitions. After the war, the Annex became known as the Maynard Ordnance Test Station (MOTS). In 1958, control of the Annex was transferred to the United States Army Natick Research and Development Command (NARADCOM). At that time, the principle use of the reservation was troop training. NARADCOM also conducted testing and experiments at the Annex. The Annex was utilized by other agencies or operators for a variety of purposes including testing, training, and waste disposal. NARADCOM maintained control of the military reservation until 1982, at which time custody of the entire Annex was transferred to Fort Devens, which used the Annex primarily for the training of active duty, Army Reserve, and Army and Air National Guard personnel.

The Annex is located in Middlesex County, Massachusetts, covers approximately 4.3 square miles (2,750 acres) and includes portions of the towns of Maynard, Hudson, Stow, and Sudbury. Figure 1-1 presents the site location.

The Annex is divided into two sections by Hudson Road. Present activities in the southern, smaller section include the Capehart Family Housing Area (CFHA), a military family housing area consisting of 35 housing units, and an area where cloth durability testing is performed. All of the southern section, except the CFHA, was identified for potential excessing (disposal of the land by the military allowing a return to non-military use). Excessing activities are presently on hold pending outcome of the facility remedial investigation/feasibility study (RI/FS) activities. The active operations in the larger northern section include several individual housing units, a U. S. Air Force (USAF) radar installation, a Federal Emergency Management Agency (FEMA) regional operations center, and a guardhouse at the main gate. The installation is also used by a number of local groups, including the Massachusetts Fire Fighting Academy (MFFA), the National Guard, and permitted recreational users. Because of its easy accessibility, the site is also used by unauthorized persons.

2.2 BACKGROUND

The topography of the Annex is level to slightly undulated in the lowlands with oval-shaped hills composed of glacial till (drumlins). The terrain is dominated by numerous lakes, bogs, marshes, swamps, and kettles. The drier areas consist of well-drained, coarse-grained materials as indicated by the number of gravel (borrow) pits throughout the installation. Most of the hills lie in an area along the northern border of the Annex with a low ridge extending south-southwest through the central portion of the Annex. Elevations range from 170 to 321 feet above mean sea level within the boundaries of the Annex.

Most of the Annex is within the drainage basin of the Assabet River which flows in an easterly direction along the northwest edge of the Annex. The majority of the northern portion of the Annex drains northward via Honey Brook and Taylor Brook which flow into the Assabet River. The western section flows west into Boons Pond. The eastern section of the southern portion of the site drains toward the east into Stearns Mill Pond and the western section drains into White Pond. Several smaller unnamed tributaries feed into Taylor Brook or Honey Brook, Puffer Pond, and the Assabet River itself.

Flow rates are generally low within the on-site stream channels due to the highly permeable soils, shallow depth to ground water and low slopes on this broad outwash plain. Poorly drained sections or lowlands are found throughout the Annex, with the largest extent occurring southeast of the centralized drumlins. These lowlands include bogs, marshes, swamps, and a multitude of small waterholes. On-site conditions are conducive to good infiltration/percolation rather than runoff. The little runoff which does occur from the small hills is presumed to collect in the swampy areas and in the few existing streams.

Generally, the top of the unconfined saturated zone at the Annex is near the ground surface, as indicated by the swamps, bogs, and waterholes. Depth to the ground water table is generally less than 15 feet, with the ground water gradient approximating area topography (flow is from topographic highs to lows). Ground water flows mostly through the outwash underlying the lowlands of the site. Water occurs in only limited quantities in bedrock fractures, and transmissivity in the tight till formation is poor as indicated by water supply investigations conducted in similar areas (Dufresne-Henry, Inc., 1982). Ground water flow in the northern portion of the Annex is towards or parallel to the flow directions of Taylor and Honey Brook for the most part, except in the far southwest reaches where ground water flow is towards Boons and White Ponds.

Ground water is used as a source of potable water within a 3-mile radius of the Annex. On the Annex, drinking water is generally obtained from public water supply or from bottled water. Several domestic wells exist on site but are not currently in use. Residents on Boons Pond draw water from private wells that may be downgradient from the Annex. Ground water is also used as a source of potable water by the towns of Stow, Sudbury, Maynard, and Hudson. The municipal wells used by these towns are not considered likely to be influenced by the Annex.

2.3 PREVIOUS INVESTIGATIONS

The OHM investigation at the Annex focused on three areas of primary concern, where full RIs were conducted: AOCs A4, A7, and A9. Studies were also conducted in numerous other areas of the facility to attempt to define the facility-wide nature and extent of any residual chemicals (Figure 1-1). Detailed information on these investigations and on the results is presented in the full SI/RI Report. A brief summary of key findings in each of the RI areas and facility-wide is provided in the following sections of the risk assessment addendum. The SI/RI Report also summarizes results from investigations previously conducted at the facility by other contractors. Two other contractors, Ecology & Environment, Inc. (E&E) and ABB Environmental have perfomed or are currently performing investigations of several other areas on the Annex; these results are not included in the OHM reports.

2.4 BACKGROUND SOILS

A detailed discussion of the sampling and analysis program to determine background levels of chemicals in near-site soils is provided in the SI/RI Report. A brief discussion of background chemical

levels is provided below. Table 2-1 summarizes the levels of chemicals detected during the background sampling effort.

Sampling was conducted at 12 off-site locations around the facility in order to characterize levels of chemicals present in background, non-site-affected soils. Chemicals detected in these soils can be naturally occurring, may be present from anthropogenic (man-made) sources, or both. Metals occur naturally in the environment and levels on-site were compared with off-site (background) levels to establish if the on-site metal levels were caused by site activities. Lead levels in background soils are often the result of both naturally occurring lead and lead deposited as a result of the widespread use of lead for industrial purposes (including its use in leaded gasoline). Naturally occurring lead levels in the Northeast are generally in the range of 2 to 30 mg/kg [Goldberg-Zoino and Associates (GZA), 1991] but lead levels in urban areas often exceed 100 mg/kg (Chaney, 1985). Two site-specific background lead concentrations were above the range commonly encountered for naturally occurring lead in the eastern United States and were not included in calculating average background concentrations. Similarly, arsenic may be present from both natural sources and as a result of past widespread use in pesticides, and a single apparently elevated arsenic concentration was excluded in calculating average background concentrations.

Organic chemicals are not commonly present in naturally occurring background samples, with the occasional exception of the polycyclic aromatic hydrocarbons (PAHs). The PAHs are products of incomplete combustion and as such are naturally occurring in burned areas, although they are generally found at highest concentrations in areas impacted by man. The State of Massachusetts, in Subpart C of the proposed revision to the Massachusetts Contingency Plan (March 1992) has determined that a level of up to 10 mg/kg of PAHs can be considered indicative of background concentrations. Menzie et al. (1992) listed concentrations in forest and rural soils of 0.01 to 1.3 mg/kg for carcinogenic PAHs[1]. Menzie et al. (1992) reports levels of carcinogenic PAHs (plus benzo[ghi]perylene) in urban soils ranging from 0.06 to 5.8 mg/kg, with a median value of 1.1 mg/kg. These authors also note that road dust contained very high levels of PAHs, with a median of 137 mg/kg and a range of 8 to 336 mg/kg.

2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT) and its breakdown products, 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD) and 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE), were also detected in background soils. DDT and its breakdown products (collectively referred to as $\sum$DDT), are very persistent chemicals in the environment and were widely used prior to approximately 1970 to control gypsy moth infestations, for crop use, and for mosquito control. Consequently, its presence in off-site background soils in an area that has been used for farming and that probably was sprayed for gypsy moths is not unexpected. On the other hand, the military probably also sprayed for insect control and the locations of the background samples near to the base do not totally exclude the possibility that direct military spraying or drift from such spraying is the cause of the elevated levels. On-site soil concentrations of DDT, DDD, and DDE were compared with background levels to evaluate the potential for site-related activities to have contributed to elevated levels of this organochlorine pesticide. It should be noted that other organochlorine pesticides were less commonly used for wide area spraying and although not detected in the 12 background samples collected, are likely to be present in other off-site areas or on the facility.

[1]Menzie et al (1992) includes benzo(ghi)perylene among the carcinogenic PAHs. This compound is not commonly considered to be carcinogenic (Poirier, 1992).

3.0 AOC A4

AOC A4, Waste Dump, is located in the eastern portion of the Annex adjacent to the East Gate as shown on Figure 2-1. This area was reportedly used for about 4 years during the late 1960s and early 1970s for the burial of unidentified chemical wastes. Interviews with a Natick employee indicated drums may also have been buried near the East Gate.

The area is approximately 1,000 feet long by 200 feet wide and contains a surface dump in a depression at the southwest end along with an old building foundation and stone well at the northeast end. The building foundation has been identified as the site of the Rice Tavern or Vose Farm.

Figure 2-1 is a map of AOC A4 showing the locations for all investigative work performed and samples collected. Tables 3-1 to 3-4 summarize sampling results from the OHM Phase I sampling. Results from the Phase II sampling effort are described in the SI/RI Addendum and summarized in Tables 3-5 to 3-9. Only chemicals detected at levels above background concentrations are included in the risk assessment summary tables in order to focus on key chemicals. Complete data tables are provided in the SI/RI Addendum.

3.1 PREVIOUS RISK ASSESSMENT RESULTS

The contaminants identified during the Phase I investigation in AOC A4 included:

- Soil samples contained metals, organochlorine pesticides, a volatile organic compound (VOC), two PAHs, and a phthalate ester.
- Ground water contained trace levels of solvents, pesticides, and insect repellant.
- Dacthal was detected in a surface water sample from AOC A4.
- Sediment samples contained solvents, and an explosive.

3.1.1 Results

Risks were estimated in the January 1994 BRA for AOC A4 under both current use and future use scenarios. Based on USEPA guidance, lead was evaluated separately. The results of the assessment for the different scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.02	0.05
Cancer Risk	1×10^{-8}	2×10^{-8}

(These estimates excluded risks associated with metals considered to be present only at background levels, specifically arsenic and beryllium.)

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.1	0.3
Cancer Risk	1×10^{-7}	3×10^{-7}

(Excluding background metals.)

Sediment Ingestion

	Average	Maximum
Hazard Index	0.07	0.1
Cancer Risk	1×10^{-5}	3×10^{-5}

(Elevated risk based on a single high arsenic level.)

Ground Water Use

	Average	Maximum
Hazard Index	0.1	0.5
Cancer Risk	2×10^{-5}	6×10^{-5}

(Elevated risk based on arsenic, DEHP, and heptachlor epoxide also exceeded target risk levels, but were only detected once.)

AOC A4 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and contacting soil and using water from a private well on the site is:

Total Systemic and Cancer Risk
Residential Use Scenario

	Average	Maximum
Hazard Index	0.2	0.8
Cancer Risk	2×10^{-5}	6×10^{-5}

Lead

For exposure to lead which currently has no toxicity criterion, risks were evaluated using USEPA's Uptake/Biokinetic (UBK) Model, Version 0.5. Concentrations in AOC A4 environmental media were used as input values in the model and the estimated blood lead levels from the model were compared with blood

lead levels considered to be of concern for children (10 μg/dl). Lead levels reported for AOC A4 in the Phase I investigation were:

Soils: average conc. = 20 mg/kg; max conc. = 53 mg/kg
(570 mg/kg was detected in subsurface soils)
Sediment: average conc. = 11 mg/kg; max conc. = 15 mg/kg
Ground Water: average conc. = 23 μg/L; max conc. = 190 μg/L
(Average without the single high value is 2 μg/L)

Based on the UBK model, continuous consumption of water containing the maximum lead level detected (190 μg/liter) would raise blood lead levels in children to above the target level (10 μg/dl) in approximately 2 years. Excluding this single value, lead levels in AOC A4 do not produce blood lead levels above the USEPA target blood lead level.

3.1.2 Discussion

Actual risks are likely to be substantially lower than indicated by this estimate. Arsenic, quite possibly at background levels, was the largest contributor to risks for AOC A4. Arsenic was present at background levels in soils and was only detected once in AOC A4 ground water at a concentration (3 μg/L) that is well below the USEPA Drinking Water Standard (50 μg/L). Background arsenic levels in ground water were not determined specifically for this site but the level detected at AOC A4 is similar to levels reported as background in Fort Devens ground water. Heptachlor epoxide and bis-2(ethylhexyl)phthalate also contributed to risk in ground water. Lead was elevated in the October 1992 sampling round (190 μg/L) but was not detected (CRL = 1.5 μg/L) in the June 1992 sampling of this same well. Further sampling to evaluate the presence of lead in this well was determined to be necessary before any final conclusions can be reached.

3.2 PHASE II FINDINGS

Results of the Phase II investigation conducted by OHM in late 1993 are described in detail in the Nature and Extent section of the SI/RI Addendum and are summarized in Tables 3-5 to 3-9 of this report. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling include lead (surface soils and ground water), DEHP (ground water), arsenic (test pits), and beryllium (test pits and sediments).

Lead was detected in a surface soil sample collected from the basement of the old tavern at a concentration of 520 mg/kg (890 mg/kg in the associated duplicate), a level in the same range as the previous maximum for AOC A4 of 570 mg/kg. The Phase II sampling confirmed that lead is present at hot spots in AOC A4 but is not widespread in site soils. Lead was not detected in a filtered ground water sample from the well which had previously yielded conflicting results (190 μg/liter in November 1992; $<$ 1.5 μg/liter in June 1992). Low levels of lead (5.2 μg/liter) were detected in an unfiltered sample from this well, further confirming that the single high hit was anomalous and probably associated with lead in suspended particulate matter.

DEHP was not detected in ground water during the Phase II sampling effort. This chemical is a common laboratory and field blank contaminant and its presence in one of seven previous ground water samples may be a result of laboratory contamination rather than an indication of its presence on site.

Arsenic was detected in a subsurface soil sample and in a sediment sample in Phase I at levels that were elevated compared with site-specific background but that were considered to be a possible indication of variability in the geology of the area. High naturally occurring arsenic levels occur in northeastern Massachusetts and the Annex may be influenced by these high natural arsenic deposits. A single elevated arsenic concentration (40 mg/kg) was reported in the Phase II sampling, a finding that is consistent with the Phase I results and may be indicative of naturally elevated arsenic levels in this area.

Beryllium was detected in 6 of 12 test pit samples, with all detected concentrations ranging from 0.4 mg/kg to 0.64 mg/kg. These levels are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.4 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values may be indicative of background beryllium concentrations. Beryllium was also detected in two of nine sediment samples at 6.6 and 1.5 mg/kg. These values are higher than other beryllium results for AOC A4 and for the Annex as a whole. However, they are consistent with the range of background levels in soils in the Eastern United States (Table 2-1).

3.3 RISK CHARACTERIZATION

In AOC A4, lead levels were elevated in an October 1992 ground water sample but not in the June 1992 sample from the same well. The Phase II sampling confirmed that the high value was anomalous and that lead is not a concern in ground water in AOC A4. A single high lead concentration in soils (570 mg/kg) was also reported close to this well in the Phase I investigation and an additional hot spot was detected in the Phase II sampling. These levels are slightly above the USEPA action level of 400 mg/kg. However, elevated lead levels do not appear to be widespread in this study area (SA) and frequent contact with hotspots is unlikely.

DEHP was not detected in Phase II sampling, suggesting that the previous single detected concentration was not site related. Heptachlor epoxide was also not detected in the Phase II sampling and may have been associated with particulate matter. Arsenic continues to be detected infrequently at levels above site-specific background. It is suspected that these occasional hits are indicative of naturally elevated arsenic, but it is not possible to make a definitive determination of the source based on available information.

Beryllium was detected in test pit soils and in sediments at levels somewhat higher than previously reported for the area. Risks posed by beryllium under the residential scenario in the BRA were 2×10^{-6} at a maximum concentration of 0.35 mg/kg. Assuming that contact with test pit soils was possible, risks posed by beryllium (maximum concentration of 0.64 mg/kg) would be approximately twice as high as listed in the BRA, or 4×10^{-6}, above the target risk level of 10^{-6} but within the target risk range for remediation of 10^{-4} to 10^{-6}. As noted above, these beryllium concentrations may be indicative of background levels for the area.

Beryllium was detected in two sediment samples at levels substantially higher than levels reported elsewhere on the site. Risk associated with the maximum concentration detected (6.6 mg/kg) under the exposure scenario for residential contact with sediments would be 1×10^{-5}.

As noted in the BRA, the primary purpose of the investigations in this area was to locate drums that had allegedly been buried in the area. No evidence of such disposal was found and overall, this area appears unlikely to pose significant health risks. It should also be noted that the residential use scenario may well be inappropriate for this area, given its potential historical significance.

4.0 AOC A7

AOC A7, Old Gravel Pit Landfill, is a 10-acre site located northeast of the USAF Radar Station along the northern boundary of the installation (Figure 1-1). The northern edge of the site overlooks the Assabet River. This area was reportedly used between the late 1950s and mid 1970s for the disposal of drums and other chemical containers. Interviews with Natick Laboratory employees who participated in chemical disposal activities in the early to mid 1970s, indicate that quart- to gallon-sized metal and glass containers of chemicals were disposed of in this area on a weekly basis. Excess chemicals and waste being temporarily stored in bunkers may also have been disposed of in this area. Unauthorized surface dumping by the general public also occurred during the 1970s until site access was restricted.

A surface dump with discarded furniture and debris is located within a wooded section at the east end of AOC A7, approximately 100 feet north of Patrol Road. This area, which has previously been referred to as SA P8, is a possible transformer disposal site. SA P8 is now considered to be a part of AOC A7; not a separate SA.

Figure 3-1 is a map of AOC A7 showing the locations for all investigative work performed and samples collected. Tables 4-1 to 4-4 summarize sampling results from the OHM Phase I sampling. Results from the current sampling effort are described in the SI/RI Addendum and summarized in Tables 4-5 to 4-8. Only chemicals detected at levels above background concentrations are included in these summary tables; complete data tables are provided in the SI/RI Addendum.

4.1 PREVIOUS RISK ASSESSMENT RESULTS

The following contaminants were detected in AOC A7 during the Phase I sampling effort reported in the SI/RI Report:

- Soil samples contained numerous organic and inorganic contaminants including heavy metals, organochlorine pesticides, herbicides, an explosive, PAHs, other semivolatile organic compounds, and chlorinated and non-chlorinated solvents.
- Ground water sampling detected organochlorine pesticides, chlorinated solvents, and acetone.
- Surface water samples contained elevated levels of iron.
- Sediment samples contained metals, an insect repellant (probably introduced during sample collection), a nitrosamine, and two solvents.

4.1.1 Results

Risks estimated for AOC A7 under current use and future use scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.09	0.9
Cancer Risk	3×10^{-6}	3×10^{-5}

[Chemical exceeding target risk levels were polycyclic aromatic hydrocarbons (PAHs) and arsenic (both possibly at background levels, DDT, and polychlorinated biphenyls (PCBs).]

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.4	4
Cancer Risk	4×10^{-5}	3×10^{-4}

(Much of the risk is associated with a single high concentration of DDT; other chemicals detected at levels exceeding target risk goals include PAHs, dieldrin, and PCBs.)

Sediment Ingestion

	Average	Maximum
Hazard Index	0.6	0.7
Cancer Risk	1×10^{-5}	2×10^{-5}

(Arsenic was responsible for most of the elevated risks in AOC A7 sediments.)

Ground Water Use

	Average	Maximum
Hazard Index	0.2	1
Cancer Risk	3×10^{-5}	2×10^{-4}

It should be noted that a third of the risk for water use was associated with a single detection of arsenic at a concentration (3 μg/L) that is well below the current USEPA Drinking Water Standard for this compound (50 μg/L). It should also be noted that the compounds posing risks [e.g., arsenic (ground water), PAHs and herbicides (soils), various solvents, pesticides, and PCBs (ground water)] were detected infrequently.

AOC A7 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and contacting soil and using water from a private well on the site is:

Total Systemic and Cancer Risk
Residential Use Scenario

	Average	Maximum
Hazard Index	0.6	5
Cancer Risk	7×10^{-5}	5×10^{-4}

Lead

For exposure to lead, risks were evaluated using USEPA's Uptake/Biokinetic Model and results from the model were compared with an USEPA blood lead action level of 10 μg/dl. Lead levels reported for AOC A7 in the Phase I investigation were:

Soil: average conc. = 70 mg/kg; max conc. = 400 mg/kg
Sediment: average conc. = 9 mg/kg; max conc. = 12 mg/kg
Ground Water: average conc. = 4 μg/L; max conc. = 19 μg/L

Based on the UBK model, lead does not pose a health risk in AOC A7.

4.1.2 Discussion

Much of the risk estimated for this area is associated with the presence of hot spots (areas of localized contamination) and for risks of the magnitude estimated in this report to occur would require frequent contact with these points. Such contact is unlikely, even in the equally unlikely event that a house were to be constructed on the site and next to the hot spot. Consequently, actual risks are probably substantially lower than risk estimates based on maximum exposure point concentrations. However, AOC A7 does contain an area that was used for the disposal of laboratory refuse. This area and locations downgradient from the area were not studied in detail in the Phase I investigation but were a focus of the Phase II study.

4.2 PHASE II FINDINGS

Results of the Phase II investigation conducted by OHM in late 1993 at AOC A7 are described in detail in the Nature and Extent section of the SI/RI Addendum and are summarized in Tables 4-5 to 4-8 of this report. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling, include lead (test pits), arsenic (sediments), beryllium (test pits and well borings), DDT (test pits), chloroform (test pits and ground water), 1,1,2,2-tetrachloroethane [1,1,2,2-tetrachloroethane (PCA); ground water), tetrachloroethylene [perchloroethylene (PCE); ground water), chlordane (test pits), and lindane (ground water).

Lead (3,900 mg/kg), beryllium (0.48 mg/kg), DDT (610 mg/kg), and chlordane (30 mg/kg for alpha and gamma combined) were found at somewhat higher maximum concentrations in Phase II test pit samples than in Phase I soil sampling. Arsenic was also detected at a higher concentration in sediments (35 mg/kg). The lead and chlordane levels are approximately an order of magnitude higher than the maximum Phase I results. DDT was present at a concentration only slightly higher than the Phase I result. The arsenic and beryllium concentrations are slightly above site-specific background levels calculated in the BRA. However, natural levels of metals can vary substantially depending on local geology and the slight elevations in AOC A7 may be examples of natural variability in metal levels in the area of the Annex.

As part of the Phase II investigation, test trenches were dug in the west central portion of the site to delineate the horizontal extent of buried laboratory glassware. Wells were also located downgradient from this area to evaluate potential effects on ground water. The laboratory glassware contained unknown liquid in some cases, and clearly presents a hazard. Levels of several chemicals were elevated in ground water downgradient from the lab waste area in the Phase II sampling event. Specifically, maximum concentrations of the chlorinated solvents chloroform (300 μg/liter), PCA (200 μg/liter), and PCE (130 μg/liter) were substantially higher than reported in the January 1994 RI/FS report. Lindane concentrations were also elevated (maximum concentration of 3.6 μg/liter) and in addition, lindane was detected more frequently (7 of 10 samples were positive).

4.3 RISK CHARACTERIZATION

As noted in the BRA, AOC A7 had allegedly been used as a dump for laboratory wastes, trash, and general debris and evidence of such use was clear during the investigation. Numerous points of contamination were noted in soils. Elevated levels of several chemicals were detected in ground water and the water is currently unsuitable for potable water supply. The Phase II results generally confirm these findings. Ground water and soils at the site show sporadic occurrences of elevated levels of contaminants and further investigation would probably identify additional evidence of such hot spots.

The Phase II sampling effort also confirmed concerns about the potential for unknown hazards at the site. During test pit digging, brown glass bottles (apparently laboratory glassware) were uncovered, which appeared to smoke when disturbed. Because the contents of these bottles or similar dumped materials is unknown, there is a possibility (albeit small) that unstable or shock sensitive materials are present in the landfill. If such materials are present, digging into the landfill may pose a substantial hazard to workers.

5.0 AOC A9

AOC A9, POL Burn Area, is located north of Patrol Road by the North Gate as shown on Figure 1-1. Now inactive, this area was in use since the late 1950s for flame-retardant clothing testing, destruction of confiscated fireworks, and fire fighting training.

AOC A9 is level, nearly square, and covers approximately 7 acres. An unnamed stream west of the area between AOCs A7 and A9 flows towards the Assabet River which is located to the north. The area is completely fenced and has a berm surrounding it.

Figure 4-1 is a map of this area showing all sampling points and significant features. Tables 5-1 to 5-3 summarize sampling results from the OHM Phase I sampling. Results from the Phase II sampling effort are described in the SI/RI Addendum and summarized in Tables 5-4 to 5-7. Only chemicals detected at levels above background concentrations are included in the risk assessment summary tables; complete data tables are provided in the SI/RI Addendum.

5.1 PREVIOUS RISK ASSESSMENT RESULTS

Contaminants detected in AOC A9 during the Phase I investigation include:

- Soil samples contained elevated levels of several metals, organochlorine pesticides, PAHs, several other semivolatile organic compounds, and VOCs. Other VOCs were detected in soil gas but not in soil samples.

- Ground water contained sodium, explosives, pesticides, insect repellant (probably introduced during sampling), chlorinated solvents and petroleum-related volatile and semivolatile organic compounds.

5.1.1 Results

Risks estimated in the January 1994 report for AOC A9 under current use and future use scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.03	0.1
Cancer Risk	2×10^{-6}	7×10^{-6}

(A single elevated arsenic concentration was responsible for risks in AOC A9.)

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.2	0.6
Cancer Risk	3×10^{-5}	1×10^{-4}

(The single elevated arsenic concentration was responsible for the elevated risks under this scenario.)

Ground Water Use

	Average	Maximum
Hazard Index	1	10
Cancer Risk	3×10^{-5}	2×10^{-4}

(A single high detection of 1,3,5-trinitrobenzene was responsible for the hazard index exceeding one; risks above the target risk goal (10^{-6} risk) were posed by arsenic, 1,1-DCE, methylene chloride, trichloroethylene, DEHP, heptachlor epoxide, PCBs, and trinitrotoluene. Most of these were present only in a single sample.)

AOC 9 - Future Use Summary

The total risk estimated to be associated with the rather unlikely scenario of living in a residential dwelling located on the site and consuming water from a private well on the site is:

Total Systemic and Cancer Risk
Residential Use Scenario

	Average	Maximum
Hazard Index	1	10
Cancer Risk	6×10^{-5}	2×10^{-4}

Lead

For exposure to lead, risks were evaluated by comparing blood lead levels estimated using USEPA's Uptake/Biokinetic Model with an USEPA blood lead action level of 10 μg/dl. Lead levels reported for AOC A9 in the Phase I investigation were:

Soil: average conc. = 81 mg/kg; max conc. = 450 mg/kg
Ground Water: average conc. = 3 μg/L; max conc. = 10 μg/L

Based on the UBK model, lead does not pose a health risk in AOC A9.

5.1.2 Discussion

Actual risks are likely to be substantially lower than indicated by this estimate. Much of the elevated risk is associated with sporadic detections of single compounds and frequent repeated contact with these hot spots is unlikely.

The chemical posing the greatest risk at AOC A9 is arsenic, which was detected in a single ground water sample at a concentration (4 μg/L) that is well below the USEPA Drinking Water Standard (50 μg/L). Several other compounds which contribute to risks are also present in only a single sample. Residual petroleum hydrocarbons and halogenated VOCs (primarily 1,1,1-trichloroethane) are present in subsurface soils and ground water at this site. Arsenic was also responsible for the risks posed by site soils, with a single hot spot initially responsible for the elevated risks. Subsequent sampling has identified elevated arsenic levels in a ditch on the southwest side of the site.

5.2 PHASE II FINDINGS

Results of the Phase II investigation conducted by OHM in late 1993 at AOC A9 are described in detail in the Nature and Extent section of the SI/RI Addendum and are summarized in Tables 5-4 to 5-7 of this report. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling, include arsenic (soils), beryllium (soils), lead (ground water), thallium (soils), 1,1-DCE (ground water), 1,1,1-TCA (ground water), ethylbenzene (ground water), toluene (ground water), and xylene (ground water). A number of compounds, including chlorinated pesticides and PAHs, that were detected in the Phase I sampling were not detected in the Phase II investigation.

Arsenic was detected at elevated concentrations in the drainage ditch on the southwestern side of AOC A9, confirming previous findings for this area. The maximum concentration detected (140 mg/kg) was slightly higher than observed in previous sampling events. Beryllium was detected in soil with a maximum concentration of 0.69 mg/kg. Levels reported are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.34 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values may be indicative of background beryllium concentrations. A single sample taken in the northwest corner of the site, in the same location as the highest lead sample, contained thallium at 304 mg/kg.

Lead was detected in a single sample at a concentration of 41 μg/liter, somewhat higher than the maximum of 9.5 μg/liter reported in the Phase I investigation. However, lead was detected less frequently in this sampling round.

VOCs, including the halogenated compounds 1,1-DCE and 1,1,1-TCA and the petroleum-derived monocyclic aromatics ethylbenzene, toluene, and xylene, were detected at concentrations that were generally a factor of 10 higher than detected in the Phase I sampling in this area. The compound 1,1-DCE was detected in three of nine (3 of 9) samples at a maximum concentration of 70 μg/liter. 1,1,1-TCA was detected in 6 of 9 samples, and in 3 of 9 was present at over 500 μg/liter, with a maximum concentration of 2,000 μg/liter. Ethylbenzene and toluene were both present in 3 of 9 samples with maximum concentrations of 2,000 μg/liter. Xylene was present in 4 of 9 samples, with the two highest concentrations being 8,000 and 4,000 μg/liter.

5.3 RISK CHARACTERIZATION

Several volatile compounds were detected in ground water at levels well above concentrations reported in the SI/RI Report. The presence of these higher levels warrants additional quantitative evaluation of potential risks associated with these chemicals. Consequently, risks were estimated under the future residential use scenario described in the BRA, namely the use of the water for domestic purposes. It should be stressed that such use is unlikely at AOC A9 as the Massachusetts Department of Environmental Protection (MADEP) has ruled that water in the area does not meet state criteria for a domestic water source. However, the use was evaluated for consistency with the previous risk assessment.

Use of site ground water or surface water as a source of domestic water can lead to exposure via three pathways: ingestion, dermal absorption, and inhalation (volatiles only). Past exposure assessments have generally focused on the ingestion pathway. However, several studies have been completed that address exposure to volatiles via dermal absorption while bathing (including showering) or via inhalation while showering or using domestic water for non-contact purposes (dishwashing, in-home clothes washing, etc.). Both inhalation and dermal absorption appear to contribute doses of VOCs that are roughly equivalent to the dose delivered by ingesting water at the standard rate of 2 liters/day (USEPA, 1992). In order to account for exposure to VOCs via these other pathways, a factor of two will be incorporated into the dose estimates developed based on ingestion exposure. Other agencies use slightly different multipliers (MADEP suggests a factor of three), while still others do not use multipliers in these cases. Considering that conservative exposure parameters are used in calculating exposure via ingestion, inhalation, and dermal absorption and that the combination of these parameters could lead to very conservative estimates of risk, the use of a factor of two seems appropriate.

Exposure via ingestion of ground water or surface water can be calculated using the equation:

$$CDI = \frac{CW \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CDI = Average daily intake of the chemical (mg/kg/day),
CW = Chemical concentration in water (μg/L)
IR = Water consumption rate (2 liters/day)
CF = Conversion factor (10^{-3} mg/μg)
FI = Relative fraction absorbed from water (100 percent)
EF = Frequency of site contact (350 days/365 days)
ED = Exposure duration (30 years)
BW = Body weight (70 kg)
AT = Averaging time (30 or 70 years).

Using these equations and the average and maximum chemical concentrations in ground water from AOC A9, CDI levels can be calculated for ground water ingestion and are presented in Table 5-8. For volatiles, a factor of two has been multiplied by the CDI from the equation above to derive the adjusted CDI for ingestion, inhalation, and dermal absorption exposure. These CDIs can be combined with the

toxicity criteria presented in Table 1-1 to indicate risks posed by the chemicals. Table 5-9 contains these values.

A review of Table 5-9 indicates that estimated cancer risks (maximum of 1×10^{-3}) are somewhat higher than reported in the BRA, primarily as a result of the higher 1,1-DCE concentrations. Noncancer risks are in the same range as the previous risk assessment (HI=30 as compared with the previous value of HI=20). However, as noted above, the ground water in AOC A9 is considered inadequate for domestic use and consequently, it is unlikely that exposure would occur via this pathway. The presence of solvents and petroleum-derived compounds in ground water confirms previous conclusions that site ground water and associated subsurface soils showed evidence that the previous clean up was somewhat incomplete, but fairly low levels of petroleum-based compounds and solvents (1,1-DCE and 1,1,1-TCA) are present. Considering that natural attenuation, dilution, and probably degradation are likely to reduce concentrations of these constituents and that ground water is unlikely to be used, further action may or may not be warranted.

Arsenic was present at elevated concentrations in soils in the southwest corner of this area. Use of the site for residential purposes is probably unlikely to occur and if it did occur, a layer of topsoils would almost certainly be required which would act to preclude contact with this material. Similarly, contact with the lead and thallium that were detected in single samples at the northwest corner of the site is unlikely.

6.0 FACILITY-WIDE

In addition to the samples that were collected from the three RI areas, during the first phase of OHM's investigation at the Annex, samples were collected from a large number of other areas of potential concern at the facility. In the BRA, data from this sampling effort were used to calculate risks for the same current use and potential future use scenarios as were used for the RI areas. However, because of the large area represented by the sampling, average values are really only useful as a screening tool. If maximum and average values do not pose a risk, then it is unlikely that the evaluated chemical poses a risk at the facility. However, if results suggest that a particular chemical may pose a risk at the Annex, further evaluation is required to determine if the potential for harm is isolated (a few hot spots) or more widespread.

The Phase II evaluation of non-RI areas focused on sites where Phase I sampling had suggested contamination may be present. Therefore, these samples are quite biased, and although indicative of chemical concentrations at hot spots, are not representative of the site. Consequently, a base-wide risk estimate using these samples would be inappropriate. This section addresses results for the individual hot spot areas, and discusses the risk consequences of these findings.

6.1 PREVIOUS RISK ASSESSMENT RESULTS

Risks estimated in the BRA for the overall Annex (excluding the three RI areas) under current use and future use scenarios were:

Current Use

Soil Ingestion

	Average	Maximum
Hazard Index	0.6	0.8
Cancer Risk	9×10^{-6}	1×10^{-4}

Future Use (Residential Scenario)

Soil Ingestion

	Average	Maximum
Hazard Index	0.3	0.4
Cancer Risk	1×10^{-4}	1×10^{-3}

Ground Water Use

	Average	Maximum
Hazard Index	0.3	3
Cancer Risk	5×10^{-5}	3×10^{-4}

Surface Water Use (Puffer Pond)

	Average	Maximum
Hazard Index	0.2	0.3
Cancer Risk	3×10^{-5}	6×10^{-5}

Arsenic, which was responsible for much of this risk, was only detected in surface water twice at levels only slightly above the detection limit. The levels detected (maximum of 3 μg/liter) are similar to levels seen sporadically in ground water and may represent background for the area.

Lead

For exposure to lead, risks are evaluated by comparing blood lead levels estimated using USEPA's Uptake/Biokinetic Model with an USEPA blood lead action level of 10 μg/dl. Lead levels reported for the facility are:

Soil: average conc. = 370 mg/kg; max conc. = 16,000 mg/kg
Ground Water: average conc. = 2 μg/L; max conc. = 12 μg/L
Surface Water: average conc. = 5 μg/L; max conc. = 10 μg/L

Only two soil samples contained lead at levels above 1,000 mg/kg. The maximum level detected, 16,000 mg/kg, produced blood lead levels well above the USEPA action level for blood lead. However, soils and ground water across most of the site contain lead at levels that do not pose a health risk.

Discussion

The facility-wide sampling conducted during the Phase I investigation was not random but was focused on areas of potential concern. The purpose of this sampling was primarily to indicate areas that might require further investigation. However, an important secondary function of this effort was to collect data that would provide a picture of the entire site and associated risks. If this sampling effort had failed to indicate any contamination in areas that were considered most likely to have residual chemicals, it would suggest that the site is very unlikely to pose a problem. On the other hand, if the site contamination was widespread and high, further action would clearly be warranted. The results of the sampling indicate that overall, the site is fairly uncontaminated, but some areas do require further investigation and possibly cleanup. Chemicals responsible for risks in these SAs were generally the same chemicals that are of concern in the three RI areas. The specific areas requiring further investigation will be addressed separately. The BRA documented attempts to provide an overview of possible risks. Consequently, the risks presented in this evaluation are not representative of the Annex but of areas of possible concern on the Annex.

Puffer Pond, and in particular, the consumption of fish from the pond was of concern based on the presence of mercury at a concentration exceeding state and federal action levels in a large pickerel captured from the pond. A study was performed to evaluate the potential for risks to be associated with eating fish from the pond. Based on this study, no risks above the USEPA target criteria would be posed by regular consumption of fish from Puffer Pond. However, the study did not collect large predatory species which

are most likely to contain elevated mercury levels. The sampling did confirm that mercury levels were not substantially different from levels in fish from other area ponds (e.g., Walden Pond and Sandy Pond in Lincoln; Echo Lake in Hopkinton).

6.2 PHASE II FINDINGS

In addition to the three RI areas, Phase II investigations were conducted by OHM in late 1993 in SAs A3, P5, P4, P7, P17, P19, P20, P25, P35, P49, and P51. Two additional areas were sampled (P59 and P60) where drums and metallic debris were discovered. Figure 1-1 indicates the locations of the SAs. Results of the investigation of these areas are described in detail in the Nature and Extent section of the SI/RI Addendum and are summarized in Tables 6-1 to 6-13 of this report. Specific findings that relate to risk issues in each of these areas are described separately in the following sections. Only chemicals detected at levels above background concentrations are included in the summary tables; complete data tables are provided in the SI/RI Addendum.

6.2.1 SA A3

SA A3 is a gravel pit that was used as a dumping ground for trash and debris. The focus of the Phase II investigation in the area was to determine if drums had been buried at the site. No evidence of drums was uncovered during the investigation. The only chemical detected at a concentration that was significantly elevated or that was of interest because of its relationship to results of the Phase I sampling was beryllium.

Beryllium was detected in 9 of 13 samples, at concentrations ranging from 0.4 to 0.57 mg/kg. Levels reported are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.47 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values may be indicative of background beryllium concentrations.

6.2.2 SA P5

SA P5 is located immediately south of SA A3 on the edge of a swamp and consists of several drums found scattered in the area. Beryllium was detected in all four samples collected in Phase II, at concentrations ranging from 0.4 to 0.55 mg/kg. As noted above for SA A3, these concentrations appear to be consistent with natural beryllium levels.

6.2.3 SA P4

SA P4, located east of the parachute testing drop zone, contained four drums secured with a nylon harness sitting on a pallet. Phase I sampling had indicated that elevated arsenic concentrations were associated with these drums. The Phase II sampling confirmed these findings, with elevated arsenic reported in two of the confirmatory samples at 130 mg/kg and 210 mg/kg. In addition, elevated levels of polycyclic aromatic hydrocarbons were also detected (total carcinogenic PAHs of approximately 10 mg/kg).

6.2.4 SA P7

SA P7 had previously been identified as a possible dumping area and Phase I sampling had indicated the presence of toluene in a single sample. Phase II sampling was conducted to verify this sample result but no toluene was detected.

6.2.5 SA P17

SA P17 is an area where debris burial occurred during the 1960s and 1970s. Phase I sampling had indicated that elevated arsenic concentrations were associated with a 55-gallon drum located on the western edge of the area. The Phase II sampling confirmed these findings, with elevated arsenic reported in all four of the confirmatory samples at concentrations ranging from 240 mg/kg to 260 mg/kg. Beryllium was also detected in all four samples collected in Phase II, at concentrations ranging from 0.4 to 0.58 mg/kg.

6.2.6 SA P19

No significant findings were reported for SA P19, a cleared tracked area that had been used for a troop encampment.

6.2.7 SA P20

SA P20 was a small borrow pit with evidence of metal debris and a partially buried drum. A Phase II surface soil sampling revealed elevated levels of lead, with a maximum concentration of 3,000 mg/kg. Beryllium was detected in 1 of 4 samples at a concentration of 0.57 mg/kg.

6.2.8 SA P25

SA P25 is a former test chamber used for velocity experiments. Phase I sampling had shown total DDT and its derivatives DDD and DDE ($\sum$DDT) levels of 1.2 mg/kg. Lower levels, in the range of 0.1 to 0.8 mg/kg were detected in the Phase II sampling. Given the probable spraying of the area for mosquito and gypsy moth control and the rather low levels detected, a source of DDT in SA P25 appears unlikely.

6.2.9 SA P35

SA P35 is the main gate guard shack. Sampling in this area revealed slightly elevated levels of lead (100 mg/kg to 360 mg/kg), probably associated with releases from automobiles using leaded gasoline. Arsenic was detected at a maximum concentration of 32 mg/kg and $\sum$DDT was present at a maximum concentration of 5 mg/kg. Both arsenic and $\sum$DDT may be the result of pesticide spraying near the building or leakage from spray trucks.

6.2.10 SA P49

SA P49 consisted of two drums located west of Bunker 323 in the center of the Annex. Phase I sampling had shown $\sum$DDT levels of 0.4 mg/kg. Similar levels, in the range of 0.5 mg/kg, were detected in the Phase II sampling. Given the probable spraying of the area for mosquito and gypsy moth control and the rather low levels detected, a source of DDT in SA P49 appears unlikely.

6.2.11 SA P51

SA P51 consisted of a drum located near SA A5 along White Pond Road. Phase I sampling had shown ∑DDT levels of 1 mg/kg. Similar levels, in the range of 0.5 to 1 mg/kg, were detected in the Phase II sampling. Given the probable spraying of the area for mosquito and gypsy moth control and the rather low levels detected, a source of DDT in SA P51 appears unlikely. Slightly elevated levels of lead (77 mg/kg) and mercury (0.37 mg/kg) were also reported in the Phase I sampling results. Similar lead levels were reported (maximum of 70 mg/kg) but no mercury was detected in the Phase II sampling.

6.2.12 Additional Facility-Wide Sampling

Samples were collected from two additional areas of the Annex based on observations made during the Phase II investigation. Sediment samples were collected from a swampy area adjacent to Taylor Brook north of Bunker 319 after debris was noted in the area. Confirmatory drum samples were taken from near a drum discovered between Patrol Road and the boundary fence west of SA P30. The sediment samples contained somewhat elevated levels of arsenic (maximum concentration of 36 mg/kg), ∑DDT (maximum concentration of 10 mg/kg), and lead (3 of 5 samples >100 mg/kg; maximum of 120 mg/kg). The confirmatory drum samples contained the highest levels of arsenic detected on the Annex, 260 and 460 mg/kg.

6.3 RISK CHARACTERIZATION

Phase II sampling was conducted to confirm Phase I sampling results. Based on the results of this sampling, elevated concentrations of chemicals are located at several points across the Annex (hot spots) and further action to address these hot spots will be required. Beryllium was detected much more frequently and at higher levels in Phase II sampling (average concentration in soils of 0.5 mg/kg) than in Phase I sampling (average concentration in soils of 0.38 mg/kg) in both the facility-wide sampling and in the RI areas. The reason for this is unclear but a different laboratory was used to analyze data and the results may relate to laboratory differences and not to actual site concentrations.

7.0 CONCLUSIONS

The BRA and this addendum were prepared to evaluate the potential for residual chemicals present at the Annex to pose a risk to individuals using the site under current conditions or in the future. Currently, use of the site is somewhat restricted although unauthorized entry is not difficult. The greatest potential exposure is likely to be associated with unauthorized use by school-age children. Exposure under a current use scenario is most likely to occur via direct contact with, and subsequent ingestion or dermal absorption of chemicals in site soils.

Although it is unlikely that future use of the Annex would include building houses on large portions of the facility (planned use for the Annex involves transfer of the property to the U.S. Fish and Wildlife Service), such use can not be precluded if sections of the facility are excessed (sold by the military). Because this scenario posed the highest potential for exposure, residential use of the facility in the future was evaluated to estimate maximum likely risks. Under this scenario, it was assumed that exposure could occur via direct contact with soils and sediments (ingestion or dermal absorption), use of on-site ground water or surface water, and via consumption of fish.

Following USEPA Region I guidance, risks were assessed using both average and maximum concentrations of the chemicals in the different environmental media at the site. The maximum concentration represents exposure that would be associated with repeated contact with the most highly contaminated area on the site. The average concentration assumes that an individual receives an exposure from a wider distribution of sources. USEPA uses a target cancer risk goal of one in one million (10^{-6}) and typically regulates within a range of 10^{-4} to 10^{-6}. For noncarcinogens, USEPA assumes that adverse health effects are unlikely if the estimated exposure dose is lower than the reference toxicity criteria (called the reference dose or RfD). The ratio of exposure dose to RfD is termed the Hazard Quotient or HQ and the sum of these ratios for multiple chemical exposure is called the Hazard Index or HI. An HI less than one is considered unlikely to be of concern.

The OHM investigation at the site focused on three areas of primary concern, where full RIs were conducted, AOCs A4, A7, and A9. Studies were also conducted in numerous other areas of the facility to attempt to define the facility-wide nature and extent of any residual chemicals.

In order to ensure that public health is adequately protected, conservative (unlikely to underestimate risk) assumptions were used in deriving both the exposure estimate and the toxicity values. Because of the use of these conservative (although not necessarily worst case) assumptions, it is likely that actual risks are considerably lower than risks estimated in this report.

7.1 AOC A4

As estimated in the BRA, exposure under current site conditions via soil ingestion and dermal absorption in AOC A4 produced a total hazard index for ingestion and dermal absorption exposure to soils less than one, suggesting that it is improbable that exposure to chemicals poses a risk of systemic toxicity. The sum of the cancer risks for direct contact with soils in AOC A4 indicates that under current conditions, direct contact via soil ingestion and dermal absorption is unlikely to pose a risk above the upper-bound excess lifetime cancer risk level of 1×10^{-6} used as a target risk level for this site.

As estimated in the January 1994 BRA, for a scenario involving potential future use of AOC A4 for residential purposes and exposure via soil ingestion and dermal absorption, the total hazard index for

ingestion and dermal absorption exposure to soils was less than one suggesting that it is improbable that exposure to chemicals by direct contact poses a risk of systemic toxicity. The sum of the cancer risks for direct contact with soils in AOC A4 is 3×10^{-7}. For a drinking water exposure scenario, the hazard index for the noncarcinogens was also less than one. The total excess lifetime cancer risk for this route was 6×10^{-5}, based on the potential for exposure to arsenic, heptachlor epoxide, and DEHP in the water. These values suggest that under a residential use scenario, future use of AOC A4 ground water exceeds the upper-bound excess lifetime cancer risk level of 1×10^{-6} used as a target risk level for this site. The exposure estimates and toxicity criteria were developed using health protective assumptions, so that actual risks associated with exposure in the area are unlikely to exceed the risks estimated in this risk assessment, but may be lower.

The data collected during the Phase II sampling event generally supports the findings described in the January 1994 BRA. Beryllium was detected frequently at concentrations slightly above previously reported values. However, the regular distribution of the material and the lack of a possible source for beryllium suggests that the reported beryllium concentrations are representative of background. Lead was confirmed to be present at hot spots in the area but was not widespread. Lead, heptachlor epoxide, and DEHP had been a concern in ground water based on the Phase I sampling; the results of the Phase II sampling suggest that these are not a problem at the site. In addition, the site ground water is unlikely to be used for domestic water supply.

7.2 AOC A7

As estimated in the BRA, for direct contact exposure under current conditions in AOC A7, the total hazard index for ingestion and dermal absorption exposure to soils is less than one, suggesting that it is unlikely that exposure to chemicals poses a risk of systemic toxicity. The sum of the cancer risks for direct contact with surface soils in AOC A7 is in the middle of the risk range of 10^{-4} to 10^{-6} used by USEPA in making regulatory decisions. The risk is based in large part on B[a]P, which was present in a single sample at a concentration of 2 μg/g. Benzo(a)pyrene (B[a]P) and other PAHs are commonly occurring in background soils at similar levels.

As estimated in the BRA, on-site residential use exposure via soil ingestion and dermal absorption in AOC A7 produced a maximum hazard index for ingestion and dermal absorption exposure to soils greater than one, suggesting that it is possible that exposure to chemicals poses a risk of systemic toxicity. The maximum total excess lifetime cancer risk for direct contact exposure (soil ingestion and dermal absorption) is 3×10^{-4}, based primarily on the potential exposure to B[a]P, several chlorinated pesticides, PCBs, and N-nitrosodi-propylamine. This value is above the upper-bound excess lifetime cancer risk level of 1×10^{-6} used as a target risk level for this site and is also slightly above the risk range of 10^{-4} to 10^{-6} used by USEPA in making regulatory decisions. However, B[a]P is present in only 2 of 55 samples and at levels that are likely to be encountered in background soils, PCB 1260 was only present in 1 of 50 samples, and N-nitrosodi-propylamine was only present in a single sediment sample. Consequently, contact with soils containing these material is unlikely and actual risks are likely to be substantially lower than estimated.

For AOC A7 ground water, the maximum hazard index for the noncarcinogens estimated in the BRA was approximately equal to one, suggesting that exposure to chemicals in ground water would pose a risk of systemic toxicity due to the presence of organochlorine pesticides, if the water were used for domestic purposes. The total excess lifetime cancer risk for this route was 2×10^{-4}, based primarily on the presence

of organochlorine pesticides in the water. This value is at the upper end of the risk range used by USEPA in making regulatory decisions. It should be noted that the organochlorine pesticides are not very soluble in water and may be bound to suspended soil particles in the sample. These suspended particles would probably settle out of water in a domestic well and consequently, exposure to the organochlorine pesticides is unlikely from a private well located on the site. It should also be noted that, with the exception of lindane which was present in 2 of 18 samples, the compounds posing risks were detected in only 1 of the 18 samples collected from the area.

Phase II sampling results generally confirm the Phase I findings that soils and ground water in AOC A7 are contaminated. Furthermore, the sampling also indicated that unknown quantities and types of chemical waste materials may be present in the west-central portion of the site where laboratory waste disposal occured. Risks posed by these unknown materials cannot be reliably quantified but may be substantial. In addition, the unknown materials may pose a safety hazard if chemically unstable materials are present.

7.3 AOC A9

As estimated in the BRA, risks associated with direct contact (soil ingestion and dermal absorption) exposure under current conditions via soil ingestion in AOC A9 produced a total hazard index for exposure to soils less than one, suggesting that it is unlikely that exposure to chemicals poses a risk of systemic toxicity. The sum of the cancer risks for direct contact with soils in AOC A9 is 7×10^{-6}, based primarily on ingestion exposure to arsenic. This value is slightly above the upper-bound excess lifetime cancer risk level of 1×10^{-6} used as a target risk level for this site. It should be noted that a single elevated arsenic value was responsible for this risk.

For on-site residential use, exposure via direct contact (soil ingestion and dermal absorption) in AOC A9, the hazard index for the noncarcinogens was estimated in the BRA to be less than one, indicating that it is unlikely that exposure to chemicals in this area poses a risk of systemic toxicity. The total excess lifetime cancer risk for direct contact is 1×10^{-4}, based primarily on the potential exposure to arsenic. The risk value for arsenic is at the upper end of USEPA's target risk range for this site.

For ground water exposure, the hazard index for the noncarcinogens exceeded one, suggesting that exposure to chemicals in ground water is of potential concern for systemic toxicity. However, the chemical posing the greatest concern (1,3,5-trimethyl benzene) was only detected once in the ground water. The total excess lifetime cancer risk for this route was 2×10^{-4}, above the upper-bound excess lifetime cancer risk level of 1×10^{-6} used as a target risk level for this site and above the risk range used by USEPA in making regulatory decisions. However, most of the compounds posing risks were only detected once in ground water.

The Phase II sampling confirmed the presence of arsenic in soils near the southwestern corner of AOC A9, while thallium was detected in a sample at the northwest corner of the site where an elevated lead level was reported in the Phase I sampling. Regular contact with these areas could pose unacceptable health risks, but such frequent contact is unlikely. In addition, elevated levels of several volatile chemicals were detected in ground water, indicating that the remediation conducted in the area had not been sufficient to entirely remove soils contaminated during fire training activities. Use of the water for domestic purposes would pose an elevated health risk but such use is unlikely based on the MADEP determination that the ground water in the area is not adequate for domestic water supply.

7.4 FACILITY-WIDE EVALUATION

The Phase I and Phase II investigations focused on target areas of potential concern, with the Phase II sampling effort primarily directed at confirming results of the Phase I sampling. Both sampling rounds indicate that hot spots of higher chemical concentrations do exist on the facility. Further action to address these hot spots may be necessary. However, no evidence of widespread contamination was found. Hot spots, such as those present at the Annex, almost certainly also exist in off-facility areas (for example, lead and carcinogenic PAHs are present at elevated concentrations along roadways and in urban areas; Menzie et al., 1992; USEPA, 1989) and the risks posed by the site are probably not substantially different from risks that could be found in many urban or even suburban areas in the United States.

8.0 REFERENCES

DeCesare, G.J. 1991. (Letter to A.S. Johnson, Biomonitoring Program Manager, Technical Services Branch, Massachusetts DWPC. RE: Walden and Sandy Ponds Toxics In Fish Monitoring.) February 25, 1991.

Environmental Protection Agency (EPA) 1988. Superfund Exposure Assessment Manual. Office of Remedial Response, USEPA, Washington, D.C. April 1988. EPA 540/1-88-001

Environmental Protection Agency, Region I (EPA) 1989. Supplemental Risk Assessment Guidance for the Superfund Program (Draft Final). U.S. EPA Region I Risk Assessment Work Group. June 1989. EPA 901/5-89-001

Environmental Protection Agency (EPA) 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. July 1989. EPA 600/8-89/043

Environmental Protection Agency (EPA) 1989. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. July 1989. OSWER Directive 9285.701A

Environmental Protection Agency (EPA) 1989. Air/Superfund National Technical Guidance Study Series - Procedures for Conducting Air Pathway Analyses for Superfund Applications (Interim Final) Volumes I-IV. Office of Air Quality Planning and Standards, Research Triangle Park, NC EPA 450/1-89-001 - EPA 450/1-89-004

Environmental Protection Agency (EPA) 1990. Guidance for Data Useability in Risk Assessment (Interim Final). Office of Emergency and Remedial Response. Washington, D.C. EPA 540G-90-008

Environmental Protection Agency (EPA) 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03

Environmental Protection Agency (EPA) 1991. Health Effects Assessment Summary Tables: Annual FY-1991. Office of Emergency and Remedial Response, Washington, D.C., OERR 9200.6-303-(91-1)

Environmental Protection Agency (EPA) 1992. Integrated Risk Information System (IRIS). Chemical-Specific Reference Doses and Cancer Potency Factors and EPA Toxicology Background Documents. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, Ohio.

Maietta, R.. 1988. (Letter to A.S. Johnson, Biomonitoring Program Manager, Technical Services Branch, Massachusetts DWPC. RE: 1987 Echo Lake Fish Toxics Monitoring.) March 16, 1988.

Menzie, C.A., Potocki, B.B., Santodonato, J. 1992. Exposure to carcinogenic PAHs in the environment. Environ Sci Technol 26:1278-1284.

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TABLES

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TABLE 1-1
TOXICITY VALUES FOR CHEMICALS DETECTED
AT THE SUDBURY ANNEX

CONTAMINANT	RfD (mg/kg/day)	CSF (1/(mg/kg/day))	Weight-of-Evidence Classification
METALS:			
Aluminum	1.00E+00 s		D
Antimony	4.00E-04 i		Not Evaluated i
Arsenic	3.00E-04 i	1.75E+00 i	A i
Barium	7.00E-02 i		Not Evaluated i
Beryllium	5.00E-03 i	4.30E+00 i	B2 i
Cadmium (food)	1.00E-03 i		B1 ** i
Cadmium (water)	5.00E-04 i		B1 ** i
Calcium			
Chromium (as Chromium VI)	5.00E-03 i		A ** i
Cobalt			
Copper	3.71E-02 h		D i
Iron			
Lead	*	*	B2 i
Magnesium			
Manganese	5.00E-03 s		D i
Mercury	3.00E-04 h		D i
Nickel	2.00E-02 i		Not Evaluated i
Potassium			
Selenium	5.00E-03 i		D i
Silver	5.00E-03 i		D i
Sodium			
Vanadium	7.00E-03 h		D h
Zinc	3.00E-01 i		D i
VOLATILE ORGANICS:			
1,1,1-Trichloroethane (1,1,1-TCA)	9.00E-02 h		D i
1,1,2-Trichloroethane	4.00E-03 i	5.70E-02 i	C i
1,1,3-Trimethylcyclohexane			
1,1-Dichloroethylene	9.00E-03 i	6.00E-01 i	C i
1,2-Dichloroethane		9.10E-02 i	B2 i
1,3-Dimethylcyclohexane			
1,4-Dimethylcyclohexane			
2-Propanol			
Acetone	1.00E-01 i		D i
Benzene		2.90E-02 i	A i
Carbon disulfide	1.00E-01 i		Not Evaluated i
Chlorobenzene	2.00E-02 i		D i
Chlorodifluoromethane			
Chloroform	1.00E-02 i	6.10E-03 i	B2 i
Chloromethane		1.30E-02 h	C h
Ethylbenzene	1.00E-01 i		D i
Ethylmethyl benzene			
Methyl-N-butyl ketone			
Methylene chloride	6.00E-02 i	7.50E-03 i	B2 i

TABLE 1-1
TOXICITY VALUES FOR CHEMICALS DETECTED
AT THE SUDBURY ANNEX

VOLATILE ORGANICS (cont):						
Methylethyl ketone	6.00E-01	h			D	i
Methylisobutyl ketone	8.00E-02	h			No Data	i
Nonane						
Octane						
Propylbenzene						
Tetrachloroethylene (PCE)	1.00E-02	i	5.20E-02	s	Under Review	i
Toluene	2.00E-01	i			D	i
Trichloroethylene (TCE)	6.00E-03	s	1.10E-02	s	B2	i
Trichlorofluoromethane	3.00E-01	i			Not Evaluated	i
Xylenes	2.00E+00	i			D	i
alpha-Pinene						
BNAs:						
1,2,3,4-Tetramethylbenzene						
1,2,3-Trimethylbenzene						
1,3,5-Trimethylbenzene						
1,5-Dimethylnaphthalene						
1-Ethyl-2-methylbenzene						
1-Methylnaphthalene						
2-Methylnaphthalene						
9H-Carbazole			2.00E-02	h	B2	h
Acenaphthene	6.00E-02	i			Not Evaluated	i
Anthracene	3.00E-01	i			D	i
Benzo[a]anthracene ***			7.30E+00		B2	i
Benzo[a]pyrene			7.30E+00	i	B2	i
Benzo[b]fluoranthene ***			7.30E+00		B2	i
Benzo[b]fluorene						
Benzo[g,h,i]perylene					D	i
Bis(2-ethylhexyl)phthalate	2.00E-02	i	1.40E-02	i	B2	i
Camphor						
Chrysene ***			7.30E+00		B2	i
Di-N-butyl phthalate	1.00E-01	i			D	i
Di-N-octyl phthalate	2.00E-02	h				
Dibenzofuran					D	i
Diethyl phthalate	8.00E-01	i			D	i
Fluoranthene	4.00E-02	i			D	i
Fluorene	4.00E-02	i			D	i
Hexadecanoic acid						
Indeno[1,2,3-c,d]pyrene ***			7.30E+00		B2	i
Isophorone	2.00E-01	i	9.50E-04	i	C	i
Mesityl oxide						
N,N-Bis(2-hydroxyethyl)dodecamide						
N-Nitrosodi-N-propylamine			7.00E+00	i	B2	i
Naphthalene	4.00E-02	h			D	i
Octadecanoic acid						
Phenanthrene	2.90E-02	s			D	i
Pyrene	3.00E-02	i			D	i
Sulfur						

TABLE 1-1
TOXICITY VALUES FOR CHEMICALS DETECTED
AT THE SUDBURY ANNEX

PCB/PESTICIDES:						
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	5.00E-04	i	3.40E-01	i	B2	i
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)			2.40E-01	i	B2	i
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)			3.40E-01	i	B2	i
Dieldrin	5.00E-05	i	1.60E+01	i	B2	i
Endosulfan sulfate ***	6.00E-03	i			Not Evaluated	i
Endrin	3.00E-04	i			D	i
Endrin aldehyde ***	3.00E-04	i			D	i
Heptachlor	5.00E-04	i	4.50E+00	i	B2	i
Heptachlor epoxide	1.30E-05	i	9.10E+00	i	B2	i
Lindane	3.00E-04	i	1.30E+00	h	C	i
N,N-Diethyl-3-methylbenzamide (DEET)						
PCB 1242			7.70E+00	i	B2	i
PCB 1248			7.70E+00	i	B2	i
PCB 1254	2.00E-05		7.70E+00	i	B2	i
PCB 1260			7.70E+00	i	B2	i
alpha-Benzenehexachloride			6.30E+00	i	B2	i
alpha-Chlordane ***	6.00E-05	i	1.30E+00	i	B2	i
alpha-Endosulfan ***	6.00E-03	i			Not Evaluated	i
beta-Benzenehexachloride			1.80E+00	i	C	i
beta-Endosulfan ***	6.00E-03	i			Not Evaluated	i
gamma-Chlordane ***	6.00E-05	i	1.30E+00	i	B2	i
HERBICIDES:						
Dacthal (DCPA)	5.00E-01	i			Not Evaluated	i
Silvex	1.00E-02	i			Not Evaluated	i
EXPLOSIVES:						
1,3,5-Trinitrobenzene	5.00E-05	i			Under Review	i
2,4,6-Trinitrotoluene	5.00E-04	i	3.00E-02	i	C	i
2,6-Dinitrotoluene	1.00E-03	s	6.80E-01	i	B2	i
3-Nitrotoluene	1.00E-02	h			D	e
Cyclonite (RDX)	3.00E-03	i	1.10E-01	i	C	i
Cyclotetramethylenetetranitramine (HMX)	5.00E-02	i			D	i
Nitroglycerine						
Pentaerythritol tetranitrate						
PHOSPHATE:						
Phosphate						
ORGANIC CARBON:						
Total Organic Carbon						
TOTAL PETROLEUM HYDROCARBONS:						
Petroleum distillates						

FOOTNOTES:

RfD = Oral Reference Dose
CSF = Oral Cancer Slope Factor

* - Toxicity values for lead are not available and risk has been assessed using EPA's UBK Model

** - Carcinogenic via inhalation route only

TABLE 1-1
TOXICITY VALUES FOR CHEMICALS DETECTED
AT THE SUDBURY ANNEX

*** - Toxicity values not available; values for related compounds substituted as follows:
endosulfan sulfate, alpha-, and beta-endosulfan = value for endosulfan
endrin aldehyde = value for endrin
alpha- and gamma-chlordane = value for chlordane
CSF for benzo[a]pyrene used for all carcinogenic (B2) polycyclic aromatic hydrocarbons (PAHs) based on discussion with the EPA Region I toxicologist

EPA is currently deciding whether tetrachloroethylene is a class B2 or C carcinogen.

IRIS lists two RfDs for cadmium; value for food (1E-3) used for all soil/sediment exposure scenarios, value for water (5E-4) used for exposure via drinking water

Values used are USEPA criteria; MADEP may use slightly different values

Dacthal = 2,3,5,6-tetrachloro-1,4-benzenecarboxylic acid dimethyl ester

Key to References:
e = EPA 1986. Health and Environmental Effects Profile for Nitrotoluenes (o-, m-, p-).
h = EPA 1994. Health Effects Assessment Summary Tables.
i = EPA 1994. Integrated Risk Information System (IRIS).
o = Environmental Protection Agency (EPA) 1991. Health Advisory for Aluminum. Office of Drinking Water, Washington, DC.
s = EPA 1994. Risk-Based Concentration Table, Fourth Quarter 1994.

Table 2-1
Levels of Chemicals in Background Soils
Near the Sudbury Training Annex Site and Background Metal
Concentrations in Soils in the Eastern United States

	Sudbury Area						Shacklette and Boerngen, 1984	
Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)	Mean Detection (mg/kg)		95% UCL (mg/kg)		Mean (mg/kg)	Range (mg/kg)
METALS:								
Aluminum	12/12	18000.00	11116.67	**(1.11)	13204.18	**(1.32)	** 5.7	0.7 - >10
Arsenic	11/11	13.00	6.90		8.24		7.4	<0.1 - 73
Barium	9/12	54.70	18.22		25.39		420	10 - 1500
Beryllium	4/12	0.64	0.21		0.30		0.85	<1 - 7
Cadmium	7/12	1.79	0.53		0.77			
Calcium	4/12	1140.00	417.33	**(0.04)	633.50	**(0.06)	** 0.63	0.01 - 28
Chromium	12/12	62.50	18.01		25.55		52	1 - 1000
Cobalt	3/12	7.30	1.96		2.96		9.2	<0.3 - 70
Copper	12/12	19.50	8.13		10.56		22	<1 - 700
Iron	12/12	28000.00	12683.33	**(1.27)	15381.77	**(1.54)	** 2.5	0.01 - >10
Lead	10/10	68.00	30.30		40.71			
Magnesium	12/12	5060.00	1815.83		2391.06			
Manganese	12/12	1100.00	258.62		425.13		640	<2 - 7000
Mercury	5/12	0.11	0.05		0.07		0.12	<0.01 - 3.4
Nickel	12/12	23.20	8.68		11.26		18	<5 - 700
Potassium	12/12	700.00	401.25	**(0.04)	471.17	**(0.05)	-	**0.006 - 3.7
Vanadium	12/12	51.20	21.79		27.22			
Zinc	12/12	85.80	29.21		39.75		52	<5 - 2900
VOLATILE ORGANICS:								
Acetone	5/12	0.05	0.02		0.03			
Methylene chloride	3/12	0.02	0.01		0.01			
BNAs:								
Di-N-butyl phthalate	10/12	9.00	2.60		3.81			
PCB/PESTICIDES:								
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DD	7/12	0.08	0.03		0.05			
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	2/12	0.02	0.01		0.02			
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	3/12	0.05	0.02		0.03			
Dieldrin	1/12	0.01	0.01		0.01			
PHOSPHATE:								
Phosphate	4/12	19.50	3.09		6.00			

NOTES:

1. Mean and 95% UCL calculations (Sudbury Area) are based on all non-detects equal to1/2 of detection limit
2. Mean shown (Eastern U.S.) is estimated arithmetic mean
3. Outliers for lead (110 & 260 mg/kg) and arsenic (190 mg/kg) were not included in these summary statistics
4. Di-N-butyl phthalate was also detected in the method blanks and therefore, is probably a laboratory contaminant rather than a contaminant of background soils

** = Percent Concentration

Table 3-1
Surface Soil Sampling Results - Area A4

Chemical	Frequency (No. Detect/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
METALS:			
Aluminum	6/6	10183.33	12000.00
Antimony	1/6	2.40	9.43
Arsenic	6/6	5.44	8.60
Barium	6/6	23.50	31.70
Beryllium	2/6	0.18	0.35
Cadmium	3/6	1.49	7.42
Calcium	4/6	494.83	1110.00
Chromium	6/6	15.77	19.00
Cobalt	3/6	2.45	4.80
Copper	6/6	8.13	12.00
Iron	6/6	11500.00	12000.00
Lead	6/6	19.67	53.00
Magnesium	6/6	2158.33	3170.00
Manganese	6/6	145.97	270.00
Mercury	3/6	0.06	0.09
Nickel	6/6	8.32	10.50
Potassium	6/6	816.83	1710.00
Vanadium	6/6	20.18	22.50
Zinc	6/6	219.17	1200.00
VOLATILE ORGANICS:			
Acetone	1/6	0.01	0.02
Methylene chloride	3/6	0.01	0.02
BNAs:			
Di-N-butyl phthalate	5/6	3.46	7.00
Fluoranthene	1/6	0.94	4.00
Phenanthrene	1/6	0.94	4.00
PCB/PESTICIDES:			
DDT	4/6	0.05	0.16
DDE	2/6	0.05	0.21

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene

Table 3-2
Total Soil Sampling Results - Area A4

Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)
METALS:		
Aluminum	13/13	16000.00
Antimony	1/13	9.43
Arsenic	13/13	30.00
Barium	13/13	83.70
Beryllium	5/13	0.41
Cadmium	7/13	7.42
Calcium	9/13	1700.00
Chromium	13/13	31.40
Cobalt	8/13	5.70
Copper	13/13	28.50
Iron	13/13	23000.00
Lead	13/13	570.00
Magnesium	13/13	5370.00
Manganese	13/13	270.00
Mercury	4/13	0.10
Nickel	13/13	14.40
Potassium	13/13	4210.00
Vanadium	13/13	37.40
Zinc	13/13	1200.00
VOLATILE ORGANICS:		
Acetone	1/14	0.02
Methylene chloride	8/14	0.03
alpha-Pinene	1/14	0.27
BNAs:		
Bis (2-ethylhexyl) phthalate	3/13	0.57
Di-N-butyl phthalate	11/13	7.00
Fluoranthene	1/13	4.00
Phenanthrene	1/13	4.00
PCB/PESTICIDES:		
DDT	7/13	0.16
DDE	5/13	0.21
alpha-Endosulfan	1/13	0.02
ORGANIC CARBON:		
Total Organic Carbon	2/2	1880.00

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene

Table 3-3
Sediment Sampling Results - Area A4

Chemical	Frequency (No. Detect/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
METALS:			
Aluminum	3/3	8100.00	10000.00
Arsenic	3/3	19.79	36.00
Barium	2/3	20.75	30.90
Calcium	3/3	970.00	1500.00
Chromium	2/3	9.64	13.90
Cobalt	2/3	2.96	4.41
Copper	2/3	6.03	9.77
Iron	3/3	8633.33	11000.00
Lead	3/3	11.33	15.00
Magnesium	3/3	1512.33	2140.00
Manganese	3/3	169.80	380.00
Nickel	3/3	6.09	8.49
Potassium	2/3	598.17	1180.00
Vanadium	3/3	13.42	18.10
Zinc	3/3	24.77	38.40
VOLATILE ORGANICS:			
Acetone	1/3	0.04	0.10
Methylene chloride	3/3	0.03	0.05
EXPLOSIVES:			
Cyclotetramethylenetetranitramine (HMX)	1/2	0.58	0.91
ORGANIC CARBON:			
Total Organic Carbon	3/3	33800.00	44100.00

Table 3-4
Groundwater Sampling Results - Area A4

(Combined Data from All Sampling Rounds)

Chemical	Frequency (No. Detect/Total)	Mean Detection (ug/l)	Maximum Detection (ug/l)
METALS:			
Aluminum	1/9	77.00	349.00
Arsenic	1/9	0.72	2.74
Calcium	9/9	9091.11	11300.00
Iron	5/9	904.04	2720.00
Lead	5/9	22.91	190.00
Magnesium	2/9	1850.56	5870.00
Manganese	9/9	179.47	381.00
Mercury	1/9	0.14	0.88
Potassium	8/9	14085.56	69300.00
Sodium	9/9	6683.33	9490.00
Zinc	9/9	19.83	39.30
VOLATILE ORGANICS:			
Acetone	1/10	2.22	9.00
Toluene	2/10	0.98	3.20
BNAs:			
Bis (2-ethylhexyl) phthalate	1/9	1.95	7.80
PCB/PESTICIDES:			
Heptachlor epoxide	2/9	0.004	0.02
N,N-Diethyl-3-methylbenzamide (DEET)	1/9	2.44	22.00
beta-Endosulfan	1/9	0.01	0.05

NOTES:

** = *Compound was tentatively identified; limit of detection unknown therefore, no mean calculated*

During the October 1992 sampling round, only enough sample volume for volatile organics analysis could be obtained from OHM-A4-4.

Table 3-5

Summary of Phase II Surface Soil Results - Area A4 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A4SO5B	DUPSO01C
METALS:			
Barium	25.39	100.00	91.70
Cadmium	0.77	12.10	13.50
Calcium	633.50	5890.00	5470.00
Copper	10.56	42.20	48.20
Iron	15381.77	18000.00	20000.00
Lead	40.71	520.00	890.00
Mercury	0.07	0.55	0.19
Nickel	11.26	12.10	10.60
Potassium	471.17	740.00	544.00
Sodium	ND	77.80	78.70
Zinc	39.75	2420.00	2550.00
BNAs:			
Anthracene	ND	0.28	NA
Benzo[a]anthracene	ND	0.48	NA
Benzo[a]pyrene	ND	0.49	NA
Benzo[g,h,i]perylene	ND	0.51	NA
Bis (2-ethylhexyl) phthalate	ND	0.40	NA
Chrysene	ND	0.91	NA
Fluoranthene	ND	1.70	NA
Indeno[1,2,3-c,d]pyrene	ND	0.43	NA
Phenanthrene	ND	0.80	NA
PCB/PESTICIDES:			
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.45	NA
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.23	NA

NOTES:

NA = Not analyzed

ND = Compound was not detected

Table 3-6
Summary of Phase II Boring Results - Area A4 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A4SB50B,C
METALS:		
Barium	25.39	47.80
Calcium	633.50	1010.00
Cobalt	2.96	4.27
Nickel	11.26	12.60
Potassium	471.17	1710.00
ORGANIC CARBON:		
TOC	NA	25600.00

NOTES:

No BNAs, volatile organics, PCB/pesticides, or organophosphorus pesticides were detected
NA = Not analyzed

Table 3-7
Summary of Phase II Test Pit Results - Area A4 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A4TPD1	A4TPD2	A4TPD3	A4TPE1	A4TPE2	A4TPE3	A4TPF1	A4TPF2	A4TPF3	A4TPG1	A4TPG2	A4TPG3
METALS:													
Aluminum	13204.18	9400	6900	5470	11000	14000	13000	7600	9900	8300	9900	12000	12000
Arsenic	8.24	4.2	2.3	3	4.6	5.5	5.7	2.8	3.3	2.6	4.2	4.6	40
Barium	25.39	22.7	47.3	40	46.7	55.3	69.5	36.8	55.4	72.2	69.3	74.6	68.3
Beryllium	0.30	ND	ND	ND	0.415	0.639	0.489	ND	ND	ND	0.421	0.5	0.639
Calcium	633.50	337	463	657	1120	568	2790	744	546	801	1580	1050	1110
Chromium	25.55	18.6 B	13.5 B	11.9 B	18.7	20.5	43	45.5	31.7 B	25.7 B	16.9	19	19.7
Cobalt	2.96	ND	ND	ND	4.59	7.38	7.76	3.16	ND	ND	6.77	7.33	8.58
Copper	10.56	5.67	7.01	7.01	11.8	16.8	23.6	18.6	28.7	22.3	13.7	15.2	21.6
Iron	15381.77	12000	10000	9100	14000	17000	20000	9700	13000	14000	14000	18000	21000
Magnesium	2391.06	3210	2460	2200	3190	3510	6800	2600	3610	3690	2950	4030	3910
Nickel	11.26	ND	ND	ND	10.4	11.8	25.7	ND	ND	16.3	13.7	21.6	21.4
Potassium	471.17	1160	1850	1530	2330	2140	2570	2060	2150	3290	2040	2700	2370
Sodium	ND	ND	ND	ND	101	93.8	274	63.7	ND	68	124	90.9	123
Vanadium	27.22	20.9	18.5	15.4	26.1	27.4	30.8	20	25.6	29	24.4	27.7	28.2
PETROLEUM HYDROCARBONS:													
TPH	NA	NA	NA	NA	ND	ND	ND	34.9	ND	ND	ND	ND	ND

NOTES:

NA = Not analyzed
ND = Compound was not detected

Table 3-8
Summary of Phase II Sediment Results - Area A4 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A4SD5B1	A4SD5B2	A4SD5B3	A4SD6B1	A4SD6B2	A4SD6B3	A4SD7B1	A4SD7B2	A4SD7B3
METALS:										
Aluminum	13204.18	5850	6700	4630	6350	11200	5470	6350	9570	18400
Barium	25.39	19.4	13	16.1	ND	44	28.3	79.5	102	231
Beryllium	0.30	ND	ND	ND	ND	1.51	ND	ND	ND	6.57
Calcium	633.50	1950	875	703	24400	8090	1330	25900	28500	20500
Copper	10.56	ND	ND	ND	ND	ND	ND	ND	ND	29.5
Nickel	11.26	ND	ND	ND	ND	ND	ND	ND	ND	59.1
Potassium	471.17	ND	374	751	ND	549	741	ND	ND	982
Selenium	ND	0.65	ND	ND	2.1	1.6	ND	3.2	6.1	3
Sodium	ND	ND	ND	ND	436	174	72.8	ND	ND	ND
Vanadium	27.22	8.86	10.8	9.36	17.7	13.5	12.1	ND	25.5	37.5
Zinc	39.75	13.6	13.8	15.2	34.7	21.1	32	40.3	ND	ND
VOLATILE ORGANICS:										
Acetone	0.03	ND	0.063	ND	ND	ND	ND	0.6	0.59	ND
Benzene	ND	0.008	ND	ND	ND	ND	ND	ND	ND	ND
Methyl ethyl ketone	ND	ND	0.028	ND	ND	0.007	ND	0.13	0.077	ND
BNAs:										
Bis (2-ethylhexyl) phthalate	ND	ND	0.74	ND	3.3	2.1	ND	3.3	ND	4.6
PCB/PESTICIDES:										
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	ND	ND	ND	0.098	ND	ND	ND	ND	ND
ORGANIC CARBON:										
Total Organic Carbon	NA	NA	NA	NA	1000000 (a)	537000	16300	1000000 (a)	1000000 (a	1000000 (a)

NOTES:

(a) = Reported total organic carbon (TOC) concentrations for some samples exceeded 100 percent. For these samples, TOC concentrations have been listed as 100 percent (1000000 mg/kg).
Sample A4SD4B, which was submitted for explosives analysis only, was not analyzed.
NA = Not analyzed

Table 3-9
Summary of Phase II Groundwater Results - Area A4 (ug/l)

Chemical	DMGW4C TOTAL	DMGW4C DISSOLVED	A4GW4C TOTAL	A4GW4C DISSOLVED	A4GW50A DISSOLVED	A4GW5C TOTAL	A4GW5C DISSOLVED
METALS:							
Aluminum	19800	ND	2870	ND	ND	10900	ND
Iron	37000	2190	2810	ND	ND	14000	ND
Lead	13	ND	ND	ND	ND	5.2	ND
Manganese	225	76.3	121	71.3	983	201	13.1

NOTES:

ND = Compound was not detected
Total = Total metals (unfiltered)
Dissolved = Dissolved (filtered) metals

Table 4-1
Surface Soil Sampling Results - Area A7

Chemical	Frequency (No. Detect/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
METALS:			
Aluminum	14/14	6935.71	10000.00
Arsenic	14/14	5.85	8.10
Barium	13/14	55.07	353.00
Cadmium	4/14	0.48	2.03
Calcium	14/14	807.36	2460.00
Chromium	14/14	30.78	200.00
Cobalt	11/14	3.23	5.78
Copper	14/14	14.34	31.10
Iron	14/14	12057.14	21000.00
Lead	14/14	69.64	400.00
Magnesium	14/14	2652.14	3580.00
Manganese	14/14	153.99	270.00
Mercury	6/14	0.07	0.22
Nickel	14/14	9.80	16.30
Potassium	14/14	1537.36	2140.00
Silver	1/14	0.55	2.84
Vanadium	14/14	18.74	25.00
Zinc	14/14	53.31	210.00
VOLATILE ORGANICS:			
Acetone	2/14	0.03	0.30
Methylene chloride	6/14	0.01	0.02
Propylbenzene	1/14	**	0.01
Xylenes, total combined	1/14	0.003	0.02
alpha-Pinene	1/14	**	0.16
BNAs:			
1,2,3,4-Tetramethylbenzene	1/14	**	3.00
1,3,5-Trimethylbenzene	1/14	**	3.00
1-Ethyl-2-methylbenzene	1/14	**	2.00
2-Methylnaphthalene	1/14	1.18	10.00
Anthracene	1/14	0.51	2.00
Benzo[a]anthracene	1/14	1.51	3.00
Benzo[a]pyrene	1/14	0.61	2.00
Bis (2-ethylhexyl) phthalate	2/14	2.29	8.00
Fluoranthene	2/14	0.70	3.00
Naphthalene	1/14	0.61	2.00
Phenanthrene	1/14	0.73	5.00
Pyrene	1/14	1.68	4.00

Table 4-1
Surface Soil Sampling Results - Area A7

Chemical	Frequency (No. Detect/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
PCB/PESTICIDES:			
DDT	10/14	27.64	380.00
DDD	3/14	0.16	0.89
DDE	5/14	6.23	86.00
Dieldrin	3/14	0.08	0.26
Endosulfan sulfate	1/14	0.10	0.08
Heptachlor	1/14	0.08	0.06
PCB 1260	1/14	0.42	1.63
alpha-Chlordane	2/14	0.05	0.21
beta-Benzenehexachloride	1/14	0.04	0.02
beta-Endosulfan	2/14	0.07	0.19
gamma-Chlordane	2/14	0.17	0.10
HERBICIDES:			
Dacthal (DCPA)	1/14	0.01	0.08
Silvex	1/14	0.004	0.01

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDD = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene
Dacthal = 2,3,5,6-tetrachloro-1,4-benzenecarboxylic acid dimethyl ester

** = Compound was tentatively identified; limit of detection unknown therefore, no mean calculated

For some compounds (e.g., Heptachlor), the value for half the detection limit exceeded the maximum value detected due to variations in detection limits. In these cases, the average exceeds the maximum.

Table 4-2
Total Soil Sampling Results - Area A7

Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)
METALS:		
Aluminum	58/58	18000.00
Arsenic	58/58	27.00
Barium	56/58	353.00
Beryllium	4/58	0.36
Cadmium	44/58	27.50
Calcium	50/58	5420.00
Chromium	58/58	270.00
Cobalt	43/58	11.90
Copper	58/58	250.00
Iron	58/58	22000.00
Lead	58/58	400.00
Magnesium	58/58	6670.00
Manganese	58/58	480.00
Mercury	16/58	0.92
Nickel	58/58	18.70
Potassium	58/58	6720.00
Silver	2/58	19.00
Vanadium	58/58	63.40
Zinc	58/58	840.00
VOLATILE ORGANICS:		
1,1,2-Trichloroethane	1/83	20.00
1,2-Dichloroethane	1/83	1.00
Acetone	8/83	0.30
Chlorobenzene	2/83	0.56
Chloroform	2/83	20.00
Methylene chloride	21/83	0.03
Nonane	1/83	0.03
Octane	1/83	6.00
Propylbenzene	1/83	0.01
Tetrachloroethylene (PCE)	2/83	20.00
Toluene	3/83	0.002
Trichloroethylene (TCE)	1/83	0.10
Trichlorofluoromethane	1/83	0.11
Xylenes, total combined	2/83	0.10
alpha-Pinene	2/83	0.16
BNAs:		
1,2,3,4-Tetramethylbenzene	1/58	3.00
1,3,5-Trimethylbenzene	1/58	3.00
1-Ethyl-2-methylbenzene	1/58	2.00
2-Methylnaphthalene	3/58	10.00
Anthracene	2/58	2.00
Benzo[a]anthracene	2/58	3.00
Benzo[a]pyrene	2/58	2.00
Benzo[b]fluoranthene	1/58	1.20
Benzo[g,h,i]perylene	1/58	0.39
Bis (2-ethylhexyl) phthalate	13/58	8.00
Chrysene	1/58	0.79
Di-N-butyl phthalate	33/58	10.00

Table 4-2
Total Soil Sampling Results - Area A7

Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)
BNAs (cont.):		
Fluoranthene	3/58	3.00
Fluorene	1/58	0.91
Hexadecanoic acid	1/58	13.00
Indeno[1,2,3-c,d]pyrene	1/58	0.54
Naphthalene	1/58	2.00
Octadecanoic acid	1/58	6.50
Phenanthrene	3/58	5.00
Pyrene	2/58	4.00
Sulfur	1/58	1.60
PCB/PESTICIDES:		
DDT	25/54	380.00
DDD	10/54	64.00
DDE	14/54	86.00
Dieldrin	5/54	0.26
Endosulfan sulfate	1/54	0.08
Heptachlor	4/54	0.06
Heptachlor epoxide	4/54	0.06
Lindane	3/54	0.52
PCB 1242	1/54	0.17
PCB 1248	1/54	0.04
PCB 1254	5/54	2.00
PCB 1260	1/54	1.63
alpha-Chlordane	7/54	0.91
alpha-Endosulfan	1/54	0.01
beta-Benzenehexachloride	1/54	0.02
beta-Endosulfan	2/54	0.19
gamma-Chlordane	6/54	1.70
HERBICIDES:		
Dacthal (DCPA)	1/56	0.08
Silvex	1/56	0.01
EXPLOSIVES:		
Cyclonite (RDX)	1/56	4.72
ORGANIC CARBON:		
Total Organic Carbon	7/7	2480.00

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDD = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene
Dacthal = 2,3,5,6-tetrachloro-1,4-benzenecarboxylic acid dimethyl ester

Table 4-3
Sediment Sampling Results - Area A7

Chemical	Frequency (No. Detect/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
METALS:			
Aluminum	2/2	9600.00	15000.00
Arsenic	2/2	13.00	14.00
Barium	2/2	24.20	27.20
Beryllium	1/2	0.24	0.38
Calcium	1/2	409.75	663.00
Chromium	2/2	12.71	17.20
Cobalt	2/2	8.44	11.60
Copper	2/2	10.25	17.00
Iron	2/2	13500.00	16000.00
Lead	2/2	9.05	12.00
Magnesium	2/2	1880.00	2230.00
Manganese	2/2	999.70	1900.00
Nickel	2/2	16.73	25.70
Potassium	2/2	573.50	599.00
Vanadium	2/2	13.29	17.90
Zinc	2/2	26.75	29.90
VOLATILE ORGANICS:			
Acetone	1/2	0.02	0.02
Methylene chloride	2/2	0.02	0.02
BNAs:			
Bis (2-ethylhexyl) phthalate	1/2	0.36	0.55
Di-N-butyl phthalate	2/2	2.10	2.60
N,N-Bis(2-hydroxyethyl)dodecanamide	1/2	**	1.40
N-Nitrosodi-N-propylamine	1/2	0.90	1.70
ORGANIC CARBON:			
Total Organic Carbon	2/2	5840.00	6190.00

NOTES:

** = Compound was tentatively identified; limit of detection unknown therefore, no mean calculated

Table 4-4
Groundwater Sampling Results - Area A7

(Combined Data from All Sampling Rounds)

Chemical	Frequency (No.Detect/Total)	Mean Detection (ug/l)	Maximum Detection (ug/l)
METALS:			
Aluminum	2/17	49.56	640.00
Arsenic	1/17	0.54	2.98
Barium	4/17	1.27	7.77
Calcium	17/17	9445.88	24100.00
Chromium	1/17	0.70	5.27
Copper	4/17	2.78	8.54
Iron	6/17	271.16	2540.00
Lead	11/17	4.06	18.70
Magnesium	9/17	2080.76	5080.00
Manganese	17/17	88.91	313.00
Potassium	15/17	3195.88	5620.00
Sodium	13/17	5047.65	10600.00
Vanadium	2/17	0.81	5.09
Zinc	13/17	22.55	91.90
VOLATILE ORGANICS:			
Acetone	7/18	7.16	20.00
Chlorobenzene	1/18	0.76	10.00
Chloroform	2/18	2.20	24.00
Chloromethane	2/18	0.43	3.31
Methylene chloride	5/18	2.99	8.43
Tetrachloroethylene (PCE)	4/18	2.84	15.00
Toluene	1/18	0.32	2.20
BNAs:			
Di-N-butyl phthalate	5/13	2.45	6.10
Naphthalene	1/13	1.04	7.30
PCB/PESTICIDES:			
DDT	2/17	0.02	0.08
DDD	2/17	0.07	0.45
Dieldrin	1/17	0.01	0.10
Endrin	2/17	0.02	0.14
Endrin aldehyde	1/17	0.02	0.16
Heptachlor epoxide	2/17	0.01	0.17
Lindane	3/17	0.32	2.80
alpha-Benzenehexachloride	2/17	0.03	0.27
alpha-Chlordane	3/17	0.01	0.06
beta-Endosulfan	2/17	0.01	0.04
PHOSPHATE:			
Phosphate	4/9	20.80	57.90

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDD = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane

Table does not include data from the upgradient well, OHM-A7-13.

Table 4-5
Summary of Phase II Boring Results - Area A7
(values are in mg/kg unless otherwise noted)

Chemical	Phase I Background Soil 95% UCL	A7SB51B	A7SB52B	A7SB16B	A7SB18B	A7SB19B	A7SB17B (ug/l)	DUPSB02C (ug/l)
METALS:								
Barium	25.39	61.3	NA	NA	NA	NA	1700	600
Beryllium	0.30	0.517	NA	NA	NA	NA	ND	ND
Cadmium	0.77	ND	NA	NA	NA	NA	5	5.8
Chromium	25.55	26.9	NA	NA	NA	NA	26	7.9
Cobalt	2.96	3.67	NA	NA	NA	NA	ND	ND
Copper	10.56	18.8	NA	NA	NA	NA	ND	ND
Iron	15381.77	18000	NA	NA	NA	NA	ND	ND
Lead	40.71	7.2	NA	NA	NA	NA	1100	810
Magnesium	2391.06	3910	NA	NA	NA	NA	ND	ND
Nickel	11.26	12.3	NA	NA	NA	NA	ND	ND
Potassium	471.17	2960	NA	NA	NA	NA	ND	ND
Sodium	ND	94.7	NA	NA	NA	NA	ND	ND
Vanadium	27.22	29.9	NA	NA	NA	NA	ND	ND
VOLATILE ORGANICS:								
Methyl ethyl ketone	ND	0.004	NA	NA	NA	NA	ND	ND
BNAs:								
Bis (2-ethylhexyl) phthalate	ND	1.6	NA	NA	NA	NA	ND	ND
PCB/PESTICIDES:								
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	ND	ND	0.033	1.4	3.8	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	ND	ND	0.023	0.228	1.2	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	ND	ND	ND	0.064	0.065	ND	ND
Lindane	ND	ND	ND	0.015	ND	ND	56	23
ORGANIC CARBON:								
Total Organic Carbon	NA	5850	3470	NA	NA	NA	NA	NA

NOTES:

A7SB17B and DUPSB02C are leachate samples (full TCLP extraction analysis). Therefore, concentrations are reported as ug/l.

There were no positive detections for samples A7SB13B, A7SB14B, A7SB15B, and A7SB20B, which were analyzed for PCB/pesticides and organophosphorus pesticides only.

NA = Not analyzed
ND = Compound was not detected

Table 4-6
Summary of Phase II Test Pit Results - Area A7 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A7TPQ1	A7TPQ2	A7TPQ3	A7TPQ4	A7TPR1	DUPTP02C	A7TPR2	A7TPS1	A7TPS2	A7TPS3	A7TPT1	A7TPT2	A7TPT3
METALS:														
Arsenic	8.24	NA	NA	NA	NA	4.6	3.8	4.1	4.3	3.9	5.1	NA	NA	NA
Barium	25.39	NA	NA	NA	NA	31.1	37.6	46.7	43.6	47	67.9	NA	NA	NA
Beryllium	0.30	NA	NA	NA	NA	0.406	ND	ND	ND	0.366	0.489	NA	NA	NA
Calcium	633.50	NA	NA	NA	NA	186	246	384	2440	1570	609	NA	NA	NA
Chromium	25.55	NA	NA	NA	NA	15.3	14.5	33.2	17.1 B	42.8 B	24.6	NA	NA	NA
Copper	10.56	NA	NA	NA	NA	8.78	10.6	9.1	19.8	66.1	21.2	NA	NA	NA
Iron	15381.77	NA	NA	NA	NA	12000	12000	11000	11000	16000	22000	NA	NA	NA
Lead	40.71	NA	NA	NA	NA	11	20	3900	330	520	7	NA	NA	NA
Magnesium	2391.06	NA	NA	NA	NA	1970	2460	2880	2410	2720	4730	NA	NA	NA
Mercury	0.07	NA	NA	NA	NA	ND	ND	0.467	0.372	ND	ND	NA	NA	NA
Nickel	11.26	NA	NA	NA	NA	ND	ND	ND	14.2	13.9	10.6	NA	NA	NA
Potassium	471.17	NA	NA	NA	NA	912	1620	1980	1130	1190	4220	NA	NA	NA
Silver	ND	NA	NA	NA	NA	ND	ND	ND	1.07	ND	ND	NA	NA	NA
Sodium	ND	NA	NA	NA	NA	ND	ND	ND	74.5	ND	83	NA	NA	NA
Vanadium	27.22	NA	NA	NA	NA	19.4	19.5	22.3	145	33.8	40.1	NA	NA	NA
Zinc	39.75	NA	NA	NA	NA	28.5	26.2	36.1	136	107	49.5	NA	NA	NA
VOLATILE ORGANICS:														
Chlorobenzene	ND	NA	NA	NA	NA	ND	ND	6.5	NA	NA	NA	NA	NA	NA
Chloroform	ND	NA	NA	NA	NA	0.004	ND	ND	NA	NA	NA	NA	NA	NA
Ethylbenzene	ND	NA	NA	NA	NA	ND	ND	0.95	NA	NA	NA	NA	NA	NA
Methylene chloride	0.01	NA	NA	NA	NA	ND	0.009	ND	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (PCE)	ND	NA	NA	NA	NA	0.049	0.035	2.9	NA	NA	NA	NA	NA	NA
Xylenes, total combined	ND	NA	NA	NA	NA	ND	ND	4.1	NA	NA	NA	NA	NA	NA
BNAs:														
2-Methylnaphthalene	ND	NA	NA	NA	NA	2	ND	3	NA	NA	NA	NA	NA	NA
Bis (2-ethylhexyl) phthalate	ND	NA	NA	NA	NA	3	4	4	NA	NA	NA	NA	NA	NA
Di-N-butyl phthalate	3.81	NA	NA	NA	NA	10	ND	ND	NA	NA	NA	NA	NA	NA
Phenanthrene	ND	NA	NA	NA	NA	1	ND	3	NA	NA	NA	NA	NA	NA
PCB/PESTICIDES:														
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	20	0.033	350	610	ND	ND	ND	ND	ND	0.033	0.117	0.23	0.095
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	ND	ND	ND	210	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.79	ND	5.9	8	ND	ND	ND	1.1	0.21	0.01	0.024	0.049	0.02
Dieldrin	0.01	ND	ND	ND	ND	0.95	4.9	1.5	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	4.1	0.46	ND	0.029	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	0.29	0.05	ND	0.007	0.011	ND
Lindane	ND	ND	ND	ND	ND	ND	ND	0.67	ND	ND	ND	ND	ND	ND
PCB 1260	ND	ND	ND	ND	ND	ND	3.1	2.4	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND	0.48	0.4	10	1.1	0.031	0.07	0.038	0.015
beta-Endosulfan	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.012	ND
gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	20	2.4	0.06	ND	0.055	ND
ORGANOPHOSPHOROUS PESTICIDES:														
Demeton-O	NA	ND	ND	ND	ND	2	0.62	ND	ND	ND	ND	ND	ND	ND
Methyl parathion	NA	ND	ND	ND	ND	0.11	ND	0.61	ND	ND	ND	ND	ND	ND
Fenthion	NA	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND	ND	ND	ND
PHOSPHATE:														
Phosphate	6.00	NA	NA	NA	NA	450	400	360	NA	NA	NA	NA	NA	NA

NOTES:

ND = compound was not detected
NA = Not analyzed
B = ound was detected in the laboratory method blank

Table 4-7
Summary of Phase II Sediment Results - Area A7 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A7SD3B,C	DUPSD01C,2C
METALS:			
Arsenic	8.24	28	35
Barium	25.39	66.4	68.4
Calcium	633.50	5690	5370
Iron	15381.77	14000	17000
Manganese	425.13	460	529
Selenium	ND	2.4	2.2
Zinc	39.75	44	50.8
VOLATILE ORGANICS:			
Acetone	0.03	0.3	0.23
Methyl ethyl ketone	ND	0.05	0.04
ORGANIC CARBON:			
Total Organic Carbon	NA	1000000 (a)	923000
PHOSPHATE:			
Phosphate	6.00	570	600

NOTES:

(a) = Reported total organic carbon (TOC) concentration for this sample exceeded 100 percent. Therefore, the TOC concentration has been set at 100 percent (1000000 mg/kg) in this table.

NA = Not analyzed
ND = Compound was not detected

Table 4-8

Summary of Phase II Groundwater Results - Area A7 (ug/l)

Chemical	A7GW45C1	A7GW45C2	A7GW46C1	A7GW46C2	A7GW51A1	A7GW51A2	A7GW52A1	A7GW52A2	A7GW8C1	A7GW8C2
VOLATILE ORGANICS:										
cis-1,2-Dichloroethylene	--	--	--	--	7.6	--	--	--	ND	--
1,1,1-Trichloroethane	--	--	--	--	6.8	--	--	--	ND	--
1,1,2-Trichloroethane	--	--	--	--	ND	--	--	--	7.2	--
Acetone	--	--	--	--	ND	--	--	--	9000	--
Carbon tetrachloride	--	--	--	--	ND	--	--	--	16	--
Chlorobenzene	--	--	--	--	13	--	--	--	ND	--
Chloroform	--	--	--	--	120	--	--	--	300	--
Tetrachloroethane	--	--	--	--	200	--	--	--	ND	--
Tetrachloroethylene (PCE)	--	--	--	--	130	--	--	--	38	--
Trichloroethylene (TCE)	--	--	--	--	50	--	--	--	ND	--
PCB/PESTICIDES:										
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	ND	ND	ND	ND	ND	ND	ND	ND	0.232	ND
Lindane	ND	ND	3.1	2.8	3.5	3.6	0.067	0.079	0.49	ND
alpha-Benzenehexachloride	ND	ND	0.143	0.149	ND	ND	ND	ND	0.03	ND

NOTES:

-- = Sample was not analyzed for this compound

ND = Compound was not detected

Table 5-1
Phase I Surface Soil Sampling Results - Area A9

Chemical	Frequency (No. Detects/Total)	Mean Detection (mg/kg)	Maximum Detection (mg/kg)
METALS:			
Aluminum	7/7	8771.43	10000.00
Arsenic	7/7	13.92	46.00
Barium	7/7	27.47	50.60
Cadmium	3/7	0.46	1.44
Calcium	2/7	285.07	647.00
Chromium	7/7	16.64	24.50
Cobalt	7/7	3.42	6.10
Copper	7/7	19.30	75.00
Iron	7/7	11157.14	15000.00
Lead	7/7	81.39	450.00
Magnesium	7/7	2514.29	4070.00
Manganese	7/7	114.94	190.00
Nickel	7/7	8.63	13.90
Potassium	7/7	1485.29	2870.00
Vanadium	7/7	20.53	26.70
Zinc	7/7	45.90	109.00
VOLATILE ORGANICS:			
Acetone	1/7	0.01	0.01
Methylene chloride	4/7	0.01	0.01
alpha-Pinene	3/7	**	0.32
BNAs:			
Bis (2-ethylhexyl) phthalate	1/7	1.37	0.58
Di-N-butyl phthalate	5/7	1.69	4.00
PCB/PESTICIDES:			
DDT	2/7	0.01	0.06
DDE	1/7	0.01	0.03

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene

For some compounds (e.g., Bis (2-ethylhexyl) phthalate), the value for half the detection limit exceeded the maximum value detected due to variations in detection limits. In these cases, the average exceeds the maximum.

** = Compound was tentatively identified; limit of detection unknown therefore, no mean calculated

Table 5-2
Phase I Total Soil Sampling Results - Area A9

Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)
METALS:		
Aluminum	40/40	12000.00
Arsenic	40/40	70.00
Barium	40/40	50.60
Beryllium	2/40	0.34
Cadmium	21/40	1.64
Calcium	31/40	1550.00
Chromium	40/40	24.50
Cobalt	19/40	6.10
Copper	40/40	75.00
Iron	40/40	17000.00
Lead	40/40	450.00
Magnesium	40/40	4070.00
Manganese	40/40	410.00
Mercury	1/40	0.11
Nickel	40/40	13.90
Potassium	40/40	2870.00
Vanadium	40/40	26.70
Zinc	40/40	109.00
VOLATILE ORGANICS:		
1,1,1-Trichloroethane (1,1,1-TCA)	3/40	0.20
1,1,3-Trimethylcyclohexane	1/40	0.03
1,3-Dimethylcyclohexane	1/40	0.04
1,4-Dimethylcyclohexane	1/40	0.01
Acetone	4/40	0.03
Ethylbenzene	2/40	0.01
Methylene chloride	14/40	0.02
Methylethyl ketone	1/40	0.01
Xylenes, total combined	4/40	0.50
alpha-Pinene	4/40	0.32
BNAs:		
2-Methylnaphthalene	1/40	10.00
Benzo[a]pyrene	1/40	0.29
Bis (2-ethylhexyl) phthalate	18/40	5.00
Chrysene	1/40	0.31
Di-N-octyl phthalate	1/40	0.50
Dibenzofuran	1/40	1.40
Fluoranthene	4/40	1.40
Fluorene	1/40	2.40
Indeno[1,2,3-c,d]pyrene	1/40	0.23
Naphthalene	1/40	2.30
Phenanthrene	3/40	10.00
Pyrene	1/40	0.39

Table 5-2
Phase I Total Soil Sampling Results - Area A9

Chemical	Frequency (No. Detect/Total)	Maximum Detection (mg/kg)
PCB/PESTICIDES:		
DDT	5/40	0.06
DDD	1/40	0.09
DDE	2/40	0.03
Heptachlor epoxide	1/40	0.02
EXPLOSIVES:		
2,6-Dinitrotoluene	1/40	1.10
ORGANIC CARBON:		
Total Organic Carbon	15/15	19700.00

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDD = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane
DDE = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene

Table 5-3
Groundwater Sampling Results - Area A9

(Combined Data from All Sampling Rounds)

Chemical	Frequency (No.Detect/Total)	Mean Detection (ug/l)	Maximum Detection (ug/l)
METALS:			
Arsenic	1/15	0.77	4.11
Calcium	15/15	7069.33	9080.00
Chromium	1/15	2.24	14.40
Copper	2/15	4.04	7.29
Iron	4/15	438.41	3250.00
Lead	13/15	3.10	9.54
Magnesium	2/15	1195.67	2690.00
Manganese	12/15	169.98	542.00
Potassium	10/15	2132.67	3570.00
Sodium	14/15	6459.33	26400.00
Zinc	12/15	15.76	64.10
VOLATILE ORGANICS:			
1,1,1-Trichloroethane (1,1,1-TCA)	4/15	32.97	400.00
1,1-Dichloroethylene	1/15	0.83	5.10
Acetone	1/15	2.41	13.00
Ethylbenzene	1/15	4.70	25.00
Ethylmethyl benzene	1/15	12.67	190.00
Methylene chloride	3/15	8.70	100.00
Toluene	2/15	2.09	17.00
Trichloroethylene (TCE)	1/15	1.01	4.60
Xylenes, total combined	2/15	28.18	200.00
BNAs:			
1,2,3,4-Tetramethylbenzene	1/15	1.40	21.00
1,2,3-Trimethylbenzene	1/15	8.00	120.00
1-Ethyl-2-methylbenzene	1/15	10.00	150.00
1-Methylnaphthalene	1/15	0.93	14.00
2-Methylnaphthalene	2/15	3.94	27.00
Bis (2-ethylhexyl) phthalate	1/15	4.18	40.00
Di-N-butyl phthalate	6/15	2.51	6.40
Naphthalene	2/15	7.48	57.00
PCB/PESTICIDES:			
Endrin aldehyde	1/15	0.03	0.18
Heptachlor epoxide	1/15	0.004	0.05
N,N-Diethyl-3-methylbenzamide (DEET)	4/15	3.80	16.00
PCB 1254	1/15	0.03	0.10
alpha-Chlordane	1/15	0.01	0.03
beta-Endosulfan	1/15	0.00	0.02
EXPLOSIVES:			
1,3,5-Trinitrobenzene	1/15	1.50	20.80
2,4,6-Trinitrotoluene	1/15	1.09	15.40
3-Nitrotoluene	1/15	0.20	1.34
PHOSPHATE:			
Phosphate	1/3	7.03	11.10

NOTES:

DDT = 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DDD = 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane

** = Compound was tentatively identified; limit of detection unknown therefore, no mean calculated

OHM-A9-49 was not sampled during the October 1992 sampling round

Table 5-4

Summary of Phase II Surface Soil Results - Area A9 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A9SO7B	A9SO8B	A9SO9B	A9SO10B
METALS:					
Aluminum	13204.18	14000	11000	7100	11000
Arsenic	8.24	20	4.1	6.9	9.3
Barium	25.39	32.8	75.8	38.5	31.5
Beryllium	0.30	0.547	ND	ND	0.547
Calcium	633.50	474	2010	926	460
Chromium	25.55	16.2	53.9	13.7	15.4
Cobalt	2.96	3.76	3.96	ND	3.76
Copper	10.56	7.14	11.7	6.92	5.63
Iron	15381.77	12000	16000	9900	9900
Lead	40.71	26	31	35	270
Magnesium	2391.06	2020	5720	2260	1830
Nickel	11.26	ND	12	ND	ND
Potassium	471.17	766	2990	1020	608
Selenium	ND	0.45	0.33	0.35	0.51
Sodium	ND	61.7	280	66.6	ND
Thallium	ND	304	ND	ND	ND
Vanadium	27.22	22.9	48.7	20.3	20.8
Zinc	39.75	28	42.3	28.6	28.2

NOTES:

ND = Compound was not detected

Table 5-5
Summary of Phase II Well Boring Results - Area A9 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A9SB53B	DUPSB01C	A9SB54B	A9SB55B	A9SB56B	A9SB57B	A9SB58B	FWSB5B
METALS:									
Arsenic	8.24	6	5.8	5.7	4.6	5.1	5.9	4.3	10.0
Barium	25.39	15	11.8	27.1	22.9	18.9	22.1	16.2	36.5
Calcium	633.50	707	828	1140	1100	1060	1190	1100	1690
Chromium	25.55	10.6 B	7.21 B	8.01	99.1	8.61	11.3	11.9	12.7
Cobalt	2.96	ND	ND	ND	3.54	ND	ND	ND	ND
Potassium	471.17	898	727	1040	1260	1050	1240	851	1750
Selenium	ND	ND	ND	ND	2.8	ND	ND	ND	ND
Sodium	ND	ND	ND	ND	ND	58.6	ND	ND	ND
VOLATILE ORGANICS:	0.03								
1,1,1-Trichloroethane (1,1,1-TCA)	ND	ND	ND	ND	0.006	ND	ND	ND	ND
Ethylbenzene	ND	0.006	ND	0.018	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	0.019	ND	ND	ND	ND	0.004
Xylenes, total combined	ND	0.044	0.043	0.1	0.048	ND	ND	ND	ND
BNAs:									
2-Methylnaphthalene	ND	ND	NA	ND	2.2	ND	ND	ND	ND
Bis (2-ethylhexyl) phthalate	ND	0.69	NA	0.79	5.7	0.73	0.62	0.44	0.54
Dibenzofuran	ND	ND	NA	ND	0.27	ND	ND	ND	ND
Fluoranthene	ND	ND	NA	ND	0.51	ND	ND	ND	ND
Naphthalene	ND	ND	NA	ND	0.44	ND	ND	ND	ND
Phenanthrene	ND	ND	NA	ND	2.5	ND	ND	ND	ND
PCB/PESTICIDES:									
beta-Endosulfan	ND	ND	NA	ND	0.01	ND	ND	ND	ND
ORGANIC CARBON:									
Total Organic Carbon	NA	4110	2550	2820	5940	1520	3760	4350	4180

NOTES:

NA = Not analyzed
ND = Compound was not detected
B = Compound was detected in the laboratory method blank

Table 5-6
Summary of Phase II Hand Auger and Soil Boring Results - Area A9

Chemical	Phase I Background Soil 95% UCL	A9HA5B	A9HA6B	A9HA7B	A9HA8B	A9SB10B	A9SB11B
METALS:							
Aluminum	13204.18	15000	17000	5200	7300	4440	4960
Arsenic	8.24	140	14	6.4	7.6	3.7	4.1
Barium	25.39	42.7	31.5	18.1	20.6	19.1	22.7
Beryllium	0.30	0.676	0.692	ND	ND	ND	ND
Calcium	633.50	369	241	601	373	510	865
Cobalt	2.96	4.86	4.85	ND	ND	ND	ND
Magnesium	2391.06	2030	2170	2150	2730	1820	1810
Potassium	471.17	547	411	1110	1250	1100	1020
Selenium	ND	0.54	0.49	0.27	0.23	ND	ND

NOTES:

These samples were analyzed for metals only
ND = Compound was not detected

Table 5-7
Summary of Phase II Groundwater Results - Area A9 (ug/l)

Chemical	DMGW8C	DMGW9AC	A9GW47C	A9GW53A	A9GW54A	A9GW55A	A9GW56A,B	A9GW57A,B	A9GW58A	FWGW5A
METALS:										
Aluminum	371	880	2220	173	113	ND	ND	ND	147	ND
Arsenic	ND	ND	ND	20	ND	ND	ND	ND	ND	ND
Calcium	11000	14600	16700	18400	11200	11100	10300	11800	13700	6900
Iron	496	904	2260	7010	ND	ND	163	ND	201	287
Lead	ND	ND	ND	ND	41	ND	ND	ND	ND	ND
Manganese	49.2	478	701	1660	709	222	1280	26.1	44.2	ND
Magnesium	1050	899	1750	1190	639	718	968	783	779	520
Potassium	1760	ND	3150	2080	1650	1970	2800	2830	1970	ND
Sodium	5320	2250	6140	2180	1470	10800	6500	2600	2650	3190
Zinc	575	969	863	1070	629	549	373	564	837	436
VOLATILE ORGANICS:										
1,1,1-Trichloroethane	28	ND	500	ND	ND	900	2000	18	46	ND
1,1-Dichloroethylene	ND	ND	17	ND	ND	20	70	ND	ND	ND
Acetone	ND	15	ND	ND	400	ND	ND	ND	ND	ND
Ethylbenzene	ND	170	ND	1000	2000	ND	ND	ND	ND	ND
Toluene	ND	21	ND	400	2000	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	ND	ND	7.4	ND	ND	ND	ND	ND	ND	ND
Xylenes, total combined	ND	460	ND	4000	8000	100	ND	ND	ND	ND
BNAs:										
2-Methylnaphthalene	ND	22	ND	33	81	81	ND	ND	ND	ND
Naphthalene	ND	83	ND	150	90	400	ND	ND	ND	ND

NOTES:

ND = Compound was not detected

Table 5-8
Chronic Daily Intake For Key Chemicals
In Area A9 - Groundwater
Residential Use Scenario

NONCARCINOGENIC EFFECTS

Chemical	Frequency (No.Detect/Total)	Mean Detection (ug/l)	CDI (mg/kg/day)	Maximum Detection (ug/l)	CDI (mg/kg/day)
METALS:					
Aluminum	6/10	410.40	1.1E-02	2220.00	6.1E-02
Arsenic	1/10	3.50	9.6E-05	20.00	5.5E-04
Calcium	10/10	11914.29	3.3E-01	18400.00	5.0E-01
Iron	7/10	11471.00	3.1E-01	7010.00	1.9E-01
Lead	1/10	5.90	1.6E-04	41.00	1.1E-03
Magnesium	10/10	799.57	2.2E-02	1190.00	3.3E-02
Manganese	9/10	518.90	1.4E-02	1660.00	4.5E-02
Potassium	8/10	1989.29	5.5E-02	2830.00	7.8E-02
Sodium	10/10	4198.57	1.2E-01	10800.00	3.0E-01
Zinc	10/10	686.50	1.9E-02	1070.00	2.9E-02
VOLATILE ORGANICS:					
1,1,1-Trichloroethane (1,1,1-TCA)	6/10	359.70	2.0E-02	2000.00	3.8E-03
1,1-Dichloroethylene	3/10	21.95	1.2E-03	70.00	1.1E-01
Acetone	2/10	60.00	3.3E-03	400.00	2.2E-02
Ethylbenzene	3/10	321.25	1.8E-02	2000.00	1.1E-01
Toluene	3/10	246.35	1.3E-02	2000.00	1.1E-01
Trichloroethylene (TCE)	1/10	14.99	8.2E-04	7.40	4.1E-04
Xylenes, total	4/10	1259.75	6.9E-02	8000.00	4.4E-01
BNAs:					
2-Methylnaphthalene	4/10	24.70	6.8E-04	81.00	2.2E-03
Naphthalene	4/10	75.30	2.1E-03	400.00	1.1E-02

CARCINOGENIC EFFECTS

Chemical	Frequency (No.Detect/Total)	Mean Detection (ug/l)	CDI (mg/kg/day)	Maximum Detection (ug/l)	CDI (mg/kg/day)
METALS:					
Arsenic	1/10	4.29	5.0E-05	20.00	2.3E-04
VOLATILE ORGANICS:					
1,1-Dichloroethylene	3/10	21.95	5.2E-04	70.00	1.6E-03
Trichloroethylene (TCE)	1/10	14.99	3.5E-04	7.40	1.7E-04

NOTES:

NA - Not Available

For some compounds (e.g., Trichloroethylene), the value for half the detection limit exeeded the maximum value detected due to variations in detection limits. In these cases, the average exceeds the maximum.

Table 5-9
Potential Health Risks Associated with Exposure
to Key Chemicals in Area A9 - Groundwater
Residential Use Scenario

NONCARCINOGENIC EFFECTS

Chemical	Frequency (No.Detect/Total)	RFD (mg/kg/day)	Mean Detection (ug/l)	CDI (mg/kg/day)	HQ (CDI/RfD)	Maximum Detection (ug/l)	CDI (mg/kg/day)	HQ (CDI/RfD)
METALS:								
Aluminum	3/7	2.90E+00	92.43	2.5E-03	9E-04	173.00	4.7E-03	2E-03
Arsenic	1/7	3.00E-04	4.29	1.2E-04	4E-01	20.00	5.5E-04	2E+00
Calcium	7/7	NA	11914.29	3.3E-01		18400.00	5.0E-01	
Iron	4/7	NA	1120.14	3.1E-02		7010.00	1.9E-01	
Lead	1/7	NA	7.57	2.1E-04		41.00	1.1E-03	
Magnesium	7/7	NA	799.57	2.2E-02		1190.00	3.3E-02	
Manganese	7/7	5.00E-03	579.76	1.6E-02	3E+00	1660.00	4.5E-02	9E+00
Potassium	6/7	NA	1989.29	5.5E-02		2830.00	7.8E-02	
Sodium	7/7	NA	4198.57	1.2E-01		10800.00	3.0E-01	
Zinc	7/7	3.00E-01	636.86	1.7E-02	6E-02	1070.00	2.9E-02	1E-01
VOLATILE ORGANICS:								
1,1,1-Trichloroethane (1,1,1-TCA)	6/10	9.00E-02	359.70	2.0E-02	2E-01	2000.00	3.8E-03	4E-02
1,1-Dichloroethylene	3/10	9.00E-03	21.95	1.2E-03	1E-01	70.00	1.1E-01	1E+01
Acetone	2/10	1.00E-01	60.00	3.3E-03	3E-02	400.00	2.2E-02	2E-01
Ethylbenzene	3/10	1.00E-01	321.25	1.8E-02	2E-01	2000.00	1.1E-01	1E+00
Toluene	3/10	2.00E-01	246.35	1.3E-02	7E-02	2000.00	1.1E-01	5E-01
Trichloroethylene (TCE)	1/10	6.00E-03	14.99	8.2E-04	1E-01	7.40	4.1E-04	7E-02
Xylenes, total	4/10	2.00E+00	1259.75	6.9E-02	3E-02	8000.00	4.4E-01	2E-01
BNAs:								
2-Methylnaphthalene	4/10	NA	24.70	6.8E-04		81.00	2.2E-03	
Naphthalene	4/10	4.00E-02	75.30	2.1E-03	5E-02	400.00	1.1E-02	3E-01
				HI=	4E+00		HI=	3E+01

Table 5-9
Potential Health Risks Associated with Exposure
to Key Chemicals in Area A9 - Groundwater
Residential Use Scenario

CARCINOGENIC EFFECTS Chemical	Frequency (No.Detect/Total)	CSF (1/(mg/kg/day))	Mean Detection (ug/l)	CDI (mg/kg/day)	Risk (CDI*CSF)	Maximum Detection (ug/l)	CDI (mg/kg/day)	Risk (CDI*CSF)
METALS:								
Arsenic	1/7	1.75E+00	4.29	5.0E-05	9E-05	20.00	2.3E-04	4E-04
VOLATILE ORGANICS:								
1,1-Dichloroethylene	3/10	6.00E-01	21.95	5.2E-04	3E-04	70.00	1.6E-03	1E-03
Trichloroethylene (TCE)	1/10	1.10E-02	14.99	3.5E-04	4E-06	7.40	1.7E-04	2E-06
				Total Risk=	4E-04		Total Risk=	1E-03

NOTES:

NA - Not Available

All lead levels in Area A9 were evaluated using EPA's UBK Model (see text)

For some compounds (e.g., Trichloroethylene), the value for half the detection limit exeeded the maximum value detected due to variations in detection limits. In these cases, the average exceeds the maximum.

Table 6-1
Summary of Phase II Test Pit Results - Area A3 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	A3TPA1	A3TPA2	A3TPA3	A3TPB1	A3TPC1	A3TPC2	A3TPC3	A3TPD1	A3TPD2	A3TPD3	A3TPE1	A3TPE2	A3TPE3
METALS:														
Arsenic	8.24	4.2	3.5	2.5	3.5	8.0	6.8	3.8	5.8	5.4	5.0	9.9	3.0	4.4
Barium	25.39	35.6	26.7	38.3	31.1	30	37.7	57.5	31.4	37.6	44.3	37.6	60.2	41.3
Beryllium	0.30	ND	ND	0.376	0.379	0.561	0.522	0.506	0.541	0.41	0.535	0.568	0.5	0.511
Calcium	633.50	872	411	620	438	368	357	233	320	439	435	606	251	399
Cobalt	2.96	ND	4.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	10.56	10.5	6.02	5.62	6.82	7.95	7.65	10.8	7.67	14.9	8.19	7.4	9.37	9.58
Magnesium	2391.06	3130	2350	1820	1820	2350	1900	2470	1720	2080	3030	1700	2220	2030
Potassium	471.17	2000	1540	1510	1320	1010	1430	1940	985	1390	1600	471	1930	1550
Selenium	ND	ND	ND	ND	ND	0.33	0.44	ND	ND	ND	ND	0.28	ND	ND
Sodium	ND	ND	ND	ND	62.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	39.75	32	23.6	17.2	19.3	38.6	23.6	32.3	29.2	53	36.7	43.7	21.8	27.6
BNAs:														
Bis (2-ethylhexyl) phthalate	ND	ND	ND	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	0.27	0.25	ND	ND	0.6	0.31	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.24	0.28	0.15	ND	ND
PCB/PESTICIDES:														
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DD	0.05	0.013	ND	ND	0.048	ND	0.236	ND	0.035	0.013	0.032	0.078	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	ND	ND	ND	0.037	ND	0.034	ND	0.054	0.015	0.05	0.037	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	ND	ND	ND	0.033	ND	0.079	ND	0.036	0.015	0.033	0.068	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.007
PCB 1254	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	0.007	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:

ND = Compound was not detected

Table 6-2

Summary of Phase II Surface Soil Results - Area P5 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P5SO1B	P5SO2B	P5SO3B	P5SO4B
METALS:					
Arsenic	8.24	9.4	8.4	12	18
Barium	25.39	21.9	18.7	23.6	32.5
Beryllium	0.30	0.406	0.415	0.426	0.547
Calcium	633.50	272	499	696	1040
Cobalt	2.96	3.58	ND	ND	3.24
Lead	40.71	85	33	41	60
Potassium	471.17	774	624	584	536
Selenium	ND	0.32	0.33	0.35	0.31
Sodium	ND	78.1	ND	ND	ND

NOTES:

ND = Compound was not detected

Table 6-3
Summary of Phase II Sediment Results - Area P5 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P5SD2B	P5SD3B	P5SD4B
METALS:				
Aluminum	13204.18	8760	6390	17900
Barium	25.39	41.6	51.7	44.1
Calcium	633.50	13600	13000	4220
Lead	40.71	22	68	33
Selenium	ND	2.4	2.3	2
Zinc	39.75	26.9	52.5	35.8

NOTES:

ND = Compound was not detected

Table 6-4

Summary of Phase II Surface Soil Results - Area P4 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P4SO1B,C	P4SO2B,C	P4SO3B,C	P4SO4B,C
METALS:					
Arsenic	8.24	7.1	7.2	130	210
Barium	25.39	23	13.9	33.8	24.2
Copper	10.56	8.54	5.31	18.1	12.5
Iron	15381.77	9200	7000	16000	10000
Lead	40.71	44	10	31	17
Potassium	471.17	1370	626	722	1300
Selenium	ND	0.43	0.28	1.7	0.27
Vanadium	27.22	33.3	11.4	25.4	16.4
BNAs:					
Acenaphthylene	ND	ND	ND	ND	0.76
Anthracene	ND	ND	ND	ND	0.61
Benzo[a]anthracene	ND	ND	ND	ND	1.4
Benzo[a]pyrene	ND	ND	ND	ND	1.6
Benzo[b]fluoranthene	ND	ND	ND	ND	2.2
Pyrene	ND	ND	ND	ND	4
Benzo[g,h,i]perylene	ND	ND	ND	ND	1.5
Benzo[k]fluoranthene	ND	ND	ND	ND	2.4
Chrysene	ND	ND	ND	ND	2.8
Dibenz[a,h]anthracene	ND	ND	ND	ND	0.46
Fluoranthene	ND	ND	ND	ND	3.5
Indeno[1,2,3-c,d]pyrene	ND	ND	ND	ND	1.6
Phenanthrene	ND	ND	ND	ND	1.3
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.024	0.025	0.232	0.145
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.061	0.018	0.411	0.048
Dieldrin	0.01	ND	ND	0.018	ND
Endrin	ND	ND	ND	ND	0.039

NOTES:

ND = Compound was not detected

Table 6-5
Summary of Phase II Surface Soil Results - Area P17 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P17SO1B,C	P17SO2B,C	P17SO3B,C	P17SO4B,C
METALS:					
Arsenic	8.24	260	260	250	240
Barium	25.39	27.3	29.4	21.7	21.5
Beryllium	0.30	0.582	0.448	0.436	0.507
Calcium	633.50	512	1160	320	327
Cobalt	2.96	ND	3.53	ND	ND
Lead	40.71	33	38	37	24
Selenium	ND	0.44	0.37	0.41	0.29
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.33	0.32	0.21	0.239
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.09	0.13	0.21	0.055
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.55	0.57	1.1	0.36

NOTES:

ND = Compound was not detected

Table 6-6

Summary of Phase II Confirmatory Drum Sample Results - Area P19 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P19CD1B
METALS:		
Arsenic	8.24	10.00
Barium	25.39	34.80
Beryllium	0.30	0.48
Cobalt	2.96	4.38
Lead	40.71	80.00
Potassium	471.17	480.00
Selenium	ND	0.64
PCB/PESTICIDES:		
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.075

NOTES:

Volatile organic compounds, BNAs, and organophosphorus pesticides were not detected

ND = Compound was not detected

Table 6-7

Summary of Phase II Surface Soil Sampling Results - Area P20 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P20SO2B	P20SO3B	P20SO4B	P20SO5B
METALS:					
Beryllium	0.30	ND	0.568	ND	ND
Cobalt	2.96	3.13	5.24	3.85	3.68
Copper	10.56	6.5	100	9.36	5.96
Lead	40.71	26	3000	110	14
Magnesium	2391.06	1920	2530	1750	1800
Nickel	11.26	ND	12.3	ND	ND
Potassium	471.17	887	791	474	769
Selenium	ND	ND	ND	0.25	ND

NOTES:

ND = compound was not detected

Table 6-8

Summary of Phase II Surface Soil Results - Area P25 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P25S02	P25S03	P25S04	P25S05
METALS:					
Barium	25.39	28.9	45.7	38.1	38.5
Beryllium	0.30	ND	0.401	ND	ND
Cadmium	0.77	1.32	ND	ND	0.653
Calcium	633.50	2220	710	1450	2460
Chromium	25.55	26.9	16.5	15.4	12.1
Cobalt	2.96	ND	ND	ND	ND
Copper	10.56	56.5	13.8	14.7	10.5
Magnesium	2391.06	1640	2840	2390	1930
Nickel	11.26	18.4	25	ND	ND
Potassium	471.17	890	2000	1310	1000
Silver	ND	1.5	ND	8.25	3.21
Sodium	ND	70.3	ND	ND	61.5
Zinc	39.75	300	31.9	46.6	43.2
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.36	ND	0.09	0.09
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.21	ND	ND	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.18	ND	0.5	ND
alpha-Chlordane	ND	0.007	ND	ND	ND
Endrin aldehyde	ND	0.051	ND	ND	0.061

NOTES:

ND = compound was not detected

Table 6-9

Summary of Phase II Surface Soil Results - Area P35 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P35SO2B	P35SO3B	P35SO4B	P35SO5B
METALS:					
Arsenic	8.24	7.80	32.00	5.00	4.60
Barium	25.39	163.00	31.50	34.40	35.50
Beryllium	0.30	0.45	ND	ND	ND
Cadmium	0.77	1.99	ND	ND	1.62
Calcium	633.50	1460.00	1230.00	990.00	1430.00
Cobalt	2.96	4.24	ND	ND	ND
Copper	10.56	22.30	10.40	14.70	74.00
Lead	40.71	360.00	110.00	100.00	170.00
Mercury	0.07	0.36	ND	ND	ND
Nickel	11.26	11.50	ND	ND	14.30
Potassium	471.17	720.00	615.00	591.00	597.00
Selenium	ND	0.34	0.37	ND	ND
Zinc	39.75	453.00	71.60	81.10	378.00
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	ND	0.26	1.30	0.48
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	2.60	0.09	1.20	0.43
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	1.50	0.44	2.40	0.19
Endrin aldehyde	ND	ND	0.06	0.08	0.13
Heptachlor epoxide	ND	ND	ND	ND	0.02
alpha-Chlordane	ND	2.80	0.008	0.03	0.23
gamma-Chlordane	ND	4.10	ND	ND	0.34

NOTES:

ND = compound was not detected

Table 6-10
Summary of Phase II Surface Soil Results - Area P49 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P49SO1B,C	P49SO2B,C	P49SO3B,C	P49SO4B,C
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.193	0.142	0.171	0.03
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.032	0.026	0.016	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.128	0.055	0.08	0.015
Heptachlor epoxide	ND	ND	ND	0.005	ND

NOTES:

No volatile organic compounds were detected
ND = compound was not detected

Table 6-11

Summary of Phase II Surface Soil Results - Area P51 (mg/kg)

Chemical	Phase I Background Soil 95% UCL	P51SO1B	P51SO2B	P51SO3B	P51SO4B
METALS:					
Arsenic	8.24	3.6	3.4	3.7	12
Beryllium	0.30	ND	ND	ND	0.734
Copper	10.56	9.25	11.8	12.4	26
Lead	40.71	58	56	70	45
Mercury	0.07	ND	ND	ND	ND
Selenium	ND	0.49	0.58	1.1	0.99
PCB/PESTICIDES:					
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.418	0.107	0.365	0.238
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.11	0.039	0.152	0.047
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.244	0.139	0.314	0.355
Dieldrin	0.01	ND	ND	ND	ND
alpha-Chlordane	ND	0.044	ND	0.006	ND

NOTES:

ND = Compound was not detected

Table 6-12

Summary of Phase II Facility-Wide Confirmatory Drum Sample Results (mg/kg)

Chemical	Phase I Background Soil 95% UCL	FWICD1B	FWICD2B
METALS:			
Aluminum	13204.18	12000	14000
Arsenic	8.24	260	460
Beryllium	0.30	ND	0.41
Cadmium	0.77	1.27	2.74
Lead	40.71	41	24
Potassium	471.17	326	502
Selenium	ND	0.55	0.5
BNAs:			
Bis (2-ethylhexyl) phthalate	ND	0.69	ND
PCB/PESTICIDES:			
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.14	0.231
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.033	0.07
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.092	0.199

NOTES:

ND = Compound was not detected

Table 6-13
Summary of Phase II Facility-Wide Sediment Results (mg/kg)

Chemical	Phase I Background Soil 95% UCL	FWISD21B	FWISD22B	FWISD23B	FWISD24B	FWISD25B
METALS:						
Arsenic	8.24	22	27	36	15	ND
Barium	25.39	14.9	ND	12.2	26.2	25.7
Beryllium	0.30	ND	ND	ND	ND	1.53
Calcium	633.50	462	898	461	711	1760
Copper	10.56	48.6	155	152	187	28.7
Iron	15381.77	110000	150000	130000	110000	7200
Lead	40.71	120	110	110	86	19
Nickel	11.26	ND	ND	45.2	37.7	ND
Selenium	ND	1.2	1.4	0.68	1.9	1.4
Sodium	ND	ND	ND	115	ND	ND
Zinc	39.75	49.1	75.4	50.3	58.8	27.1
BNAs:						
Benzo[a]anthracene	ND	ND	ND	0.58	ND	ND
Benzo[a]pyrene	ND	0.48	ND	0.78	ND	ND
Benzo[g,h,i]perylene	ND	ND	ND	0.78	ND	ND
Bis (2-ethylhexyl) phthalate	ND	ND	ND	ND	1.4	1.2
Chrysene	ND	0.3	ND	1	ND	ND
Fluoranthene	ND	0.3	ND	0.49	ND	ND
Indeno[1,2,3-c,d]pyrene	ND	ND	ND	0.47	ND	ND
Phenanthrene	ND	ND	ND	0.4	ND	ND
Pyrene	ND	ND	ND	1.4	ND	ND
PCB/PESTICIDES:						
2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (DDT)	0.05	0.129	0.074	5.4	0.424	ND
2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (DDD)	0.02	0.335	0.418	4.7	0.92	0.255
2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (DDE)	0.03	0.279	0.374	0.372	0.114	0.124
Lindane	ND	ND	ND	ND	ND	0.108

NOTES:

ND = Compound was not detected

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

SUPPLEMENTAL ECOLOGICAL RISK ASSESSMENT FOR THE FORT DEVENS SUDBURY TRAINING ANNEX MIDDLESEX COUNTY, MASSACHUSETTS

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EXECUTIVE SUMMARY

This supplemental ecological risk assessment (ERA) was prepared to evaluate data collected during the Phase II investigation at the Fort Devens Sudbury Training Annex (Annex) to determine whether or not findings from this investigation modify the risk estimates reported in the January 1994 ERA. This supplemental ERA complements the basewide assessment by focusing more closely on the three remedial investigation (RI) areas of contamination (AOCs) A4, A7, and A9.

The Annex is located in Middlesex County, Massachusetts, covers approximately 4.3 square miles (2,750 acres) and includes portions of the towns of Maynard, Hudson, Stow, and Sudbury. The facility was acquired by the government in the early 1940s and was initially used for holding munitions. After World War II, the principle use of the reservation was troop training, although some equipment testing and experiments were also conducted at the Annex. The Annex was also utilized by other agencies or operators for a variety of purposes including testing, training, and waste disposal. The installation is currently used by a number of local groups, including the Massachusetts Fire Fighting Academy (MFFA), the National Guard, and permitted recreational users. Because of its easy accessibility, the site is also used by unauthorized persons.

The site investigation/remedial investigation (SI/RI) conducted by OHM Remediation Services Corporation (OHM), a wholly owned subsidiary of OHM Corporation, for the U.S. Army Environmental Center (USAEC) at the Annex focused on three areas of primary concern, where full RIs were conducted: AOCs A4, A7, and A9. Studies were also conducted in numerous other areas of the facility to attempt to define the facility-wide nature and extent of any residual chemicals. A key component of this facility-wide investigation was the use of Rapid Bioassessment Procedures (RBP) to evaluate if organisms in streams draining the Annex showed any evidence of site-related stress. The baseline ERA finalized in January 1994 (OHM 1994; Appendix H) provided a preliminary assessment of the potential for ecological harm associated with chemicals present in environmental media on the base as a whole. This supplement to the baseline ERA focusses on issues related to the three RI areas.

ECOLOGICAL RISK ASSESSMENT

AOC A4

At AOC A4, lead, the chemical of primary concern, was present in soils at two hotspots and in surface water samples collected from the wetlands located west of the area. Contact with the two surface soil hotspots is unlikely to occur with sufficient frequency or duration to pose a risk to organisms using the site. The elevated lead levels reported for the surface water samples are considered to be an anomaly caused by sampling technique and are not considered indicative of a potential risk in the area. Arsenic was also detected at an elevated concentration in a sediment sample at AOC A4. This elevated arsenic concentration may be associated with pre-military pesticide use in the apple orchards that formerly existed north of (upgradient from) the wetland area. Because spraying of these orchards probably stopped over 50 years ago, the residual arsenic at the site is likely to be less available than when first applied. Considering this fact, and the infrequent detection of arsenic which suggests that contact with elevated arsenic levels will be unlikely, arsenic is considered unlikely to pose a substantial risk to organisms in the wetlands portion of AOC A4. No other chemicals were detected at the site at levels that were considered to pose a threat to wildlife in the area. The primary effects of man on AOC A4 appear to be development

of fields (which are becoming overgrown but currently provide habitat for species that frequent edges), and the development of the marsh located to the west of AOC A4, which provides habitat for wetlands organisms.

AOC A7

One concern at AOC A7 is the elevated levels of lead and several organochlorine pesticides, including 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (ppDDT), 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (ppDDE), 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (ppDDD), and chlordane, detected in soils. Based on a review of aerial photographs, AOC A7 had been cleared prior to 1943, had been used as a gravel pit and then as a disposal site, and recently has been recleared with much of the surface debris removed. The overall effect is that residual soils are of poor quality for supporting plant life and are unlikely to be a preferential habitat for any other terrestrial wildlife. Because of the poor soils and because the lead and pesticides are detected infrequently and at isolated locations (i.e., hotspots), ecological risks associated with these chemicals in soils are unlikely. A semi-quantitative screening-level evaluation of the potential for ecological harm further supports this conclusion.

The other major ecological concern at AOC A7 involves the possibility that chemicals released from the site may adversely affect organisms in the adjacent Assabet River. Levels of lindane in ground water from a well (OHM-A7-51) that is located close to the river exceed Ambient Water Quality Criteria (AWQC) and the chemical may well be migrating to the river. However, several factors suggest that adverse effects are unlikely or if they occur will be minimal. Water from the site is released only slowly due to the consistency of the soils in the area. In addition, the small volume of water released from the site will be fairly quickly diluted by the large volume of water in the river. Consequently, any impacts on river organisms will be very localized. River sediments have higher organic carbon levels than soils and this high carbon may adsorb and decrease the bioavailability of lindane to aquatic organisms. Past industrial uses and pesticide releases from upstream apple orchards are likely to have already affected the river by eliminating organisms that are particularly sensitive to the effects of chemicals. Continuing releases of pesticides and nutrients from water treatment plants, lawn care, orchards, and the golf course are likely to prevent the reestablishment of sensitive organisms in the river. Consequently, even if lindane from AOC A7 migrates to the river, it is unlikely to have a significant impact on aquatic life in the Assabet.

AOC A9

Ecological concerns in AOC A9 include the presence of arsenic at elevated levels in the southwest corner of the area, an additional soil hotspot in the northwest corner, and the potential for chemicals to migrate to the Assabet River. As in AOC A7, past human use of the site has influenced local habitat. Evidence from aerial photographs indicates that the area was used as an orchard prior to military use and that during military ownership, further clearing was done. Arsenic has been detected at slightly elevated levels in the southwest corner of the site, quite possibly as a result of prior agricultural use. An evaluation of the potential for ecological harm associated with the arsenic suggests that the levels are a cause for concern for wildlife that might use the specific area containing high arsenic on a frequent basis. Lead and thallium levels associated with a confirmatory drum sample in the northwestern edge of the site are also of potential concern for animals with limited ranges. However, organisms using the area less frequently (for example, most predators) would not be at risk. The assessment was quite conservative (i.e., designed to ensure ecological protection) and it is possible that even animals using the site frequently may not be adversely impacted.

Elevated levels of several volatile organic compounds (VOCs) and lead were detected in site ground water. Of the chemicals detected, only lead and ethylbenzene were present in ground water at levels exceeding AWQC. Based on the toxicity, concentration, and environmental behavior of these chemicals, no effect is expected on the Assabet River.

The Assabet River

Elevated levels of several chemicals, including polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides, and metals were detected in river sediments. However, the distribution of the chemicals in the river suggests that the site was not the source of these chemicals. Considering past and current uses of the river and of upstream areas, the fraction of water in the river that is contributed by the site, and the low levels of chemicals detected in site ground water, it is unlikely that the site is adversely impacting the river.

SUMMARY AND RECOMMENDATIONS FOR FURTHER ACTION

In summary, although isolated hotspots of contamination exist at the site, the infrequency of these hotspots and the general low level of chemicals at the Annex suggest that ecological risks are minimal. Consequently, if any action is taken to address ecological risks, the action should be limited to hotspot removal and possibly at AOC A7, to limiting the migration of lindane-containing ground water to the Assabet. The Annex represents a large open space area in the center of an increasingly developed metropolitan suburb. Any further actions on the site, including any remedial actions, should ensure that this area is maintained.

1.0 INTRODUCTION

Ecological Risk Assessment (ERA) is defined by the U.S. Environmental Protection Agency (USEPA) (1992) as "...a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors." A detailed ERA was prepared as Appendix H of the Site Investigation/Remedial Investigation (SI/RI) report completed by OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, in January 1994. This supplemental ERA, presented as part of the SI/RI Addendum, updates that ERA and specifically focuses on the three remedial investigation (RI) areas (AOCs A4, A7, A9).

Ecological harm can be caused by chemical, physical, or biological agents, but at Superfund sites, most emphasis is focused on evaluating the effects of chemicals on the environment. Chemical agents can cause ecological risks if:

- The chemical has the inherent ability to cause adverse effects (i.e., it is toxic to organisms) and
- The chemical can come in contact with an ecological component (i.e., populations, communities, or ecosystems) long enough and at a sufficient concentration to elicit the adverse effect.

Even simple ecosystems involve complex interactions among components, and a chemical agent does not need to be directly toxic to an organism to have an adverse effect. For example, herbicides may not be directly toxic to herbivores but by removing their food supply indirectly harm these organisms. As another example, some chemicals that bioconcentrate through trophic levels may not be toxic to species in lower trophic levels at the concentrations present in the environment, but biomagnification may lead to adverse effects on organisms in higher trophic levels.

The factors noted above all suggest means by which a chemical may have an unexpected adverse effect. There are several factors at the Ft. Devens Sudbury Training Annex (Annex) that suggest that chemicals may have less of an effect than predicted by arbitrarily comparing chemical concentrations with target criteria. Chemicals present at the site have been in place for a substantial period of time and are almost certainly more tightly bound to soil particles (and less bioavailable to organisms) than the freshly applied chemical. Chemicals at the Annex generally exist at hotspots and contact with these hotspots may not actually occur or may only occur infrequently. In addition, even for hotspots, weathering of chemicals in surface samples may be greater than weathering at greater depths, and surface soil samples that measure chemical levels in the upper six inches (15 centimeters) of soil may overestimate the potential for exposure of non-burrowing organisms which are likely to contact only the upper few centimeters of soil.

The ERA process, like the human health risk assessment process, is composed of three major elements:

- An evaluation of the adverse effects caused by the chemical (i.e., an evaluation of the chemical's inherent toxicity)
- An assessment of the potential for exposure to the chemical

- A characterization of the potential for adverse effects to occur at the specific site, based on the estimated exposure to the chemical of concern.

A major difference between a human health and an ERA is the level of complexity required to thoroughly address risks. In a human health evaluation, potential effects on a single species (humans) is assessed. However, in an ERA, potential effects on an infinitely larger number of species of concern (including both plants and animals) and the interactions among these organisms must be evaluated. A substantial amount of uncertainty is inherent in the human health risk assessment process. The complexities inherent in the evaluation of impacts on ecosystems suggest that ERA is an even more uncertain process. In addition, data on the ecological effects of chemicals is frequently complex and difficult to interpret, ambiguous or conflicting, and/or incomplete. For these reasons, ERA is a new and rather inexact science (Moriarty and Walker, 1987).

Section 2.0 of this assessment contains general information about the Annex. Information on the Assabet River and on background levels of chemicals detected in surrounding areas are also included in this section. The ERAs for the three RI SAs (AOCs A4, A7, and A9) are presented in Sections 3.0, 4.0, and 5.0, respectively. These sections describe chemicals of concern, potentially exposed organisms (target indicator species), routes of exposure, and likely ecological risk. Because of the uncertainties inherent in ERA, each section contains a discussion of uncertainty and of factors influencing risk that may not be addressed quantitatively. The concentrations of chemicals detected in the Assabet River and the potential effects of these chemicals on aquatic organisms are discussed in Section 6.0. The conclusions of the risk assessment are presented in Section 7.0. This section also contains recommendations for further action at the RI sites, based on the results of the Addendum ERA. Section 8.0 contains references.

2.0 SITE CHARACTERIZATION

This section of the risk assessment contains a brief discussion of the history of the site. Site and area features including climate, topography, geology, hydrogeology, and surface water hydrology are also summarized. In addition, a general description of the ecosystems at the Annex is presented. Information on background levels of chemicals in off-site areas is also provided. Off-site background concentrations include both naturally-occurring and anthropogenic concentrations of metals and organics.

2.1 SITE HISTORY AND LOCAL DEMOGRAPHICS

The Annex, originally known as the Maynard Ammunition Depot, was acquired by the government in the early 1940s. Prior to this time, the area had been used for farming, including use for apple orchards and cranberry bogs. During World War II, the Annex was used for holding munitions. After the war, the Annex became known as the Maynard Ordnance Test Station (MOTS). In 1958, control of the Annex was transferred to the U.S. Army Natick Research and Development Command (NARADCOM). At that time, the principle use of the reservation was troop training. NARADCOM also conducted testing and experiments at the Annex. The Annex was utilized by other agencies or operators for a variety of purposes including testing, training, and waste disposal. NARADCOM maintained control of the military reservation until 1982 at which time custody of the entire Annex was transferred to Fort Devens, which used the Annex primarily for the training of active duty, Army Reserve, and Army and Air National Guard personnel.

The Annex is located in Middlesex County, Massachusetts, covers approximately 4.3 square miles (2,750 acres) and includes portions of the towns of Maynard, Hudson, Stow, and Sudbury. Figure 1-1 in the main body of the SI/RI Addendum presents the site location.

The Annex is divided into two sections by Hudson Road. Present activities in the southern, smaller section include the Capehart Family Housing Area (CFHA), a military family housing area consisting of 35 housing units, and an area where cloth durability testing is performed. All of the southern section, except the CFHA, was identified for potential excessing (disposal of the land by the military allowing a return to non-military use). Excessing activities are presently on hold pending outcome of the facility remedial investigation/ feasibility study (RI/FS) activities. The active operations in the larger northern section include several individual housing units, a U.S. Air Force (USAF) radar installation, a Federal Emergency Management Agency (FEMA) regional operations center, and a guardhouse at the main gate. The installation is also used by a number of local groups, including the Massachusetts Fire Fighting Academy (MFFA), the National Guard, and permitted recreational users. Because of its easy accessibility, the site is also used by unauthorized persons.

2.2 PHYSICAL FEATURES

The topography of the Annex is level to slightly undulated in the lowlands with oval-shaped hills composed of glacial till (drumlins). The terrain is dominated by numerous lakes, bogs, marshes, swamps, and kettles. The drier areas consist of well-drained, coarse-grained materials as indicated by the number of gravel (borrow) pits throughout the installation. Most of the hills lie in an area along the northern border of the Annex with a low ridge extending south-southwest through the central portion of the Annex. Elevations range from 170 to 321 feet above mean sea level (MSL) within the boundaries of the Annex.

Most of the Annex is within the drainage basin of the Assabet River which flows in an easterly direction along the northwest edge of the Annex. The majority of the northern portion of the Annex drains northward via Honey Brook and Taylor Brook which flow into the Assabet River. The western section flows west into Boons Pond. The eastern section of the southern portion of the site drains toward the east into Stearns Mill Pond and the western section drains into White Pond. Several smaller unnamed tributaries feed into Taylor Brook or Honey Brook, Puffer Pond, and the Assabet River itself.

Flow rates are generally low within the on-site stream channels due to the highly permeable soils, shallow depth to ground water and low slopes on this broad outwash plain. Poorly drained sections or lowlands are found throughout the Annex, with the largest extent occurring southeast of the centralized drumlins. These lowlands include bogs, marshes, swamps, and a multitude of small waterholes. On-site conditions are conducive to good infiltration/percolation rather than runoff. The little runoff which does occur from the small hills is presumed to collect in the few existing streams and swampy areas.

Generally, the top of the unconfined saturated zone at the Annex is near the ground surface, as indicated by the swamps, bogs, and waterholes. Depth to the ground water table is generally less than 15 feet, with the ground water gradient approximating area topography (flow is from topographic highs to lows). Ground water flows mostly through the outwash underlying the lowlands of the site. Water occurs in only limited quantities in bedrock fractures, and transmissivity in the tight till formation is poor. Ground water flow in the northern portion of the Annex is towards or parallel to the flow directions of Taylor and Honey Brook for the most part, except in the far southwest reaches where ground water flow is towards Boons and White Ponds.

2.3 ECOSYSTEMS OF CONCERN

The three major ecosystems at the Annex are the terrestrial ecosystem, the wetlands ecosystem, and the aquatic ecosystem. Although these three systems are in reality linked to one another, they are considered separately for discussion purposes. However, important interrelationships among the three systems will be presented where appropriate.

2.3.1 The Terrestrial Ecosystem

Most of AOCs A4, A7, and A9 can be characterized as part of the terrestrial ecosystem at the Annex. U.S. Army Corp of Engineers USACE (1987) defines this ecosystem as *"...uplands and lowland areas that are neither deepwater aquatic habitats, wetlands, nor other special aquatic sites. They are seldom or never inundated, or if frequently inundated, they have saturated soils for only brief periods during the growing season, and, if vegetated, they normally support a prevalence of vegetation typically adapted for life only in aerobic soil conditions."*

The dominant vegetation found in the Terrestrial Ecosystem is typically adapted for life in aerobic soils only. There are no hydric soils in this system and the soils found in the terrestrial system possess aerobic soil characteristics. If inundation or saturation occurs at all, the average annual duration of this inundation or saturation is not long enough to preclude the occurrence of plant species that are typically adapted for life in aerobic soil conditions. Mesic (moderately moist) upland areas on the site are divided into forest, open fields, transitional forest, and secondary growth scrublands.

2.3.1.1 Upland Forest

The woodlands on the Annex are a mixture of second-growth oak- and maple-dominated hardwoods. Interspersed within the hardwoods are several stands of white pine that were planted as part of Ft. Devens' forest management practices. One such stand exists immediately west of AOC A9, and young volunteer pine trees also cover much of the western portion of the site. The canopy formed by the hardwoods is mostly complete. The resulting shade acts to limit thick growths of understory brush except along the edges of roads and clearings. An Endangered Species survey conducted by Anaptek (1991) under contract to Ft. Devens found that the forest floor supported a moderately diverse assemblage of herbaceous plant species. This statement is supported by the findings of Hunt (1992) during a botanical survey of the site, again under contract to Ft. Devens.

2.3.1.2 Upland Fields

Several upland fields exist throughout the Annex, including manmade fields at AOCs A4 and A9. Based on a review of aerial photographs, many of these fields were probably used for agricultural purposes prior to Army acquisition of the Annex, while other fields were established by the Army. The field at AOC A9 was formerly used as an apple orchard, but was leveled in the 1970s for use in firetraining and materials testing. The site is currently covered in large part by scrub grasses, with the western side giving way to pine trees and overall, the area appears to be in an early stage of recovery.[1]

2.3.1.3 Transitional Forest

Transitional forest surrounds the Taylor Drop Zone and the wetlands found on the Annex. This community is also found along the roadsides and on or surrounding those areas of the Annex that have been disturbed (i.e., cleared, graded) because of past base uses (e.g., the three AOCs). The transitional forest community is characterized by the high diversity of woody shrubs and vines found there. The thick understory formed by these plants and the presence of numerous fallen trees provide habitat for many other organisms. Also, food and forage is generally plentiful as a result of the high plant diversity, therefore, many organisms forage here.

2.3.2 The Wetlands Ecosystem

Those areas on the Annex which are commonly known as marshes, swamps, and bogs have been classified for this assessment under the Wetlands Ecosystem. USEPA and USACE (1987) have jointly defined the term wetlands to mean *"Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."* Numerous wetland areas exist throughout the Annex, including the area west of AOC A4. Evidence from aerial photographs suggests that at least some of the wetlands were previously drained (photographs from 1943 show a forested and apparently well drained area west of AOC A4 and south of SA A3) or had been used for cranberry bogs (photographs from 1952 show a cranberry bog north of Puffer Pond along the eastern side of Taylor Brook).

[1]Recovery: The partial or full return of a population or community to a condition that existed before the introduction of a stressor.

2.3.3 The Aquatic Ecosystem - The Assabet River

The Assabet River, located in the Concord River Basin, has a water quality classification of Class B, designated for use and protection and propagation of fish, other aquatic life, and wildlife, and for primary and secondary contact recreation [Massachusetts Department of Environmental Quality and Engineering (MADEQE), 1989]. Where designated, Class B waters "shall be suitable as a source of public water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses. These waters shall have consistently good aesthetic quality." The Westborough, Shrewsbury, Marlboro West, and Hudson wastewater treatment plants (WWTP) discharge into the Assabet River upstream from the Annex. Downstream of the Annex, the Maynard and Massachusetts Correctional Institute WWTPs discharge wastewater to the Assabet.

The Assabet River has had water quality problems in the past, mostly as a result of wastewater discharges from the WWTPs. Although dissolved oxygen deficits and excessive fecal coliform counts have declined in recent years, the river still only partially meets its Class B water quality classification. During summer months, significant portions of the river support dense populations of algae and macrophytes. Water quality problems have also occurred during the summer due to low flow rates and minimum dilution coupled with warm weather, which causes maximum organic decay and vegetative growth.

Residues of the organochlorine pesticides 2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane (ppDDT) [and its metabolites 2,2-Bis(p-chlorophenyl)-1,1-dichloroethane (ppDDD) and 2,2-Bis(p-chlorophenyl)-1,1-dichloroethene (ppDDE), which will be referred to collectively as $\sum$ppDDT], dieldrin, and endrin were detected in fish sampled from the Assabet in the mid-1970s (Nisbet and Reynolds 1984). The probable source of these pesticides was identified as Middlesex County apple orchards, many of which were located upstream from the Annex.

2.4 GENERAL ECOLOGY

Currently, the Annex is covered by mixed deciduous and pine woods and a combination of freshwater marsh, swamp, and cranberry bog. Numerous stone fences, old foundations, wells and roads indicate that, at some time in the past, the Annex was used for agriculture. Field examination indicates no overt signs of damage from military or other activities to the forest or wetland habitats.

The amount of woodland under management is estimated to be 2,300 acres, including portions in the Marlboro State Forest. Approximately four-fifths of the total area supports marketable timber. There are numerous clearings within the wooded areas that have either been created by timber harvest or as a result of wildlife management actions. Most of these clearings are less than one acre. Intermittent timber harvests have been conducted on the Annex. To date, approximately 1 million board feet of wood products from the Annex have been marketed. Supporting operations such as thinning, site preparation, and pruning have been conducted. The last major timber harvest was conducted in 1983 and was primarily a salvage operation after a hurricane struck the area. The forest management goal set for the Annex is maintenance of a diverse mixture of species and age classes, avoidance of monoculture, and the protection and perpetuation of wetland and other wildlife habitats currently present.

Conifers present at the Annex include: White Pine, Pitch Pine, Red Pine, Norway Spruce, and Eastern Hemlock. Deciduous trees include: Red Oak, White Oak, Black Oak, Beech, Birch, Black Cherry, Red Maple, Locust, White Ash, Apple, and American Elm. A wide variety of plant species are

found in the wetlands associated with Taylor Brook and Puffer Pond. Wetland types found on the Annex include swamp, high marsh, cranberry and peat bogs, wet meadows, and low marsh.

The diversity of habitat available at the Annex supports a wide variety of mammals, including whitetail deer, red fox, beaver, raccoon, skunk, muskrat, numerous rodent species, mink, and otters. The wetland and open water habitats contain populations of reptiles and amphibians such as the Eastern Painted Turtle, snapping turtles, Spotted Turtles, salamanders, and frogs. Common fish species found in Puffer Pond include largemouth bass, brown bullheads, longear sunfish, golden shiners, black crappie, and chain pickerel. Typical birds seen on the Annex include Canada geese, woodcocks, red-winged blackbirds, red-tailed hawks, red-shouldered hawks, ruffed grouse, turkey, heron, wood ducks, and a wide variety of song birds.

The Nature Conservancy has conducted field investigations on site for federal and state endangered and threatened species. A possible sighting of Blanding's Turtle, a state endangered species, was made in April 1992. Several independent studies have also focussed on the ecology of the Annex. These studies are described in further detail in the Basewide-Ecological Risk Assessment. They include: Anaptek Corporation, 1991, Endangered Species Survey, Phase I; Butler 1992, Fort Devens Sudbury Annex Inventory Summary Report; Harrington 1991, Site Investigations at the Fort Devens Annex; and Hunt 1992, Floristic Survey with Emphasis on Rare Species of the Sudbury Annex of Fort Devens Massachusetts.

2.5 BACKGROUND SOILS

A detailed discussion of the sampling and analysis program to determine background levels of chemicals in near-site soils is provided in the January 1994 SI/RI report. A brief discussion of background chemical levels is provided below. Table 2-1 summarizes the levels of chemicals detected during the background sampling effort.

Sampling was conducted at 12 off-site locations around the facility in order to characterize levels of chemicals present in background, non-site-affected soils. Chemicals detected in these soils can be naturally occurring, may be present from anthropogenic (man-made) sources, or both. Metals occur naturally in the environment and levels on-site were compared with off-site (background) levels to establish if the on-site metal levels were caused by site activities.

Two metals of particular concern at the Annex, arsenic (actually a metalloid) and lead, often occur from both natural and anthropogenic sources. Natural arsenic concentrations are quite variable in Massachusetts and possibly on the Annex. For example, at the Annex, most arsenic levels were at or below 10 mg/kg but a subsurface and apparently unimpacted sample from AOC A4 contained arsenic at a concentration of 30 mg/kg. In addition to natural variation, arsenic has been used extensively as a pesticide in orchards and cranberry bogs, and portions of the Annex and of this section of Middlesex County were, and in some cases still are, used for this purpose. Arsenic has also been used extensively as a herbicide for weed control along roadways, and may have been used for this purpose at the Annex. Lead is commonly encountered in urban areas as a result of the widespread use of lead for industrial and domestic purposes (including its use in leaded gasoline and paint). Naturally occurring lead levels in the Northeast are generally in the range of 2 to 30 mg/kg but lead levels in urban areas often exceed 100 mg/kg (Chaney, 1985) and were measured in New England cites at an average of approximately 300 mg/kg (Magee et al., 1994).

Organic chemicals are not commonly present in naturally occurring background samples, with the occasional exception of the polycyclic aromatic hydrocarbons (PAHs). The PAHs are products of incomplete combustion and as such are naturally occurring in burned areas, although they are generally found at highest concentrations in areas impacted by man. The State of Massachusetts, in Subpart C of the proposed revision to the Massachusetts Contingency Plan (March 1992) determined that a level of up to 10 mg/kg of PAHs can be considered indicative of background concentrations. Menzie et al. (1992) listed concentrations in forest and rural soils of 0.01 to 1.3 mg/kg for carcinogenic PAHs[2] (N=24). Menzie et al. (1992) reports levels of carcinogenic PAHs (plus benzo[ghi]perylene) in urban soils ranging from 0.06 to 5.8 mg/kg with a median value of 1.1 mg/kg (N=15). These authors also note that road dust contained very high levels of PAHs, with a median of 137 mg/kg and a range of 8 to 336 mg/kg (N=7).

ppDDT and its breakdown products, ppDDD and ppDDE (∑ppDDT), were also detected in background soils. ∑ppDDT is a very persistent chemical in the environment and was widely used prior to approximately 1970 to control gypsy moth infestations, for crop use, and for mosquito control. Consequently, its presence in off-site background soils in an area that has been used for farming and that probably was sprayed for gypsy moths and mosquito control is not unexpected. On the other hand, the military probably also sprayed for insect control and the locations of the background samples near to the base do not totally exclude the possibility that direct military spraying or drift from such spraying is the cause of the elevated levels. On-site soil concentrations of ppDDT, ppDDD, and ppDDE were compared with background levels to evaluate the potential for site-related activities to have contributed to elevated levels of this organochlorine pesticide.

Other organochlorine pesticides were also used for wide area spraying and although not detected in the 12 background samples collected, are likely to be present in other off-site areas or on the facility. As noted in section 2.3.3, residues of the organochlorine pesticides ∑ppDDT, dieldrin, and endrin were detected in fish sampled from the Assabet in the mid-1970s (Nisbet and Reynolds 1984). Other organochlorine pesticides that were fairly widely used in agriculture in Massachusetts include chlordane, aldrin, toxaphene, and lindane.

2.6 PHYSICAL STRESSORS

As noted in the introduction, factors other than chemical agents can substantially influence wildlife populations and ecosystems. Much of New England has been influenced by man. For example, the stone walls that run through several wooded areas of the Annex are evidence of past farming activities. The loss of the American Chestnut, which used to be a dominant tree in the region, and the arrival of the gypsy moth are two other, less desirable examples of man's influence. In addition to the actions of man, natural stressors can also influence local populations. For example, a hurricane in 1983 caused substantial damage to trees on the Annex. The effect of these physical stressors on the ecosystems of the three AOCs needs to be considered in evaluating the potential for chemically-related ecological harm.

[2]Menzie et al. (1992) includes benzo(ghi)perylene among the carcinogenic PAHs. This compound is not commonly considered to be carcinogenic (Poirier, 1992).

2.6.1 Natural Stressors

Ecological systems found on the Annex are subjected to a variety of stresses other than those that are caused by potential chemical contamination or the effects of man. These "natural" stresses (which can act singly or in concert to produce the stress) can have effects on the wildlife found on the Annex which may "mask" potential chemical stresses or, in some instances, emulate those stresses. Some of the more common "natural" stresses are listed below:

- Drought - The most obvious effect is the loss of habitat for aquatic organisms; even when water remains (as in pools), the resulting stagnation usually causes an oxygen deficit. Terrestrial plants wilt or die from lack of water.

- Flood - Washes away sessile organisms; scouring and deposition of flooded stream bottoms either washes substrate away or covers organisms with silt. Erosion removes topsoils.

- Fire - The most obvious effect of fire is the destruction of plants and animals. However, periodic fire is essential to the health of some ecosystems because it recycles nutrients and reduces competition.

- Overpopulation - Overpopulation of one or more communities reduces the available resources, resulting in disease and starvation. Overpopulation can result from the elimination of natural predators.

- Alteration of Habitat - Alteration of the habitat usually occurs as a result of human activities but can be the result of such natural events as ice storms, tornadoes, or hurricanes. Many organisms are very specific as to where they live and feed. Removal of their habitat can result in loss of the population.

2.6.2 Non-Chemical Anthropogenic Stressors

Humans can cause huge effects on ecosystems through a number of non-chemical means, and many of these effects will be detrimental to wildlife and to local ecosystems. Removing topsoil or adding fill material can lead to stressed vegetation and to adverse effects on organisms that relied on the vegetation, as the new surface soils have lower nutrient levels and water holding capacity. The open, poorly vegetated portions of AOCs A7 and A9 are likely examples of this type of physical stress. Filling or draining wetland areas, which may also have occurred on the Annex, is another example of the type of stress that can be caused by human activity. Finally, as mentioned above, the release of the gypsy moth, dutch elm disease, house cats, starlings, and the chestnut blight are all examples of biological agents imported through the physical actions of humans that have adversely impacted local ecosystems.

Not all of human effects are detrimental, however. The clearing of fields in New England (the source of all the stone walls) created a large number of open spaces and edges and was certainly beneficial to wildlife that frequent these habitats (e.g., whitetail deer). The wetlands located west of AOC A4 appears to have been created by man. Apple trees planted on the Annex prior to its purchase by the military may well have been the source of the elevated arsenic concentrations in soils. However, apples from these trees have probably also served as a valuable food source for wildlife, an example of the same action having both a negative and positive impact. Numerous other examples exist of man's physical influence on the

regional and local environment. In attempting to evaluate the potential causes of any observed environmental change, the possibility of physical actions as a source of the changes must be considered.

3.0 AOC A4

AOC A4, Waste Dump, is located in the eastern portion of the Annex adjacent to the East Gate as shown on Figure 1-1 in the main body of the SI/RI Addendum. This area was reportedly used for about 4 years during the late 1960s and early 1970s for the burial of unidentified chemical wastes. Interviews with a Natick employee indicated drums may also have been buried near the East Gate.

The area is approximately 1,000 feet long by 200 feet wide and contains a surface dump in a depression at the southwest end, along with an old building foundation and stone well at the northeast end. The building foundation has been identified as the site of the Rice Tavern or Vose Farm.

Figure 2-1 in the SI/RI Addendum is a map of AOC A4 showing the locations for all investigative work performed and samples collected. Tables D-1 to D-9 in Appendix D of the SI/RI Addendum summarize the sampling results.

3.1 ECOSYSTEMS OF CONCERN

A preliminary ecological assessment of AOC A4 was conducted during April-May 1992. The area was visited on several occasions to evaluate site conditions and determine if additional assessments were warranted. AOC A4 consists primarily of a cleared area. The northern portion of AOC A4 is wooded and bounded by a small intermittent stream (actually a dug channel). The central portion of AOC A4 is weakly colonized with grasses. This central portion had previously been cleared, apparently for farming. The lack of brush in the northern section of the central portion contrasts with the more advanced brush in the southern section of the central portion, which suggests that the northern section was cleared at a later date than the southern section. There is a depression in the southwest corner of AOC A4 which was used as a trash pit. The southern one-third of the site has been used for trash dumping as evidenced by the debris and trash scattered about. The southern portion of the area is also grass covered, but there are numerous patches of brush and tree saplings scattered around.

The western side of the site currently abuts wetlands. A review of old aerial photographs indicates that the wetland area used to be forested lowland but a dam constructed between the area and Puffer Pond converted the area to a wetland. The western portion of AOC A4 appears to be in the early stages of plant recolonization. If no further clearing is conducted, this area should slowly revegetate.

Both the field and the ecological edge formed at the junction of the field and the surrounding forest support diverse wildlife populations. On several occasions, deer were noted browsing in the area during early morning visits. Raccoon tracks, and on one occasion a raccoon, were noted in the vicinity of sample point A4SW1/A4SD1. Near the marsh at the southwest end of AOC A4, several Northern Water Snakes were observed, as well as numerous painted turtles, and on one occasion a single green heron. A red fox was seen in the southeastern corner of the area. There were several rodent runs noted in the field portion of the site.

AOC A4 is well utilized by a diverse assemblage of wildlife. Three habitat types meet on this site: field, forest, and wetland. Animals typical of all three ecotypes were observed. The animals observed did not display any physical signs of stress. While the debris scattered around the area is unsightly, it does provide habitat for organisms such as snakes and rodents. Based on these visual observations, conditions at AOC A4 do not appear to be causing any adverse ecological effects.

3.2 CHEMICALS OF POTENTIAL CONCERN

A number of chemicals were detected in AOC A4 during both the Phase I and Phase II sampling events. Concentrations of these chemicals were compared with background levels of the chemicals and with available screening-level ecological toxicity criteria to assess whether or not the chemicals were of potential concern for the site. Tables 3-1 through 3-6 include all chemicals that were detected at concentrations exceeding one or more of these screening criteria.

3.2.1 Chemicals Detected at AOC A4

The contaminants identified during the Phase I investigation in AOC A4 included:

- Soil samples contained metals, organochlorine pesticides, a volatile organic compound (VOC), two PAHs, and a phthalate ester
- Ground water contained trace levels of solvents, pesticides, and insect repellant
- Dacthal was detected in a surface water sample from AOC A4
- Sediment samples contained solvents and metals .

Results of the Phase II investigation conducted by OHM in late 1993 are described in detail in the nature and extent section of the SI/RI Addendum and are included in the results presented in Tables D-1 to D-9 in Appendix D of the Addendum. Chemicals detected in Phase II at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling include lead (surface soils), bis-2(ethylhexyl) phthalate (DEHP; ground water), arsenic (test pits), and beryllium (test pits and sediments).

Lead was detected in a surface soil sample collected from the cellar of the former Vose Tavern at a concentration of 520 mg/kg (890 mg/kg in the associated duplicate), a level in the same range as the previous maximum for AOC A4 of 570 mg/kg (detected near the general debris in the southwestern portion of the site). The Phase II sampling confirmed that lead is present at hotspots in AOC A4 but is not widespread in site soils. Lead was not detected in a filtered ground water sample from the well which had previously yielded conflicting results (190 μg/liter in November 1992; <1.5 μg/liter in June 1993). Low levels of lead (5.2 μg/liter) were detected in an unfiltered sample from this well, further confirming that the single high hit was anomalous and probably associated with lead in suspended particulate matter.

Lead was also detected at elevated concentrations (140 μg/liter in SW5B and 50 μg/liter in SW6B) in surface water samples collected in the wetland area west of AOC A4. Sediment levels at this sample point were not elevated (SD5B contained 18 mg/kg lead; SD6B contained 31 mg/kg lead), and it appears that the elevated surface water concentration may be an anomaly associated with sampling procedure. During the season in which the samples were taken, no surface water existed in the area and the samples were collected by digging into the sediment until water was encountered. The "surface water" from these samples contained suspended particulate matter, and the concentrations detected are consistent with the sediment concentrations at the same locations, assuming slightly less than 1% suspended particulate matter. That is, for the SD5B/SW5B pair, 18 mg/kg x 0.008 kg sediment/liter of water (0.8%) = 140 μg/liter.

This assessment is supported by data on other metals that suggests that ratios between the water and sediment concentrations are reasonably consistent. At the SD5B/SW5B location, ratios of surface water concentrations to sediment concentrations for the metals detected in both media ranged from 0.3% to 0.8%, with lead and calcium both at 0.8%. For the SD6B/SW6B location, ratios ranged from 0.03% to 0.7%, with most (5 of 7) values around 0.1 to 0.2%. The ratio for lead, 0.16%, was in the middle of the reported ratios. Considering the sampling approach used, the presence of suspended particulate matter in the water samples is to be expected. If the suspended particulate matter were the source of metals in the water sample, the ratios of the metal concentrations in the water to the metals concentrations in the sediment should be fairly consistent. Given expected sampling and analytical variability, and discounting the two outliers reported for sample pair SD6B/SW6B, the reported ratios are consistent and clearly suggest that suspended particulate matter, containing metals at background levels, is the source of the elevated lead reported in the surface water samples in the marsh located to the west of AOC A4. Lead, as a component of lead arsenate, may well have been used as a pesticide on the apple orchards that existed to the north of (upgradient from) the marsh prior to the Army purchasing the Annex. However, results of soil sampling for AOC A4 and SA A3/P5 do not indicate that elevated lead concentrations are widespread, as would be expected with pesticide use. Consequently, it appears most likely that the lead concentrations reported in AOC A4 surface water samples are an anomaly associated with the sampling procedures used and not an indication of a possible source of contamination.

DEHP was not detected in ground water during the Phase II sampling effort. This chemical is a common laboratory and field blank contaminant and its presence in one of seven previous ground water samples may be a result of laboratory contamination rather than an indication of its presence on site. Therefore, it will not pose a risk to ecosystems at the site.

Arsenic was detected in a subsurface soil sample and in a sediment sample during Phase I at levels that were elevated compared with site-specific background but that were considered to be a possible indication of variability in the geology of the area. High naturally occurring arsenic levels occur in northeastern Massachusetts and the Annex may be influenced by these high natural arsenic deposits. In particular, arsenic concentrations at the location of the subsurface sample were not elevated in shallower samples and the concentrations of several other metals were also elevated in this sample. It is also possible that the elevated arsenic in the sediment sample was the result of past agricultural use of arsenical pesticides in the orchards located north (upstream) from the area. A single elevated arsenic concentration (40 mg/kg; A4TPG at 3 feet bgs) was reported in soils in the Phase II sampling, a finding that is consistent with the Phase I results and also may be indicative of naturally elevated arsenic levels in this area, as arsenic levels were not elevated in shallower samples.

Beryllium was detected in 6 of 12 test pit samples, with all detected concentrations ranging from 0.4 mg/kg to 0.64 mg/kg. These levels are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.4 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values may be indicative of background beryllium concentrations. Beryllium was also detected in two of nine sediment samples at 6.6 and 1.5 mg/kg. These values are higher than other beryllium results for the Annex as a whole.

Many metals, including aluminum, arsenic, barium, beryllium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, selenium, vanadium, and zinc, were detected in sediments at concentrations exceeding the background sediment levels or ESAT criteria (Table 3-6). Several of the

metals, specifically aluminum, barium, calcium, and manganese, exceeded these screening criteria in most samples. However, a number of factors suggest that these exceedences are not a cause for concern.

A review of metal concentrations in sediments in the Assabet River indicates that the same pattern of frequent exceedences of screening criteria occurs in the river. Moreover, a comparison of metals concentrations in AOC A4 with concentrations in the river indicates that the river concentrations are generally slightly higher than the AOC A4 levels. As discussed in Section 6.0, the river concentrations do not appear to be site related. Consequently, the concentrations of metals detected in AOC A4 sediments, which are lower than the river concentrations of these metals, may also not be site-related. A second point is that the background sediment values used for comparison purposes were collected from natural streams which are likely to have high organic matter and low mineral levels. AOC A4 was previously a lowland terrestrial environment, and background soil concentrations may be more appropriate for comparison. A comparison of background soil concentrations with sediment concentrations in the AOC A4 marsh shows substantially fewer exceedences. Finally, a review of the distribution of chemical levels in the soil horizon does not suggest migration of chemicals from AOC A4 as a source of the metals. In general, concentrations do not decrease with depth, as would be expected if metals were being deposited from an upgradient source. For example, barium in A4SD7B was detected at 80 mg/kg at the surface, at 102 mg/kg at 1 foot bgs, and at 231 mg/kg at 2 feet bgs. These levels are all higher than site background for soils (maximum of around 50 mg/kg) but the pattern is consistent with natural levels (contact with potentially acidic marsh water is more likely to mobilize metals from surface soils than from subsurface soils) and barium concentrations in the eastern U.S. average 420 mg/kg, well above site background (Shacklette and Boerngen 1984). One exception to the lack of decrease with depth is arsenic, which, as discussed previously, may be present as a result of pre-military upstream use.

3.2.2 Summary

In summary, arsenic, beryllium, and lead appear to be the only metals that may be present in AOC A4 as a result of site-related activities. Arsenic was detected at elevated concentrations in two subsurface soil samples but only the single elevated concentration in sediments appears to possibly be related to human activity. The single elevated concentration (36 mg/kg) is only 4-fold higher than site background (i.e., contact with the hotspot would be unlikely to be acutely hazardous) and is not indicative of a widespread problem in the marsh. Further considering that the arsenic is likely to have been deposited over 50 years ago, and may consequently be less bioavailable than recently introduced arsenic (such as would be used in toxicity studies), it does not appear that arsenic is a chemical of concern in AOC A4 sediments. Beryllium was detected in three sediment samples at concentrations that were higher than any other samples (soil or sediments) detected at the Annex. The cause of these elevated concentrations is unclear. However, all three elevated levels were detected in samples collected from over 1 foot bgs and contact with sediments containing these elevated concentrations is generally unlikely. Beryllium is not widely used commercially and considering the depth of the samples, the elevated levels may represent natural levels. Consequently, beryllium is not considered to be a chemical of concern in AOC A4.

Lead was present in two hotspots in site soils. At one location, the sample was subsurface, and at the other, it was located in the cellar of the Vose Tavern. In both cases, exposure to environmental receptors is unlikely and risks will be minimal if they exist at all. Lead was also detected at an elevated concentration in two surface water samples but these elevated levels appear to be an artifact of sampling procedures and not an indication of site-related contamination. Finally, lead was also reported at elevated levels in a ground water sample but additional samples of this well confirmed that the elevated level was

anomalous, again probably related to a sampling error rather than to actual site contamination. Based on these findings, lead does not appear to be a chemical of concern in AOC A4, with the exception of the two soil hotspots. Even at the two hotspot locations, lead appears to be unlikely to pose risks to ecological receptors.

3.3 SUMMARY AND CONCLUSIONS

At AOC A4, lead, the chemical of primary concern, was present in soils at two hotspots and in surface water samples collected from the wetlands located west of the area. Contact with the two surface soil hotspots is unlikely to occur with sufficient frequency or duration to pose a risk to organisms using the site. The elevated lead levels reported for the surface water samples are considered to be an anomaly caused by sampling technique and are not considered indicative of a potential risk in the area. Arsenic was also detected at an elevated concentration in a sediment sample at AOC A4. This elevated arsenic concentration may be associated with pre-military pesticide used in the apple orchards that formerly existed north of (upgradient from) the wetland area. Because spraying of these orchards probably stopped over 50 years ago, the residual arsenic at the site is likely to be less available than when first applied. Considering this fact, and the infrequent detection of arsenic which suggests that regular contact with elevated arsenic levels will not occur, arsenic is considered unlikely to pose a substantial risk to organisms in the wetlands portion of AOC A4. No other chemicals were detected at the site at levels that were considered to pose a threat to wildlife in the area. The primary effects of man on AOC A4 appear to be the development of fields (which are becoming overgrown but currently provide habitat for species that frequent edges) and the development of the marsh located to the west of AOC A4, which provides habitat for wetlands organisms.

4.0 AOC A7

AOC A7, the Old Gravel Pit Landfill, is a 10-acre site located northeast of the USAF Radar Station along the northern boundary of the installation (Figure 1-1 of the SI/RI Addendum). The northern edge of the site overlooks the Assabet River. This area was reportedly used between the late 1950s and mid 1970s for the disposal of drums and other chemical containers. Interviews with Natick Laboratory employees who participated in chemical disposal activities in the early to mid 1970s, indicate that quart- to gallon-sized metal and glass containers of chemicals were disposed of in this area on a weekly basis. Excess chemicals and waste being temporarily stored in bunkers may also have been disposed of in this area. Unauthorized surface dumping by the general public also occurred during the 1970s until site access was restricted.

A surface dump with discarded furniture and debris is located within a wooded section at the east end of AOC A7, approximately 100 feet north of Patrol Road. This area, which has previously been referred to as SA P8, is now considered to be a part of AOC A7; not as a separate SA.

4.1 ECOSYSTEMS OF CONCERN

AOC A7 is representative of a terrestrial ecosystem, with the central portion of the site, which is essentially bare or sparsely vegetated, consistent with a field growing on poor quality soil and the edges consisting of upland forest. The site overlooks the Assabet River and an unnamed stream flows along the eastern side of the site and consequently, the potential for chemicals from the site to affect the aquatic ecosystem is also of concern.

A preliminary ecological assessment of AOC A7, consisting of a visual inspection and an analysis of the benthic macroinvertebrate community present in the unnamed stream flowing on the east side of the site was conducted during April-May 1992. USEPA Rapid Bioassessment Protocol I (RBP I; Plafkin et al., 1989) was used to analyze the stream community. RBP I involves the collection of physical habitat, rudimentary field water chemistry, and organism data to produce an integrated assessment of flowing waters. The concept of the RBP and the methodologies used are fully explained in the Facility-Wide Ecological Assessment (Appendix H to the January 1994 SI/RI Report).

Most of the central portion of the site is clear, with widely-spaced clumps of shrubs and pine seedlings. The clear area is either bare of vegetation or weakly colonized with grasses, indicative of an area where topsoil has either been stripped away or covered over by a mineral soil. Debris and refuse are scattered around the site. The borders of the site are forested, primarily with second growth pine, oak, and red maple.

In order to adequately describe conditions noted at this area, two ecological concepts must be discussed: community succession and edges. Odum (1953) describes succession as "...the orderly process of community change; it is the sequence of communities which replace one another in a given area." In upland forest communities such as found in this area, succession after a disturbance would generally follow the greatly simplified pattern of initial colonization by grasses and other sun-tolerant herbaceous plant species, which would gradually be replaced by woody shrubs, which would gradually be replaced by pine, which would gradually be replaced by hardwoods until the final, or climax, community of oak-hickory would be reached. There is no sharp definition between one successional community and the next, i.e., one community is only gradually replaced by the next. This succession is not a fast one. The time period

between the initial disturbance and the achievement of the climax community may be hundreds of years (Smith, 1986).

AOC A7 appears to be in the initial recolonization stages. This is evidenced by the grasses that are found on the area and the widely spaced pines and small shrubs. This recolonization period will probably last for many more years as the soils remaining on AOC A7 are poor in the nutrients and organic matter required for plant sustenance and propagation. However, as time progresses, succeeding generations of grasses will die off in the fall and decompose during the next season, which will rebuild the nutrient base and eventually allow further plant species to grow.

Pioneer communities of the type described above are generally characterized by fast-growing, seed propagating, soft-stemmed annual plants. Animals such as seed- and insect-eating birds, rodents, and grazers such as deer would be considered typical components of this community (However, deer may be kept out of AOC A7 by the fence surrounding the site if this fence remains intact). It would also be reasonable to expect the presence of predators such as raptors. During the visual inspection of this area, numerous rodent runs were noted throughout the clear area, especially in the immediate vicinity of the debris piles. Deer droppings and browse marks were also noted. The association of the rodent runs with the debris piles is not unusual as this debris offers the only shelter from predators in what is an otherwise open area. No predators or signs of predators were observed during the inspection; however, two species of hawk (red-tailed and red-shouldered) and a great-horned owl were observed elsewhere on the Annex and nothing was noted in AOC A7 that would preclude their exploitation of this area. It may be that they do not regularly utilize this relatively small area because other larger fields, such as the Taylor Drop Zone, are close at hand.

The sharp border between the clear center of AOC A7 and the surrounding forest is termed an edge. An edge is the place where two or more different vegetational communities meet (Smith, 1986). In many instances, this transition area would be expected to have the highest species diversity and abundance (Odum, 1953). The most numerous animals noted during the visual inspection of the area were birds, including cardinals, a downy woodpecker, starlings, sparrows, robins, and several other species. The large number of bird species in the edge community is to be expected, according to Odum (1953).

The portion of the stream that runs along the eastern side of the site begins on the north side of White Pond Road, near staff gage SG-8. From SG-8, the stream flows to a pool located at the Patrol Road. Adjacent to AOC A7, the stream elevation drops rapidly to a pool-culvert and the Assabet River. The stream channel between these pools is cobble-strewn for the most part, providing a swift, well-aerated riffle and, in general, excellent habitat for stream benthic macroinvertebrate species. No fish were noted in the stream.

4.1.1 Rapid Bioassessment

An examination of the benthic macroinvertebrate community found in the unnamed stream running along the eastern side of AOC A7 was conducted using Rapid Bioassessment Protocol (RBP) I (Plafkin et al., 1989), modified by enumerating at least 100 organisms rather than performing the qualitative abundance assessment that is described for this protocol (the RBP is included as an Appendix to the January 1994 Ecological Risk Assessment). Three locations were sampled. Sample RBA-6 was collected from SA P9, on the effluent end of the pool at the top of the hill near the Patrol Road. Sample RBA-8 was located on the influent end of the pool at the bottom of the hill near the point where the stream flows into

the Assabet River. Sample RBA-7 was located midway between RBA-6 and RBA-8, in what visually appeared to be the swiftest part of the stream. The results of the bioassessment are presented in the Basewide Ecological Risk Assessment (Appendix H to the Phase 1 SI/RI). These results are summarized below.

The aquatic habitat conditions measured at RBA-6, RBA-7, and RBA-8 are generally typical of what could be expected in the absence of confounding factors such as point or nonpoint source pollution or contamination. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa were found at all three sample points. Salamanders (genera unknown) were also found at all three sample points. Both of these groups are generally intolerant of pollution or contamination.

The only impairment noted at any of these stations was due to habitat limitations (i.e., natural stressors). The substrate at RBA-6 and RBA-8 was primarily decaying Sphagnum and leaf litter. Since both stations are associated with pools, it would be expected that microbial action would play a large part in the decay of these materials. Typically, this microbial action would have the effect of releasing chemicals such as carbon dioxide into the water, and reducing dissolved oxygen levels. As a result, organisms such as caddis and stone flies would not thrive. There is no indication that pollution or contamination contributed to conditions at these locations.

The greatest species diversity (an indication of the health of the system) of the three locations was found in the riffle community at RBA-7. About 40 percent of the organisms collected at this location were caddis flies, one of the taxa the USEPA lists as generally pollution-intolerant. Conditions at this station are considered typical of conditions expected from an intermittent stream in early-spring flood.

4.2 CHEMICALS OF POTENTIAL CONCERN

A number of chemicals were detected in AOC A7 during both the Phase I and Phase II sampling events. Concentrations of these chemicals were compared with background levels of the chemicals and with available screening-level ecological toxicity criteria to assess whether or not the chemicals were of potential concern for the site. Only chemicals of potential ecological concern were carried through the ERA.

4.2.1 Chemicals Detected at AOC A7

Figure 3-1 of the SI/RI Addendum is a map of AOC A7 showing the locations for all investigative work performed and samples collected. Tables 4-1 through 4-8 of this appendix, and Tables D-10 through D-15 of Appendix D in the SI/RI Addendum, present analytical results from the OHM sampling. Contaminants detected in AOC A7 during the Phase I sampling effort reported in the January 1994 SI/RI report include:

- Soil samples contained numerous organic and inorganic contaminants including heavy metals, organochlorine pesticides, herbicides, an explosive, PAHs, other semivolatile organic compounds, and chlorinated and non-chlorinated solvents
- Ground water sampling detected organochlorine pesticides, chlorinated solvents, and acetone
- Surface water samples contained elevated levels of iron

- Sediment samples contained metals, an insect repellant (probably introduced during sample collection), a nitrosamine, and two solvents.

Results of the Phase II investigation conducted by OHM in late 1993 at AOC A7 are described in detail in the nature and extent section of the SI/RI Addendum. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling, include lead (test pits), arsenic (sediments), beryllium (test pits and well borings), ppDDT (test pits), chloroform (ground water), 1,1,2,2-tetrachloroethane (PCA; ground water), tetrachloroethylene (PCE; ground water), and lindane (ground water).

Lead (3900 mg/kg in TPR @ 2 ft;), ∑ppDDT (830 mg/kg in TPQ @ 5 ft and 360 mg/kg in TPQ @ 4 ft), and chlordane (30 mg/kg for alpha and gamma combined in TPS @ 0 ft) were found at somewhat higher maximum concentrations in Phase II test pit samples than in Phase I soil sampling. Arsenic was also detected at a higher concentration in sediments (35 mg/kg). The lead and chlordane levels are approximately an order of magnitude higher than the maximum Phase I results. ppDDT was present at a concentration only slightly higher than the Phase I result. The beryllium concentrations are slightly above site-specific background levels calculated in the baseline risk assessment. However, natural levels of metals can vary substantially depending on local geology and the slight elevations in AOC A7 may be examples of natural variability in beryllium levels in the area of the Annex. Beryllium is present throughout the Annex at concentrations slightly above expected background but because there is no apparent source and the concentrations appear to be random, will not be considered further in this assessment. Further discussion on this issue is included in the Addendum to the Human Health Risk Assessment and in the Addendum to the SI/RI.

Concentrations of arsenic were highest in the upgradient sediment sample (35 mg/kg in the duplicate at A7SD3) but concentrations in the two downgradient sediment samples (14 mg/kg in A7SD1 and 12 mg/kg in A7SD2) were slightly higher than most other site samples. However, the distribution of the sample concentrations suggests a source other than AOC A7. Several areas of the Annex, including AOC A9, which may drain to the stream from the east, had previously been used for apple orchards and arsenic was a common component of pesticides used in these orchards.

Levels of several chemicals were higher in ground water in the Phase II sampling event than in the Phase I sampling. These higher concentrations are apparently the result of chemicals leaching from the laboratory waste dump located in the western part of the site (Test Trenches A and B define the lateral extent of this dump). Specifically, maximum concentrations of the chlorinated solvents chloroform (300 μg/liter in A7-GW8), PCA (200 μg/liter in A7-51), PCE (130 μg/liter in A7-51) and of the organochlorine pesticide lindane (maximum concentration of 3.6 μg/liter in A7-51) were reported in wells adjacent to (A7-GW8) or directly downgradient from (A7-51) this dumpsite.

4.2.2 Key Chemicals

Concentrations of chemicals detected in environmental media were compared with site-specific background levels of these chemicals, with environmental screening criteria provided by the USEPA Region I (ESAT values) and with Ambient Water Quality Criteria (AWQC) for chemicals in water (Tables 4-1 to 4-8). On the presumption that chemicals in ground water could migrate to the Assabet River over time, for this initial screen, ground water concentrations of chemicals were compared with water quality criteria designed to protect aquatic organisms. Based on this comparison, the chemicals listed

below were present in environmental media at AOC A7 at levels exceeding screening criteria. The criteria used for comparison are noted in parentheses after the name of the chemical.

Soils

∑ppDDT (0.5 mg/kg; ESAT)
Test Pits and Borings

TPK @ 2 ft - 7 mg/kg	B4 @ 4 ft - 3 mg/kg
TPQ @ 0 ft -21 mg/kg	SB8A @ 8 ft - 7 mg/kg
TPQ @ 4 ft - 360 mg/kg	SB8B @ 4 ft - 115 mg/kg
TPQ @ 5 ft - 830 mg/kg	B18 @ 4 ft - 1 mg/kg
TPS @ 0 ft - 1 mg/kg	B19 @ 4 ft - 5 mg/kg

Surface Soil Samples

CD1 - 0.6 mg/kg	SO9 - 8 mg/kg
CD2 - 470 mg/kg	

Dieldrin (No value listed but dieldrin is more toxic than ppDDT)
Test Pit TPR @ 0 ft - 5 mg/kg and @ 2 ft - 1.5 mg/kg

Polychlorinated Biphenyls (PCBs) (1 mg/kg; ESAT)
Test Pit TPR @ 0 ft - 3 mg/kg and @ 2 ft - 2.4 mg/kg
Surface Soil CD1 - 2 mg/kg

Chlordane (0.5 mg/kg; ESAT)
Test Pit TPS @ 0 ft - 30 mg/kg and @ 2 ft - 3.5 mg/kg

Endrin (0.5 mg/kg; ESAT)
Test Pit TPS @ 0 ft - 4 mg/kg and @ 2 ft - 0.5 mg/kg

PAHs (1 mg/kg for B[a]A and B[a]P; 5 mg/kg for phenanthrene)
Surface Soil SO6: benzo[a]anthracene - 3 mg/kg
benzo[a]pyrene - 2 mg/kg
phenanthrene - 5 mg/kg

Lead (200 mg/kg; ESAT)
Test Pit TPR @ 2 ft - 3900 mg/kg
Surface Soil CD1 - 400 mg/kg

Sediment

Arsenic (6 mg/kg; ESAT)
A7SD3 - 28/35 mg/kg (sample and duplicate)
A7SD1 - 14 mg/kg
A7SD2 - 12 mg/kg

Barium (20 mg/kg; ESAT)
A7SD3 - 66/68 mg/kg (sample and duplicate)
A7SD1 - 21 mg/kg
A7SD2 - 27 mg/kg

Copper (16 mg/kg; ESAT)
A7SD2 - 17 mg/kg

Nickel (16 mg/kg; ESAT)
A7SD2 - 26 mg/kg

Ground Water

Lindane (0.08 µg/liter: chronic AWQC)
A7GW46 - 3.1 µg/liter
A7GW8 - 0.5 µg/liter
A7GW51 - 3.6 µg/liter
A7GW52 - 0.08 µg/liter

∑ppDDT (0.001 µg/liter: chronic AWQC for ppDDT)
A7GW8 - 0.2 µg/liter (ppDDD; higher level reported in November 1992)

Heptachlor Epoxide (0.0038 µg/liter: chronic AWQC)
A7GW8 - 0.013 µg/liter (level reported in November 1992)

Chlorinated Volatile Organic Compounds
A7GW51 contained several chlorinated VOCs which were present at concentrations below any available criteria but are included as chemicals of potential concern because of their potential effect on the behavior of other constituents. chloroform (120 µg/liter), tetrachloroethylene (130 µg/liter), 1,1,2,2-tetrachloroethane (200 µg/liter), and trichloroethylene (50 µg/liter).

4.2.3 Summary

Chemicals detected in AOC A7 that are of potential concern for ecological receptors can be separated into three categories:

- Chemicals that are present in ground water and that may pose a risk to aquatic organisms in the Assabet River
- Organochlorine pesticides, metals, and PAHs that are present in soils and that may pose a risk to terrestrial wildlife. These chemicals are relatively immobile in the environment, are quite toxic, and in the case of the organochlorine pesticides, can be bioconcentrated in the environment.
- Metals present at elevated concentrations in sediments in the stream located to the east of AOC A7. These chemicals may pose a risk to benthic organisms in the stream.

Chemicals in ground water are associated with a plume that extends from the laboratory waste disposal area in the western portion of the site, northward toward, and possibly to, the river. Chemicals in soils exist at several hotspots, with most concentrated in the central portion of the site.

4.3 ECOLOGICAL TOXICITY

The potential for a chemical to adversely affect wildlife is a function of the intrinsic toxicity of the chemical to the particular target organism. Different chemicals can have vastly different toxic potencies, and different species may be affected quite differently by the same dose of a particular chemical. In addition, a chemical can indirectly affect an organism if it affects that organism's food supply or another important component of the ecosystem in a significant way. Attempting to address the potential impacts of site chemicals on all of the potential interactions that can occur within an ecosystem is a complex and difficult task. Consequently, for most ERAs, simple effects on organisms are evaluated.

As part of the Clean Water Act, levels of chemicals in water were determined that were considered unlikely to have adverse effects on aquatic organisms. These AWQC can be used to assess the potential for a chemical detected in a water body to adversely affect organisms. If concentrations in water exceed the AWQC, there is a possibility that the chemical can adversely affect aquatic organisms.

Concentrations of chemicals in soils that are of concern to terrestrial life have not been established, although USEPA is working on developing such ecological screening criteria (USEPA, 1994). In order to evaluate the potential for chemicals to affect terrestrial animals, "safe" dietary levels are established and used for comparison with chemical concentrations estimated to occur in food from the target site. Dietary levels of the chemical shown to have no adverse effect on a particular organism are determined using studies in the target species or a related organism. This dietary benchmark concentration is then compared with estimates of the site-specific concentration of the chemical in the diet. If the expected concentration of the chemical in the diet exceeds the benchmark dietary concentration, intake of the chemical may pose a risk to the organism. Conducting species-specific toxicity studies to establish benchmark dietary concentrations for the wide range of organisms that may be present at a site is not possible or even desirable. Consequently, such benchmark concentrations are typically developed by combining data on the effects of the particular chemical on laboratory species (or other previously studied species), with information and assumptions about differences between the studied species and the target species. A detailed collection of benchmark dietary concentrations for a large number of chemicals and animal species has been developed by Oak Ridge National Laboratory (Opresko et al., 1994) and will be used to evaluate the potential effects of chemicals on wildlife at the Annex.

Information on the toxicology of chemicals of potential concern is provided in this section. General information on the toxicity of the compound or element is described. In addition, toxicity criteria, specifically allowable dietary levels of these chemicals for several species found on the Annex, is provided.

4.3.1 Organochlorine Pesticides

There have been numerous studies on the effects of chlorinated pesticides (and of the related PCBs) on the aquatic and terrestrial environments. Serious pesticide contamination began occurring shortly after the end of World War II, when organic pesticides were first marketed. ppDDT, one of the first chlorinated pesticides, degrades slowly in the environment, is not very soluble in water, and is toxic to several groups of organisms, including birds and fish. Premda and Anderson (1963) exposed salmon to a 1 ppm solution

of radio-labeled ppDDT and found that a six-hour exposure to this concentration killed the fish, and further noted that the fish had accumulated approximately 4 ppm ppDDT. Several other researchers (Ide, 1957; Warner and Fenderson, 1962; Brown, 1978) have noted that the exposure of stream benthic macroinvertebrate populations to ppDDT usually caused reductions in insect biomass, a loss of diversity, and heavy mortalities in the microcrustacean populations. Similar effects have been noted on wading birds (Ohlendorf et al., 1981) and adverse effects of these compounds on terrestrial life have also been reported (Menzie et al., 1992).

In general, organochlorine pesticide concentrations increase in animals in higher trophic levels but this is not always the case and in addition, the magnitude of any increase can be unpredictable (Moriarty and Walker 1987; Nisbet 1975; Menzie et al., 1992). Many researchers have noted that environmental factors other than concentration play an important role in the bioaccumulation and biomagnification of ppDDT and its residues. Factors such as food supply, the availability of alternative food sources, an animal's range, and individual predatory strategies can all influence the amount of chemical exposure that occurs. However, the fact that biomagnification can occur and has had serious impacts on such species as the bald eagle, osprey, and peregrine falcon, clearly indicates that organochlorine pesticides are highly toxic to wildlife.

Concentrations of $\sum$ppDDT that were determined to be toxicological benchmarks for diet are: 3.8 mg/kg for the short-tailed shrew, 14 mg/kg for the meadow vole, 3.4 mg/kg for the red fox, and 5 mg/kg for the whitetail deer (Opresko et al., 1994). Toxicological benchmarks for birds were 0.0008 mg/kg for the robin and 0.0005 mg/kg for the red-tailed hawk. The levels for birds are inconsistent with the results for mammals, with the results from other studies on ppDDT and residues, and with the results for other similar organochlorine pesticides (for example, see the results for chlordane listed below). The toxicity criteria were based on results from a study that showed continued decreased reproductive success in the brown pelican even as ppDDT levels in its food supply decreased from 4 ppm to 0.15 ppm. Other results listed in Opresko et al. (1994) indicate dietary levels as high as 50 ppm as No Observed Effect Levels (NOELs), with most NOELs around 5 ppm. Several factors in the brown pelican study raise concerns, specifically the food consumption to body weight ratio seems high for a large bird and the effect of residual ppDDT levels (i.e., ppDDT stored in the body and released over time) on reproductive success does not appear to be addressed. Consequently, both the benchmark of less than 0.001 mg/kg and a value of 5 mg/kg, the lowest NOEL reported in other studies, will be used in this analysis.

Concentrations of chlordane that were determined to be toxicological benchmarks for diet are: 9.6 mg/kg for the short-tailed shrew, 36 mg/kg for the meadow vole, 8.8 mg/kg for the red fox, and 12 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 1.7 mg/kg for the robin and 1 mg/kg for the red-tailed hawk.

Opresko et al. (1994) established toxicological benchmarks for dieldrin in the diet of: 0.09 mg/kg for the short-tailed shrew, 0.35 mg/kg for the meadow vole, 0.09 mg/kg for the red fox, and 0.12 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 0.12 mg/kg for the robin and 0.07 mg/kg for the red-tailed hawk.

Concentrations of endrin that were determined to be toxicological benchmarks for diet are: 0.19 mg/kg for the short-tailed shrew, 0.71 mg/kg for the meadow vole, 0.18 mg/kg for the red fox, and 0.25 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 0.61 mg/kg for the robin and 0.37 mg/kg for the red-tailed hawk.

PCB concentrations (Arochlor 1254) that were established as toxicological benchmarks for diet are: 0.25 mg/kg for the short-tailed shrew, 0.92 mg/kg for the meadow vole, 0.83 mg/kg for the red fox, and 0.32 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 0.35 mg/kg for the robin and 0.21 mg/kg for the red-tailed hawk.

Lindane is slightly more water soluble than other organochlorine pesticides found at the Annex and at AOC A7, is of concern as a contaminant in ground water, not in soils. The AWQC for lindane is 0.08 μg/liter to protect against chronic effects and 2 μg/liter to protect against effects that might be associated with short term exposure.

4.3.2 Lead

There have been several studies on the effects of lead in the environment. Morgan and Morgan (1988a and b), studied the interactions that occurred between soil pH, calcium concentrations, and lead concentrations in the earthworms Lumbricus rubellus and Dendrodrilus rubidus and noted that an increase in soil calcium and pH inhibited the accumulation of lead in tissues, and that calcium played a more significant role in this than pH. Jensen et al. (1986) studied the relationship between phosphorus nutrition and the uptake of cadmium, copper, lead, and zinc by the algae Anabaena variabilis and noted that there was a reduction in lead uptake by phosphorus-starved cells. They also noted that phosphorus seemed to play an important role in metal uptake in general.

Concentrations of lead that were determined to be toxicological benchmarks for diet are: 38 mg/kg for the short-tailed shrew, 140 mg/kg for the meadow vole, 34 mg/kg for the red fox, and 49 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 4 mg/kg for the robin and 2 mg/kg for the red-tailed hawk.

4.3.3 Polycyclic Aromatic Hydrocarbons

As noted in Section 2.4, PAHs are products of incomplete combustion and as such are found widely in the environment. Most organisms can rapidly metabolize these compounds (Molluscs are a notable exception, although they are not an issue at this site). The PAHs constitute a large chemical class with different compounds having quite differing toxic potency. One of the more toxic compounds, at least for humans and laboratory animals, is benzo[a]pyrene. This compound will be used as a surrogate for the PAHs, as it was detected at the site, is quite toxic, and a toxicological benchmark value is available for it from Opresko et al. (1994).

Concentrations of benzo[a]pyrene that were determined to be toxicological benchmarks for diet are: 2 mg/kg for the short-tailed shrew, 8 mg/kg for the meadow vole, 2 mg/kg for the red fox, and 2.7 mg/kg for the whitetail deer. Toxicological benchmarks for birds were not available.

4.3.4 Volatile Organic Compounds

In AOC A7, chlorinated VOCs were detected in the ground water and are of concern as a potential threat to ground water not to soils. Only limited information is available on the aquatic toxicity of these compounds but they are not considered to be particularly toxic. Acute toxicity was generally observed at levels above 5 to 100 mg/liter depending on the compound and chronic toxicity generally occurs at levels above 0.8 to 20 mg/liter. In general, the more highly chlorinated compounds were more toxic than lower

chlorinated compounds. The toxicity of most compounds to aquatic organisms will depend on species-specific susceptibility, water hardness, other stressing factors (heat, cold, diet, salinity, etc), and the type of toxicity test used. Specific numeric criteria were not listed for the compounds detected at the site but the lowest concentrations causing adverse effects were listed by USEPA (1980), with USEPA noting that effects could occur at lower concentrations in more sensitive species. For chloroform, an acute concentration of 29,000 μg/liter and a chronic concentration of 1240 μg/liter were noted as lowest effect levels. An acute concentration of 5,300 μg/liter and a chronic concentration of 840 μg/liter were noted as lowest effect levels for tetrachloroethylene. For 1,1,2,2-tetrachloroethylene, an acute concentration of 9,300 μg/liter and a chronic concentration of 2,400 μg/liter were noted as lowest effect levels.

4.4 EXPOSURE ASSESSMENT

In the exposure assessment, concentrations of chemicals that could be encountered in AOC A7 are identified, potential exposure pathways are determined, and an estimate of exposure (dietary intake levels for terrestrial wildlife; water concentrations for aquatic life) are presented.

4.4.1 Aquatic Ecosystem

As noted previously, concentrations of chemicals in surface water in the Assabet at the point of release into the river are not available. Therefore, for this screening-level evaluation, levels of chemicals detected in ground water samples taken from wells close to the river were assumed to represent concentrations that could occur in pore water in the benthos at the point of release into the river. Ground water released into the river is expected to be fairly rapidly mixed with water from the river and the potential impact of site chemicals on downstream aquatic organisms is substantially decreased by this dilution. Concentrations estimated to occur in the river are compared with target concentrations to evaluate the potential for risks to aquatic organisms.

4.4.1.1 Exposure Point Concentrations

Chemicals that are present in ground water include lindane, ∑ppDDT, heptachlor epoxide, and several chlorinated VOCs. Of these, ∑ppDDT and heptachlor epoxide were only detected in unfiltered samples from well OHM-A7-8, immediately adjacent to the laboratory waste disposal area. These chemicals are highly immobile in soils and are unlikely to migrate to the Assabet. Consequently, although their concentrations in well OHM-A7-8 exceeded chronic AWQC, they are not considered to pose a risk for exposure to aquatic organisms in the Assabet River.

Lindane was present in several wells close to the laboratory waste disposal area, was present in the TCLP (leachability) sample collected from this area and is also present in the downgradient wells OHM-A7-51 and OHM-A7-52, both of which are located on the site border close to the river. The highest lindane concentration in ground water, 3.6 μg/liter was present in OHM-A7-51 and this concentration will be used as an exposure point concentration to evaluate potential exposure of benthic organisms. OHM-A7-51 also contained several other chemicals, namely the chlorinated VOCs chloroform (120 μg/liter), tetrachloroethylene (130 μg/liter), 1,1,2,2-tetrachloroethane (200 μg/liter), and trichloroethylene (50 μg/liter). The presence of these compounds in OHM-A7-51 will also be considered in the risk assessment.

In assessing the potential impact of any chemicals released from AOC A7 on organisms present in the Assabet River, the effect of dilution by the river water must be considered. As part of the hydrogeological evaluation of the area, the volume of water released from the site was estimated for both the entire A7 area and for the section of the site affected by the laboratory waste dump (the section of the site near OHM-A7-51). The volume of water estimated to be released from the entire area and from the section of AOC A7 near OHM-A7-51 are 10,000 gallons per day (gpd) and 2,500 gpd, respectively. Flow in the river is measured at a gaging station in Maynard. Median flow is 81,000,000 gpd and 90% of the time the flow exceeds 15,500,000 gpd. Based on these values, the lab waste ground water plume emanating from AOC A7 is contributing only 0.02% of the flow of the river under low flow conditions and even less (approximately 0.003%) under median flow conditions.

4.4.1.2 Exposure Scenarios and Pathways

If water from the site is carrying lindane into the Assabet River, it is possible that adverse effects might be occurring to benthic organisms living at the point of release into the river. The huge dilution provided by the river water should serve to limit the extent of any effect elsewhere in the river (i.e., on the lotic community). Birds and mammals feeding on aquatic organisms should also not be affected because of the anticipated very large dilution.

4.4.1.3 Exposure Estimates

The only chemicals present in ground water at concentrations exceeding surface water criteria designed to protect aquatic life were lindane, ∑ppDDT, and heptachlor epoxide. As noted above, ∑ppDDT and heptachlor epoxide were only detected in ground water at a single location, close to their likely disposal point, and further considering the low migration potential for these compounds, they are unlikely to enter the river and pose a risk to aquatic organisms. Lindane is present in a well close to the river (OHM-A7-51) at a concentration of 3.6 μg/liter and the well just to the west contained lindane at a concentration of 0.08 μg/liter. If water from the vicinity of these wells is carrying lindane into the Assabet River, it is possible that exposure to these levels might be occurring to benthic organisms living at the point of release into the river. The huge dilution provided by the river water should serve to limit the extent of any effect elsewhere in the river. Even under low flow (worst case conditions; assumes normal flow from the site and low flow from the river), estimated lindane concentrations would only be 0.0007 μg/liter (3.6 μg/liter x 0.02 %). In addition to lindane, benthic organisms at the point of release into the river might also be exposed to volatile organics. Concentration of these chemicals detected in the ground water at AOC A7 (OHM-A7-51) are: 120 μg/liter for chloroform, 130 μg/liter for tetrachloroethylene and 200 μg/liter for 1,1,2,2-tetrachloroethane.

4.4.2 Terrestrial Ecosystem

Concentrations of chemicals detected at hotspots in AOC A7 were used to estimate the potential for exposure in this screening-level evaluation. These concentrations were used to estimate chemical concentrations in the diet of terrestrial wildlife that might use the site and these estimated concentrations were compared with benchmark concentrations (dietary concentrations assumed to cause no adverse effect) to evaluate potential risks to terrestrial wildlife.

4.4.2.1 Exposure Point Concentration

Organochlorine pesticides, metals, and PAHs were detected at several hotspots in AOC A7. Maximum concentrations of these chemicals are listed below. For ∑ppDDT and lead, the maximum concentration was encountered in the subsurface, and contact by wildlife with this material is considered unlikely. For these chemicals, the highest surface soil concentration is also listed.

Organochlorine Pesticides and PCBs
∑ppDDT
Test Pits TPQ @ 5 ft - 830 mg/kg
Surf.Soils CD1 @ 0 ft - 470 mg/kg
Dieldrin: TPR @ 0 ft - 5 mg/kg
PCBs: TPR @ 0 ft - 3 mg/kg
Chlordane: TPS @ 0 ft - 30 mg/kg
Endrin: TPS @ 0 ft - 4 mg/kg

Lead
Test Pit TPR @ 2 ft - 3900 mg/kg
Surface Soil CD1 - 400 mg/kg

PAHs: SO6 @ 0 ft
Benzo[a]anthracene: 3 mg/kg
Benzo[a]pyrene: 2 mg/kg
Phenanthrene: 5 mg/kg

The pesticides, heavy metals, and PAHs detected at the site were only detected infrequently and at widely scattered locations (i.e., at hotspots). Consequently, frequent contact with these chemicals by most terrestrial organisms is probably unlikely. Small mammals with very limited ranges might contact a hotspot area with sufficient frequency to be exposed to site chemicals. However, the pesticides are of particular concern as a result of their potential to bioconcentrate in higher trophic levels and it is unlikely that large predators would be consuming sufficient prey that had contacted hotspots for biomagnification to be of concern. In addition, the chemicals have been on site for a considerable length of time and may well be less bioavailable than when first placed on site. Even relatively immobile compounds such as the organochlorine pesticides will migrate from the immediate soil surface (through volatilization and leaching) and the residual will become more tightly bound by soil particles.

4.4.2.2 Exposure Scenarios and Pathways

Animals that come in direct contact with areas (hotspots) containing elevated levels of chemicals may be exposed to these chemicals via direct ingestion of soils or via consumption of food that has taken up the chemicals from the soil. Ingestion of chemicals in any water sources used for drinking water could also occur but is unlikely to be a significant source of exposure considering the length of time that the chemicals have been present at the site and the results of surface water sampling. Inhalation of chemicals in dust and direct contact and dermal absorption of chemicals are other possible routes of exposure but these routes are considered likely to be less significant than direct intake via ingestion and are not considered further in this assessment.

4.4.2.3 Exposure Estimates

As noted above, concentrations of several organochlorine pesticides, PAHs and metals are elevated on site at several hotspots. As a screening-level evaluation of the potential for adverse effects to be associated with exposure, the potential ingestion exposure to chemicals from the site can be estimated. For terrestrial organisms, and in particular, at AOC A7 where high levels of chemicals have not been detected in nearby surface water, dietary intake is of primary concern.

Animals that have a small range and could use hotspot areas on a regular basis include the meadow vole, shrew, and song birds (robins). Larger predatory animals and birds such as foxes or hawks have large ranges and the possible contribution of animals from hotspots to the diet of these predators is likely to be very small. Consequently, only small animals and birds are evaluated in this screening level assessment. Home ranges for the target species are 0.1 hectare (approximately 10,000 sq ft) for shrews and robins and approximately 0.05 hectare (5,000 sq ft) for voles. Hotspot areas are a maximum of approximately 1,000 sq ft in size and consequently, robins and shrews will be assumed to take one tenth and voles will be assumed to take one fifth of their diet from the hotspot. Voles will be assumed to consume plant matter almost exclusively, while shrews and robins will be assumed to ingest a diet of insects and earthworms (earthworms may not actually be present on much of AOC A7 as a result of the poor quality of the soil).

For the chemicals of concern in site soils, uptake by plants is limited. Probably less than 1% of these materials will be taken up by plants and for this assessment, plants will be assumed to contain 1% of the soil concentrations of these materials. Menzie et al. (1992) notes that the ratio of the body concentration for insects and earthworms to soil concentration (i.e., the bioconcentration factor or BCF) is somewhat variable for organochlorine pesticides, ranging from <0.1 - 10 and selected a BCF of 0.25 for use in their study at the Baird McGuire Superfund site in Holbrook, MA. For this assessment, we will also use a BCF of 0.25, based on the assumption that the poor soils should limit the availability of earthworms, which have greater contact with soils than insects. No information was found on the storage of PAHs and lead but these compounds are generally not stored in the body to the same degree as the chlorinated compounds. Therefore a BCF of 0.1, approximately half of the chlorinated pesticide value will be used.

Because animals also consume a certain amount of soil inadvertently while feeding and while grooming, soil ingestion can also be factored in as a portion of the diet. As noted by Beyer (1994; as cited in Opresko et al., 1994), soil ingestion by meadow voles is generally approximately 2% of their diet. Higher soil intake might be expected in animals that consume insects or earthworms as a regular part of the diet. Beyer (as cited in USEPA, 1993) estimated that woodcock ingest 10% of their diet as soil. This value seems quite high and a level midway between the vole and the woodcock values or 5% will be used in this assessment for shrews and robins. Using these values and assumptions, chemical concentrations in the diet of voles and of shrews and robins can be calculated for AOC A7 using the following equations:

$$\text{Dietary Conc.}_{\text{voles}} = ((\text{soil conc} \times 0.02) + (\text{plant conc} \times 0.98)) \times 1/5$$

where:

Dietary conc	= concentration of the target chemical in the diet of the vole (mg/kg)
soil conc	= concentration of the chemical in soil (mg/kg)
0.02	= assumption that 2% of diet is soil

plant conc	= concentration of the chemical in plants used as food; concentration based on assumption of 1% uptake by plants
0.98	= assumption that 98% of diet is plants
1/5	= assumption that a hotspot constitutes 20% of a vole's range

$$\text{Dietary Conc.}_{\text{shrew/robin}} = ((\text{soil conc} \times 0.05) + (\text{invert conc} \times 0.95)) \times 1/10$$

where:

Dietary conc	= concentration of the target chemical in the diet of the shrew or robin (mg/kg)
soil conc	= concentration of the chemical in soil (mg/kg)
0.05	= assumption that 5% of diet is soil
plant conc	= concentration of the chemical in invertebrates (insects/worms) used as food; concentration based on assumption of invert:soil BCF of 0.25 for PCBs/Pesticides and 0.1 for metals/PAHs
0.95	= assumption that 95% of diet is invertebrates
1/10	= assumption that a hotspot constitutes 10% of a small predator's range

Dietary Concentrations of Chemicals for Voles

Chemical	Soil Conc. mg/kg	Plant Conc. mg/kg	Diet Conc. mg/kg
∑ppDDT	470	5	2.9
Chlordane	30	0.3	0.18
Dieldrin	5	0.05	0.03
Endrin	4	0.04	0.02
PCBs	3	0.03	0.02
Lead	400	4	2.4
PAHs	10	0.1	0.06

Dietary Concentration of Chemicals for Shrews and Robins

Chemical	Soil Conc. mg/kg	Insect/worm Conc. mg/kg	Diet Conc. mg/kg
∑ppDDT	470	120	14
Chlordane	30	7.5	0.9
Dieldrin	5	1.3	0.15
Endrin	4	1	0.12
PCBs	3	0.75	0.09
Lead	400	100	11.5
PAHs	10	2.5	0.3

Hotspots are limited in number and in extent, it is unlikely that most wildlife would come in contact with a specific location with sufficient frequency to be adversely affected. In addition, the bioavailability of site chemicals is likely to have decreased with time.

4.5 RISK CHARACTERIZATION

In this section, estimated exposure levels are compared with toxicity criteria to evaluate whether or not a chemical has the potential to pose risks to wildlife at the site. For aquatic wildlife, concentrations estimated to be present in water are compared with appropriate water quality criteria. For terrestrial life, estimated dietary concentrations of chemicals are compared with benchmark values developed by Oak Ridge National Laboratory (Opresko et al., 1994). A discussion of qualitative factors influencing possible risks in the environment is also included in order to define the uncertainties in the assessment.

4.5.1 Aquatic Ecosystem

The only chemicals present in ground water at concentrations exceeding surface water criteria designed to protect aquatic life were lindane, ∑ppDDT, and heptachlor epoxide. As noted above, ∑ppDDT and heptachlor epoxide were only detected in ground water at a single location, close to their likely disposal point, and further considering the low migration potential for these compounds, they are unlikely to enter the river and pose a risk to aquatic organisms. Lindane is present in a well close to the river (OHM-A7-51) at a concentration of 3.6 μg/liter, well above the chronic AWQC for this compound of 0.08 μg/liter. The concentration of lindane in the adjacent well to the west (OHM-A7-52) was essentially equal to the AWQC. If water from the vicinity of these wells is carrying lindane into the Assabet River, it is possible that adverse effects might be occurring to benthic organisms living at the point of release into the river. The huge dilution provided by the river water should serve to limit the extent of any effect elsewhere in the river. In addition to lindane, benthic organisms at the point of release into the river might also be exposed to volatile organics. While the concentration of these chemicals detected in the ground water at AOC A7 are below available toxicity criteria (ESAT or AWQC values) for these compounds, they may contribute to any effects caused by lindane.

Although, as noted in the previous paragraph, based strictly on a comparison of ground water concentrations with chronic AWQC, it is possible that lindane is adversely affecting aquatic life in the river, several factors suggest that if such an effect occurs, it is likely to be minimal. First, as noted above, the huge relative difference in water volume between the river and the laboratory waste ground water plume suggests that any impact would be quite localized. In addition, the increased organic carbon associated with river sediments may serve to decrease the bioavailability of lindane in the river substrate. Even without dilution and decreased bioavailability, many organisms may not be affected by the relatively low levels of chemical being released. Any organisms that are particularly sensitive to the effects of lindane are also likely to be sensitive to the effects of other organochlorine pesticides, and past heavy use of these chemicals in upstream apple orchards may have already removed these organisms from the river. The ongoing use of chemicals in the orchards that remain, on lawns, and on the golf course located across the river, further suggest that the effect of the potential lindane release from AOC A7, if it occurs, is likely to have an insignificant impact on aquatic life.

4.5.2 Terrestrial Ecosystem

Concentrations of certain of the organochlorine pesticides are rather high on site at several hotspot locations. However, as noted above, because these hotspots are limited in number and in extent, it seems quite unlikely that wildlife would come in contact with a specific location with sufficient frequency to be adversely affected. The screening approach developed by Opresko et al. (1994) involves comparing estimating dietary intake concentrations of the chemicals of concern (from Section 4.3.3) with established dietary benchmarks:

Screening-Level Risk Assessment for Voles

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio [Hazard Quotient (HQ)]
∑ppDDT	2.9	14	0.2
Chlordane	0.18	36	0.005
Dieldrin	0.03	0.35	0.09
Endrin	0.02	0.7	0.03
PCBs	0.02	0.9	0.02
Lead	2.4	140	0.02
PAHs	0.06	7.8	0.008

Screening-Level Risk Assessment for Shrews

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
∑ppDDT	14	3.8	4
Chlordane	0.9	9.6	0.1
Dieldrin	0.15	0.09	1.7
Endrin	0.12	0.19	0.6
PCBs	0.09	0.25	0.4
Lead	11.5	38	0.3
PAHs	0.3	2.1	0.1

Screening-Level Risk Assessment for Robins

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
∑ppDDT	14	0.0008	2×10^4
	14	5	3
Chlordane	0.9	1.7	0.5
Dieldrin	0.15	0.12	1.3
Endrin	0.12	0.6	0.2

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
PCBs	0.09	0.35	0.3
Lead	11.5	3.8	3
PAHs	0.3	NA	NA

NA = Not Available

Based on this comparison, intake of food and soil from hotspot areas at AOC A7 is unlikely to adversely affect meadow voles. However, several of the compounds, specifically ∑ppDDT, dieldrin and lead (birds only) may pose risks to small predatory animals such as shrews or song birds under the exposure scenarios used in the evaluation. This is not unexpected, based on the approach used in the screening level risk assessment, which is designed to ensure that risks are not overlooked. Actual risks are likely to be lower and possibly much lower. Considering the conservative (health protective) assumptions used and that all but one of the HQs were less than 5, it seems likely that chemicals in AOC A7 soils do not pose a substantial risk to wildlife.

The single very high HQ, 20,000 for ∑ppDDT exposure to robins using the Opresko et al. (1994) benchmark, is very high but as noted in the toxicity section, the benchmark value is suspect. The ∑ppDDT benchmark for birds listed by Opresko et al. (1994) is inconsistent with (substantially lower than) values for other chlorinated pesticides, with data on ∑ppDDT for mammals, and with other studies on birds listed by Opresko et al. (1994), which showed No Observed Adverse Effect Levels (NOAELs) only as low as 5 ppm in the diet. It is interesting to note that even background levels of ∑ppDDT pose unacceptable risks using this value (HQ of 7 for song birds exposed to the max background ∑ppDDT of 0.2 mg/kg) Discounting this single toxicity criterion outlier, results of the screening-level ecological assessment suggest that chemicals in AOC A7 soils do not pose a substantial risk to terrestrial wildlife that may use the area.

4.5.3 Stream Sediments

As noted in Section 4.2.2, several metals, specifically arsenic and barium in all samples and copper and nickel each in a single sample, exceeded the ESAT sediment criteria provided by USEPA. Therefore, based on a simple comparison of detected concentrations with available criteria, there is a concern that adverse effects on benthic organisms is possible. However, generic criteria such as the ESAT sediment values are by necessity based on conservative assumptions, numerous factors can influence the potential for a chemical to actually affect organisms and consequently, direct measurement of effects is a better basis for evaluating potential impacts to the ecosystem. The results of the Rapid Bioassessment conducted on the stream showed that conditions at the three sampling points were generally typical of what could be expected in the absence of pollution or contamination. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa were found at all three sample points. Salamanders (genera unknown) were also found at all three sample points. Both of these groups are generally intolerant of pollution or contamination. Based on the conditions and species observed during the RBP, it appears that the chemicals detected in sediments at concentrations exceeding the ESAT values are not adversely affecting organisms in the stream.

4.6 SUMMARY AND CONCLUSIONS

Based on observations of AOC A7, there is no visual evidence to conclude that any on-site contamination source is affecting the ecology on or in the immediate vicinity of AOC A7. These visual observations are supported by the results of the screening-level risk assessment, which indicates that ground water migration to the Assabet is unlikely to adversely affect aquatic organisms, and also suggests that the hotspots of contamination that exist on the site are unlikely to pose a significant risk to terrestrial wildlife. The principle disturbance to the environment caused by the activities of man appears to be the clearing and digging/backfilling done in association with the opening of the gravel pit and subsequent dumping activities. This perturbation will be self-correcting over time by natural succession processes; indeed the process had already begun. As a final note, bioassessment of the stream on the east side of AOC A7 showed no impairment other than what could be attributed to natural habitat limitations.

5.0 AOC A9

AOC A9, Petroleum, Oil, or Lubricants (POL) Burn Area, is located north of Patrol Road by the North Gate as shown on Figure 2-1. AOC A9 is level, nearly square, and covers approximately 7 acres. An unnamed stream west of the area flows towards the Assabet River which is located to the north. The area is completely fenced and has a berm surrounding it. Now inactive, this area was in use since the late 1950s for flame-retardant clothing testing, destruction of confiscated fireworks, and fire fighting training. A review of aerial photographs indicates that prior to use by the military, an orchard existed on the site.

5.1 ECOSYSTEMS OF CONCERN

AOC A9 is entirely a terrestrial ecosystem but solvents from the site are migrating towards the Assabet River and consequently, the potential for the site to adversely affect this aquatic ecosystem was also evaluated. A preliminary ecological assessment of AOC A9 was conducted during April and May 1992. The area was visually inspected on several occasions to determine if conditions warranted a more thorough assessment. Based on observation of the surrounding areas, this parcel was probably forested at one time. No information is available concerning when the site was first cleared but based on aerial photographs it has been clear for at least 50 years (OHM, 1992). Since the last recorded use of this site was for fire fighting training involving fuel-oil burning, deliberate actions such as mowing were regularly undertaken to restrict or control vegetation growth. Safety measures include the fence and earthen berm that completely surround the area.

This area is mostly covered by a thick growth of tall grasses, with many stands of low woody shrubs scattered throughout the area. Near the southwest corner of the site, there is a conspicuous sparsely vegetated area. This location was the area of petroleum-contaminated soil removal and backfilling (OHM, 1992A).

The animals that would be expected to utilize this area would be birds, rodents, and their associated predators such as hawks. The combination of the fence and the availability of more accessible habitat nearby would make the probability of occurrence of grazers, such as deer, unlikely.

The vegetation and topography of AOC A9 was completely altered by the activities of man and apparently maintained in that state for several years. Once use of the area stopped, recovery of the area began through the natural process of community succession. A typical scenario would start with the initial colonization of the area with fast-growing, seed propagating, annual species such as grasses. Over time, grasses would be gradually replaced by sun-tolerant woody shrubs. Larger species would begin to colonize the area and in time the final, or climax, community is achieved. The time between the initial colonization and the achievement of the climax community in this area, assuming no further alteration or interference by man, will take in excess of 100 years.

The previously remediated portion of the area in the southwest corner is also undergoing this natural process. However, the rate of recolonization is slower, probably due to the removal of topsoils and backfilling with soil of unknown origin. The stripping away of the topsoils removes the nutrients that plants require. The nutrients are being slowly replaced by the decomposition of succeeding generations of grasses. However, this process increases the time needed for the recolonization process.

Contamination resulting from spilled petroleum products was not noted in this area. Spills of petroleum products produce conspicuous spots bare of vegetation. While such patches take a long time

to "heal" (primarily after natural degradation of the contaminant), eventually they do heal. Animals tend to avoid such patches, not so much because of chemical toxicity, but more because of a response to an irritation or physical damage such as damaging flight feathers or fur by soaking them in oil. While no specific animal counts were performed on this area, there were a significant number of birds, notably robins, and insects evident during the investigation.

5.2 CHEMICALS OF POTENTIAL CONCERN

5.2.1 Chemicals Detected at AOC A9

Figure 4-1 in the Appendum is a map of this area showing all sampling points and significant features. Tables 5-1 to 5-4 summarize sampling results from the OHM sampling.

Contaminants detected in AOC A9 during the Phase I investigation include:

- Soil samples contained elevated levels of several metals, organochlorine pesticides, PAHs, several other semivolatile organic compounds, and VOCs. Other VOCs were detected in soil gas but not in soil samples.

- Ground water contained sodium, explosives, pesticides, insect repellant (probably introduced during sampling), chlorinated solvents and petroleum-related VOCs and semivolatile organic compounds.

Results of the Phase II investigation conducted by OHM in late 1993 at AOC A9 are described in detail in the nature and extent section of the SI/RI Addendum. Chemicals detected at concentrations that were significantly elevated or that were of interest because of their relationship to results of the Phase I sampling, include arsenic (soils), beryllium (soils), lead (ground water), 1,1-dichloroethylene (1,1-DCE; ground water), 1,1,1-trichloroethane (1,1,1-TCA; ground water), ethylbenzene (ground water), toluene (ground water), and xylene (ground water).

Arsenic was detected at elevated concentrations in the drainage ditch on the southwestern side of AOC A9, confirming previous findings for this area. The maximum concentration detected (140 mg/kg) was slightly higher than observed in previous sampling events. Beryllium was detected in soil with a maximum concentration of 0.69 mg/kg. Levels reported are slightly above the maximum concentration detected in the Phase I surface soil sampling of 0.34 mg/kg. The consistency of the values, the rather low levels, and the lack of any obvious source suggests that these values may be indicative of background beryllium concentrations.

Lead was detected in a single ground water sample at a concentration of 41 μg/liter, somewhat higher than the maximum of 9.5 μg/liter reported in the Phase I investigation. However, lead was detected less frequently in this sampling round.

VOCs, including the halogenated compounds 1,1-dichloroethylene and 1,1,1-TCA and the petroleum-derived monocyclic aromatics ethylbenzene, toluene, and xylene, were detected at concentrations that were generally a factor of 10 higher than detected in the Phase I sampling in this area. 1,1-DCE was detected in 3 of 9 samples at a maximum concentration of 70 μg/liter. 1,1,1-TCA was detected in 6 of 9 samples and in 3 of 9 was present at over 500 μg/liter, with a maximum concentration

of 2,000 μg/liter. Ethylbenzene and toluene were both present in 3 of 9 samples with maximum concentrations of 2,000 μg/liter. Xylene was present in 4 of 9 samples, with the two highest concentrations being 8,000 and 4,000 μg/liter.

5.2.2 Key Chemicals

Concentrations of chemicals detected in surface soils and ground water were compared with site-specific background levels of these chemicals, with environmental screening criteria provided by the USEPA (ESAT values) and with AWQC for chemicals in water (Tables 5-5 through 5-7). On the presumption that chemicals in ground water could migrate to the Assabet River over time, for this initial screen, ground water concentrations of chemicals were compared with water quality criteria designed to protect aquatic organisms. Based on this comparison, the chemicals present in environmental media at AOC A9 at levels exceeding screening criteria are presented below. The criteria used for comparison are noted in parentheses after the name of the chemical.

Soils

Arsenic (No appropriate criteria; UCL on background: 9 mg/kg)
Hand auger surface soil samples from the southwest corner of the site
A9HA1 - 56 mg/kg
A9HA2 - 59 mg/kg
A9HA3 - 70 mg/kg
A9HA4 - 65 mg/kg
A9HA5 - 140 mg/kg

Other surface soil samples
A9SO1 - 46 mg/kg

Lead (200 mg/kg)
A9CD1 - 450 mg/kg

Thallium (no criterion established but included as thallium is known to be quite toxic)
A9SO7 - 304 mg/kg

Ground Water

Lead (AWQC - 0.55 μg/liter)
A9GW54A - 41 μg/liter

Ethylbenzene (ESAT - 1600 μg/liter)
A9GW53A - 1,000 μg/liter
A9GW54A - 2,000 μg/liter

Toluene (ESAT - 875 μg/liter)
A9GW54A - 2,000 μg/liter

Xylene (no criterion established but included because it was the solvent detected at the highest level)
A9GW54A - 8,000 μg/liter

1,1,1-TCA (no criterion; ESAT criteria for 1,1,2-TCA - 9,400 μg/liter)
A9GW47C - 500 μg/liter
A9GW55A - 900 μg/liter
A9GW56A - 2,000 μg/liter

5.2.3 Summary

Chemicals detected in AOC A9 that are of potential concern for ecological receptors can be separated into two categories:

- Chemicals that are present in ground water and that may pose a risk to aquatic organisms in the Assabet River
- Metals, specifically arsenic, thallium, and lead, that are present in soils and that may pose a risk to terrestrial wildlife.

Chemicals in ground water are associated with two plumes, one containing chlorinated VOCs and the other containing petroleum-related VOCs (xylene, ethylbenzene, and toluene) that extend from the SA toward, and possibly to, the river. Concentrations of chlorinated VOCs in ground water are below ESAT levels on site, concentrations are much lower in wells closer to the river (OHM-A9-58; 1,1,1-TCA @ 46 μg/liter), and consequently, these chemicals will not be considered further in this assessment. Chemicals in soils exist at two primary hotspots, with arsenic found in the southwest corner of the area and lead and thallium associated with an old drum in the northwest corner of the area.

5.3 ECOLOGICAL TOXICITY

Information on the toxicology of chemicals of potential concern is provided in this section. General information on the toxicity of the compound or element is described. In addition, toxicity criteria, specifically, allowable dietary levels of these chemicals for several species found on the Annex, is also provided.

As part of the Clean Water Act, levels of chemicals in water were determined that were considered unlikely to have adverse effects on aquatic organisms. These AWQC can be used to assess the potential for a chemical detected in a water body to adversely affect organisms. If concentrations in water exceed the AWQC, there is a possibility that the chemical can adversely affect aquatic organisms.

Concentrations of chemicals in soils that are of concern to terrestrial life have not been established, although USEPA is working on developing such ecological screening criteria (USEPA, 1994). In order to evaluate the potential for chemicals to affect terrestrial animals, "safe" dietary levels are established and used for comparison with chemical concentrations estimated to occur in food from the target site. Dietary levels of the chemical shown to have no adverse effect on a particular organism, called benchmark dietary

concentrations, have been developed for a large number of chemicals and animal species by Oak Ridge National Laboratory (Opresko et al., 1994). These benchmark values will be used to evaluate the potential effects of chemicals on wildlife at AOC A9.

5.3.1 Arsenic

Although arsenic may be found in low levels in all plant and animal tissues (Forstner and Wittmann, 1979), it does not appear to biomagnify. The highest levels seem to occur in plants and lower animals. Therefore, those organisms most at risk would be those near the base of the food chain (i.e., primary consumers). Toxic effects at this level usually result in lower populations or loss of populations depended upon by higher trophic levels as a food source, which results in reduced populations of the higher taxon, either by starvation or by migration away from the affected area. Another effect would be the replacement of the affected species with another species. These type of effects would not be expected on the Annex, as elevated soil concentrations of arsenic are generally found in hotspots.

Concentrations of arsenic that were determined to be toxicological benchmarks for diet are: 0.26 mg/kg for the short-tailed shrew, 0.98 mg/kg for the meadow vole, 0.24 mg/kg for the red fox, and 0.34 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 1.8 mg/kg for the robin and 1 mg/kg for the red-tailed hawk.

5.3.2 Lead

There have been several studies on the adverse effects of lead in the environment. Concentrations of lead that were determined to be toxicological benchmarks for diet are: 38 mg/kg for the short-tailed shrew, 140 mg/kg for the meadow vole, 34 mg/kg for the red fox, and 49 mg/kg for the whitetail deer. Toxicological benchmarks for birds were 3.8 mg/kg for the robin and 2 mg/kg for the red-tailed hawk.

5.3.3 Thallium

Concentrations of thallium that were determined to be toxicological benchmarks for diet are: 0.035 mg/kg for the short-tailed shrew, 0.13 mg/kg for the meadow vole, 0.03 mg/kg for the red fox, and 0.045 mg/kg for the whitetail deer. Toxicological benchmarks for birds were not calculated.

5.3.4 Volatile Organic Compounds

The petroleum-related VOCs ethylbenzene, toluene, and xylene are not particularly toxic to aquatic organisms. Acute toxicity was generally observed at levels above 10 - 100 mg/liter depending on the compound and chronic toxicity generally occurs at levels above 1-10 mg/liter. Specific numeric criteria were not listed for the compounds detected at the site. However, the lowest concentrations causing adverse effects were listed by USEPA (1980), with USEPA noting that effects could occur at lower concentrations in more sensitive species. For ethylbenzene, an acute concentration of 32,000 μg/liter was noted as a lowest effect level but no chronic value was available. An acute concentration of 17,500 μg/liter was noted as a lowest effect level for toluene. No chronic lowest observed effect level was available. No concentrations were listed for xylene by USEPA (1980). A review of data presented in Vershueren noted adverse effects (96 hour LC_{50}s) of around 10,000 μg/liter to 40 μg/liter. It was also noted that trout, which exhibited a 96 hour LC_{50} of 13,500 μg/liter, also exhibited avoidance behavior at a substantially lower

concentration of 10 μg/liter. The large difference between avoidance levels and toxic levels suggests that xylene may have little if any effects in the open environment.

No criteria were available for the chlorinated VOCs detected in ground water at AOC A9. However, USEPA (1980) also listed lowest effect levels for these compounds, with acute values of 18,000 μg/liter and 11,600 μg/liter noted for 1,1,1-TCA and 1,1-DCE, respectively. No chronic values were listed for the two compounds but USEPA (1980) did list a chronic lowest effect level of 9400 μg/liter for 1,1,2-trichloroethane.

5.4 EXPOSURE ASSESSMENT

In the exposure assessment, concentrations of chemicals that could be encountered in AOC A9 are identified, potential exposure pathways are determined, and an estimate of exposure (dietary intake levels for terrestrial wildlife; water concentrations for aquatic life) are presented.

5.4.1 Aquatic Ecosystem

As noted previously, concentrations of chemicals in surface water in the Assabet at the point of release into the river are not available. Therefore, for this screening-level evaluation, levels of chemicals detected in ground water samples taken from wells close to the river were assumed to represent concentrations that could occur in pore water in the benthos at the point of release into the river. Ground water released into the river is expected to be fairly rapidly mixed with water from the river and the potential impact of site chemicals on downstream aquatic organisms is limited by this dilution.

5.4.1.1 Exposure Point Concentrations

Chemicals that are present in ground water include the petroleum-related compounds toluene, ethylbenzene, and xylene in one plume (referred to as the xylene plume as xylene is present in the greatest concentrations), and the chlorinated VOCs, 1,1,1-TCA, 1,1-DCE, and trichloroethylene (TCE) in the other. As noted in Section 5.2, the concentration of chlorinated VOCs in ground water is well below possible action levels and these compounds are not considered further in the assessment. Lead was also detected at an elevated concentration (41 μg/liter) in a sample from well OHM-A9-54, located in the xylene plume in the central area of the site. The highest concentrations of chemicals in the xylene plume were found in well OHM-A9-54 and in addition to lead, include xylene at 8,000 μg/liter and both ethylbenzene and toluene at 2,000 μg/liter. The well downgradient from OHM-A9-54 and closest to the river, well OHM-A9-53, also contained petroleum-related compounds: ethylbenzene at 1,000 μg/liter, xylene at 4,000 μg/liter and toluene at 400 μg/liter. Lead was not detected in this well, suggesting that attenuation of this compound occurs within the site boundary. Because well OHM-A9-53 is closest to the Assabet, concentrations in this well are considered likely to be most representative of concentrations from the xylene plume that could enter the river and will be used as exposure point concentrations for this screening-level evaluation.

In assessing the potential impact of any chemicals released from AOC A9 on organisms present in the Assabet River, the effect of dilution by the river water must be considered. As part of the hydrogeological evaluation of the area, the volume of water released from the site was estimated for the xylene plume. The volume of water estimated to be released from the area of the xylene plume is 5,900 gallons per day (gpd). Flow in the river is measured at a gaging station in Maynard. Median flow

is 81,000,000 gpd and 90% of the time the flow exceeds 15,500,000 gpd. Based on these values, the xylene plume is contributing only 0.04% of the flow of the river under low flow conditions and even less (<0.001%) under median flow conditions.

5.4.1.2 Exposure Scenarios and Pathways

If water from the site is carrying chemicals into the Assabet River, it is possible that adverse effects might be occurring to benthic organisms living at the point of release into the river. The huge dilution provided by the river water should serve to limit the extent of any effect elsewhere in the river (i.e., on the lotic community). Birds and mammals feeding on aquatic organisms should also not be affected because of the anticipated very large dilution.

5.4.1.3 Exposure Estimates

The only chemicals present in ground water at concentrations exceeding surface water criteria designed to protect aquatic life were ethylbenzene, toluene, and lead, all at well OHM-A9-54. As noted above, downgradient wells (specifically OHM-A9-53, but also DM9A) showed lower concentrations of the organic compounds and no lead. Lead was only detected in ground water at a single location, close to its likely disposal point, and is considered unlikely to enter the river and pose a risk to aquatic organisms. Concentrations of the three VOCs in well OHM-A9-53 are: ethylbenzene at 1,000 μg/liter, xylene at 4,000 μg/liter and toluene at 400 μg/liter. These levels will be assumed to represent potential exposure levels for benthic organisms. Assuming fairly rapid dilution of the chemicals in the river, xylene concentrations can be estimated at 2 μg/liter and concentrations of ethylbenzene and toluene will be below 1 μg/liter under low flow conditions. These levels can be compared with AWQC and the derived toxicity criterion for these chemicals to estimate risks to aquatic life.

5.4.2 Terrestrial Ecosystem

Concentrations of chemicals detected at hotspots in the AOC A9 were used to estimate the potential for exposure in this screening-level evaluation.

5.4.2.1 Exposure Point Concentration

The metals arsenic, thallium, and lead were detected at three primary hotspots in AOC A9. Arsenic was primarily present at elevated levels in the southwest corner of the area, with a single additional hotspot sample noted in the southeast corner of the area. Lead and thallium concentrations were both elevated in samples taken from the northwest corner of the area and associated with a former drum location. Maximum concentrations of these chemicals are listed below and for arsenic, an average for the southwest corner is also provided.

Arsenic
A9HA5 - 140 mg/kg
SW Ave. - 78 mg/kg

Lead
A9CD1 - 450 mg/kg

Thallium
A9SO7 - 304 mg/kg

The metals detected at the site were only detected infrequently and at widely scattered locations (i.e., at hotspots). Consequently, frequent contact with these chemicals by most terrestrial organisms is probably unlikely. As noted in Section 4.3 for AOC A7, small animals and birds with very limited ranges might contact a hotspot area with sufficient frequency to be exposed to site chemicals. The concentrations listed above will be used in estimating exposure to these organisms for the purposes of this screening-level ecological assessment. However, it is important to note that even small animals may not contact these areas frequently and furthermore, the chemicals have been on site for a considerable length of time and may well be less bioavailable than when first placed on site. Even relatively immobile compounds such as the metals will migrate from the immediate soil surface (through volatilization and leaching) and the residual will become more tightly bound by soil particles.

5.4.2.2 Exposure Scenarios and Pathways

Animals that come in direct contact with areas (hotspots) containing elevated levels of chemicals may be exposed to these chemicals via direct ingestion of soils or via consumption of food that has taken up the chemicals from the soil. Ingestion of chemicals in any water sources used for drinking water could also occur but is unlikely to be a significant source of exposure considering the length of time that the chemicals have been present at the site and the results of surface water sampling. Inhalation of chemicals in dust and direct contact and dermal absorption of chemicals are other possible routes of exposure but these routes are considered likely to be less significant than direct intake via ingestion and are not considered further in this assessment. As noted above, medium or large sized animals and birds with ranges greater than 10 hectares (i.e., animals like foxes, raccoons, deer) will not contact the site with sufficient frequency to be at risk of substantial exposure to the chemicals on site and will not be considered further.

5.4.2.3 Exposure Estimates

Concentrations of several metals are elevated on site at several hotspots. As a screening-level evaluation of the potential for adverse effects to be associated with exposure, the potential ingestion exposure of chemicals from the site can be estimated using the same approach described in Section 4.3 for exposure in AOC A7. The same animals and exposure assumptions discussed in the exposure assessment for AOC A7 can be used to assess potential risks to organisms in AOC A9. Chemical specific assumptions that will be used include a 2% uptake by plants of arsenic and a 1% uptake by plants of thallium (based on data in Opresko et al. (1994) for arsenic and data in Chaney et al. (1984) for aluminum, which is chemically related to thallium) and a BCF of 0.1 for these compounds, approximately half of the chlorinated pesticide value and the same value used for lead. Because arsenic was somewhat more widely distributed in the southwest corner of the site, an average concentration and no adjustment for range size will be used to estimate possible exposure to this metalloid.

Using these values and assumptions, chemical concentrations in the diet of voles and of shrews and robins can be calculated for AOC A9 using the following equations:

$$\text{Dietary Conc.}_{\text{voles}} = ((\text{soil conc} \times 0.02) + (\text{plant conc} \times 0.98)) \times 1/5$$

where:

Dietary conc	= concentration of the target chemical in the diet of the vole (mg/kg)
soil conc	= concentration of the chemical in soil (mg/kg)
0.02	= assumption that 2% of diet is soil
plant conc	= concentration of the chemical in plants used as food; concentration based on assumption of 2% (As) or 1% uptake by plants
0.98	= assumption that 98% of diet is plants
1 or 1/5	= assumption that a hotspot constitutes all (As only) or 20% of a vole's range

$$\text{Dietary Conc.}_{\text{shrew/robin}} = ((\text{soil conc} \times 0.05) + (\text{invert conc} \times 0.95)) \times (1 \text{ or } 1/10)$$

where:

Dietary conc	= concentration of the target chemical in the diet of the shrew or robin (mg/kg)
soil conc	= concentration of the chemical in soil (mg/kg)
0.05	= assumption that 5% of diet is soil
plant conc	= concentration of the chemical in invertebrates (insects/worms) used as food; concentration based on assumption of invert:soil BCF of 0.1 for metals
0.95	= assumption that 95% of diet is invertebrates
1 or 1/10	= assumption that a hotspot constitutes 100% (As only) or 10% of a small predator's range

Dietary Concentrations of Chemicals for Voles

Chemical	Soil Conc. mg/kg	Plant Conc. mg/kg	Diet Conc. mg/kg
Arsenic	78	1.6	3.1
Lead	450	4.5	2.7
Thallium	10	0.1	0.06

Dietary Concentration of Chemicals for Shrews and Robins

Chemical	Soil Conc. mg/kg	Insect/worm Conc. mg/kg	Diet Conc. mg/kg
Arsenic	78	7.8	11.3
Lead	450	45	6.5
Thallium	10	1	0.15

These dietary concentrations will be used to evaluate potential risks to terrestrial wildlife in AOC A9.

5.5 RISK CHARACTERIZATION

In this section, estimated exposure levels are compared with toxicity criteria to evaluate whether or not a chemical has the potential to pose risks to wildlife at the site. For aquatic wildlife, concentrations estimated to be present in water are compared with appropriate water quality criteria. For terrestrial life, estimated dietary concentrations of chemicals are compared with benchmark values developed by Oak Ridge National Laboratory (Opresko et al., 1994). A discussion of qualitative factors influencing possible risks in the environment is also included in order to define the uncertainties in the assessment.

5.5.1 Aquatic Ecosystem

The only chemicals present in ground water at concentrations exceeding surface water criteria designed to protect aquatic life were ethylbenzene, toluene, and lead, and concentrations exceeding criteria were only detected in ground water close to the center of the site and not in downgradient wells closer to the river. Consequently, it is unlikely that chemicals from AOC A9 are migrating to the Assabet at concentrations that pose a risk to aquatic life in the river. Several factors support the finding that these chemicals pose no risk to the river. Probably most importantly, the huge dilution provided by the river water should serve to limit the extent of any effect in the river. Many organisms may not be affected by the relatively low levels of chemical being released and xylene, which is present at the highest concentration, has an unpleasant taste that is typically avoided by aquatic organisms at concentrations well below toxic levels. In addition, as noted for AOC A7, the Assabet is not a pristine waterbody and the ongoing use of chemicals in upstream orchards, on lawns, and on the golf course located across the river, further suggest that any chemical release from AOC A9 is likely to have an insignificant impact on aquatic life.

5.5.2 Terrestrial Ecosystem

Concentrations of certain metals are rather high on site at several hotspot locations. However, as noted above, because these hotspots are limited in number and in extent, it seems quite unlikely that wildlife would come in contact with a specific location with sufficient frequency to be adversely affected. The screening approach developed by Opresko et al. (1994) involves comparing estimating dietary intake concentrations of the chemicals of concern (from Section 5.4.2.3) with established dietary benchmarks:

Screening-Level Risk Assessment for Voles

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
Arsenic	3.1	0.98	3
Lead	2.7	140	0.02
Thallium	0.06	0.13	0.5

Screening-Level Risk Assessment for Shrews

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
Arsenic	11.3	0.26	43
Lead	6.5	38	0.2
Thallium	0.15	0.035	4.3

Screening-Level Risk Assessment for Robins

Chemical	Diet Conc. mg/kg	Benchmark Conc. mg/kg	Ratio (HQ)
Arsenic	11.3	2	5.7
Lead	6.5	3.8	1.7
Thallium	0.15	NA	NA

NA = Not Available

Under the assumptions used in the screening-level risk assessment, intake of food and soil from hotspot areas at AOC A9 may pose risks to small mammals and birds such as voles, shrews, or song birds. As noted for AOC A7, this is not unexpected, based on the approach used in the screening level risk assessment, which is designed to ensure that risks are not overlooked. Actual risks are likely to be lower and possibly much lower. Considering the conservative (health protective) assumptions used and that all but two of the HQs were less than 5, it seems likely that chemicals in AOC A9 soils do not pose a substantial risk to wildlife.

The single high HQ, 40 for arsenic exposure to shrews in the southwest corner of the site, is not considered to represent a major cause for concern for the following reasons. The high HQ is associated with a concentration of 78 mg/kg, which is only 2-3 times higher than maximum background concentrations. In fact, average background concentrations for the site of around 7 mg/kg would pose an unacceptable risk under the scenario and assumptions used in this analysis (HQ = 3.6 for background soil concentrations). Discounting the arsenic results for shrews, results of the screening-level ecological assessment suggest that chemicals in AOC A9 soils do not pose a substantial risk to terrestrial wildlife that may use the area.

5.6 SUMMARY AND CONCLUSIONS

Based on the observations discussed in the preceding sections, there is no visual evidence to conclude that any on-site contamination source is affecting the ecology on or in the immediate vicinity of AOC A9. These visual observations are supported by the results of the screening-level risk assessment, which indicates that ground water migration to the Assabet is unlikely to adversely affect aquatic organisms, and also suggests that the hotspots of contamination that exist on the site are unlikely to pose a risk to terrestrial wildlife. Vegetation within the area is consistent with early-stage successional recovery; adverse effects on vegetation in the area appear to be the result of removal of topsoils and the associated loss of the nutrient base found there.

6.0 THE ASSABET RIVER

The Assabet River, located in the Concord River Basin, has a water quality classification of Class B, designated for use and protection and propagation of fish, other aquatic life, and wildlife, and for primary and secondary contact recreation (MADEQE, 1989). However, the Assabet River has had water quality problems in the past, mostly as a result of wastewater discharges from upstream wastewater treatment plants (WWTPs) located in Westborough, Shrewsbury, Marlboro West, and Hudson and the river still only partially meets its Class B water quality classification. During summer months, significant portions of the river support dense populations of algae and macrophytes. Water quality problems have also occurred during the summer due to low flow rates and minimum dilution coupled with warm weather, which causes maximum organic decay and vegetative growth. Past heavy use of organochlorine pesticides in upriver apple orchards and the ongoing use of chemicals in the orchards that remain, on lawns, and on the golf course located across the river, may have also impacted and continue to impact the river.

6.1 CHEMICALS OF POTENTIAL CONCERN

OHM collected and analyzed samples from three points in the river (Figure 6.1). Sample point SD14 is located upriver, near the eastern tip of Crow Island. Sample point SD15 was collected near the mouth of the stream that flows between AOCs A7 and A9. Sample point SD16 was collected downriver from the site. Samples at all three locations were collected from the surface of the river bottom, from 1 foot, and from three feet beneath the surface of the river bottom. Concentrations of chemicals detected at these locations are summarized in Table 6-1.

Chemicals detected in the river sediments were compared with screening-level sediment criteria provided in the ESAT document. Many chemicals were detected in the river sediments at concentrations exceeding these criteria. In particular, chemical concentrations exceeded the criteria in all samples at all depths for the metals arsenic, barium, cadmium and nickel (all but the surface sample at SD16) . Other metals that were detected at several locations at concentrations that exceeded the criteria are copper, mercury, and zinc. PAHs were detected at elevated concentrations in samples from SD14, located upriver from the site. The pesticides $\sum$DDT, chlordane, and PCBs were detected in samples collected from all depths at SD15.

Total organic carbon (TOC) was measured in the samples from the three locations and although somewhat variable with depth (concentrations were higher in surface samples, as would be expected) much greater variability was noted among the three locations. The upriver sample had the lowest TOC (an average of 0.5%), the downriver sample had the mid-range value (7%), and the sample collected closest to AOC A7 had by far the highest TOC (35%). The high TOC reported for SD15 suggests that substantial deposition of organic matter occurs at this location and furthermore, explains the presence of pesticides at this point and not at the other locations.

6.2 DISCUSSION AND CONCLUSIONS

The huge relative difference in water volume between the river and the ground water released from the Annex to the river suggests that any impact would be quite localized. In addition, the increased organic carbon associated with river sediments may serve to decrease the bioavailability of chemicals in the river substrate and should impede the migration of chemicals to the river. Even without dilution and decreased bioavailability, many organisms may not be affected by the relatively low levels of chemical detected at the Annex that could be released into the river. As noted above, the Assabet River is not a pristine

waterbody but has been and is being substantially impacted by numerous point source and nonpoint source releases. Any organisms that are particularly sensitive to the effects of chemicals are also likely to be sensitive to the effects of other organochlorine pesticides (released in the past), and to chemicals and nutrients currently being deposited in the river. Considering these factors, any release from the Annex, if it occurs, is likely to have an insignificant impact on the overall water quality of the Assabet River.

7.0 CONCLUSIONS

The results of site investigations of the Annex reveal a complex area consisting of several interrelated ecosystems that support a range of species in an otherwise suburban part of Eastern Massachusetts. As described in Section 2.0, eight state and/or federally listed plant species and three state-listed animal species have been identified on the site. Given the complex habitat structure and the size of the Annex, it is very possible that more rare or listed species of both plants and animals may be identified.

In all of the RI areas, detected chemicals that are of potential concern for ecological receptors can be separated into three primary categories:

- Chemicals that are present in AOCs A7 and A9 ground water and that may pose a risk to aquatic organisms in the Assabet River.

- Organochlorine pesticides, metals, and PAHs that are present in soils and that may pose a risk to terrestrial wildlife. These chemicals are present in all three AOCs but are present in hotspots on the sites and are not widely distributed.

- Metals present at elevated concentrations in surface water (AOC A4) or sediments in the stream located to the east of AOC A7. These chemicals may pose a risk to aquatic organisms.

7.1 AOC A4

At AOC A4, lead, the chemical of primarily concern, was present in soils at two hotspots and in a surface water sample collected from the wetlands located west of the area. Contact with the two surface soil hotspots is considered unlikely to occur with sufficient frequency or duration to pose a risk to organisms using the site. The elevated lead level reported for the surface water sample is considered likely to be an anomaly caused by sampling technique and is not considered indicative of a potential risk in the area. Arsenic was also detected in sediments at AOC A4. These elevated arsenic concentrations are probably associated with pesticides used in the apple orchards that formerly existed north of (upgradient from) the wetland area. Because spraying of these orchards probably stopped over 50 years ago, the residual arsenic at the site is likely to be less available than when first applied. Considering this fact, and the infrequent detection of arsenic which suggests that contact with elevated arsenic levels will be infrequent, arsenic is considered unlikely to pose a substantial risks to organisms in the wetlands portion of AOC A4.

7.2 AOC A7

Chemicals in ground water in AOC A7 are associated with a plume that extends from the laboratory waste disposal area in the west-central portion of the area, northward toward, and possibly to, the river. Chemicals in soils at AOC A7 exist at several hotspots, with most concentrated in the central portion of the site.

Based on observations of AOC A7, there is no visual evidence to conclude that any on-site contamination is affecting the ecology of AOC A7. The results of the screening-level risk assessment, indicate that ground water migration to the Assabet is unlikely to adversely affect aquatic organisms, and also suggests that the hotspots of contamination that exist on the site are unlikely to pose a significant risk to terrestrial wildlife. The principle disturbance to the environment caused by the activities of man appears

to be the clearing and digging/backfilling done in association with the opening of the gravel pit and subsequent dumping activities. This perturbation will be self-correcting over time by natural succession processes; indeed the process had already begun. As a final note, bioassessment of the stream on the east side of AOC A7 showed no impairment other than what could be attributed to natural habitat limitations.

7.3 AOC A9

Chemicals in ground water at AOC A9 are associated with two plumes, one containing chlorinated VOCs and the other containing petroleum-related VOCs (xylene, ethylbenzene, and toluene) that extend from the area toward, and possibly to, the river. Concentrations of chlorinated VOCs in ground water were below screening level criteria on site, concentrations are much lower in wells closer to the river and consequently, these chemicals were not considered further in this assessment. Chemicals in soils exist at two primary hotspots, with arsenic found in the southwest corner of the area and lead and thallium associated with an old drum in the northwest corner of the area.

In AOC A9, the results of the screening-level risk assessment, indicate that ground water migration of petroleum-related VOCs to the Assabet is unlikely to adversely affect aquatic organisms, and also suggests that the hotspots of contamination that exist on the site are unlikely to pose a risk to terrestrial wildlife. Vegetation within the area is consistent with early-stage successional recovery; adverse effects on vegetation in the area appear to be the result of removal of topsoils and the associated loss of the nutrient base found there.

7.4 ASSABET RIVER

A review of the concentrations of chemicals detected in sediments in the Assabet River indicates that several screening-level criteria are exceeded. However, the distribution of the chemicals, both with depth and with regards to their relationship to the site (upstream versus downstream) suggests that the elevated concentrations are a result of past releases to the river from off-site sources. For example, pesticides are concentrated in the sediments at the mouth of the small stream that runs between AOCs A7 and A9 and might appear to be site related. However, no evidence of substantial use of these pesticides on site in a manner that would lead to their presence in the river was noted and the pesticides on site at AOC A7 are concentrated in hotspots and with the exception of lindane which was not detected in the river, do not appear to be migrating. Furthermore, pesticide concentrations were detected at depths as great as 3 feet below the sediment surface, and based on the high total organic carbon detected, appear to be present at this location as a result of upstream use of these pesticides in apple orchards and the physical characteristics of the river that lead to deposition of material at this point. Based on examination of the chemicals detected in the river and their relationship to site chemicals, it appears unlikely that the Annex is significantly affecting water quality in the Assabet River.

7.5 SUMMARY

In summary, a review of the chemical concentrations detected in environmental media in the three RI areas at the Annex suggests that any possible impacts would be minimal. The presence of hotspots of metal and pesticide concentrations in soils at the site are likely to pose the greatest potential concern but because these hotspots are infrequent, the probability of regular contact and adverse effects is somewhat limited. Concentrations of chemicals that may enter the Assabet River from the site are either already below AWQC or are likely to be substantially influenced by dilution, adsorption, etc, such that they are

unlikely to adversely affect the river. Many metals were present in sediments at concentrations that are well above screening criteria. However, a review of the distribution of the concentrations does not indicate that the site is the source of these elevated levels. In addition, as noted in Boucher et al. (1992) metal concentrations well above screening criteria may not have adverse effects. These researchers noted that maximum lead and zinc concentrations of 845 mg/kg and 521 mg/kg, well above sediment screening values of 35-110 mg/kg (lead) and 50-125 mg/kg (zinc), produced pore water concentrations that were near or below AWQCs. These findings as supported by the findings of Gambrell (1994), who noted that metals in wetland soils (sediments) are retained more strongly than in upland soils.

8.0 REFERENCES

Anaptek Corporation. 1991. Endangered species survey. Phase I. An environmental inventory of wildlife species and their habitats. Anaptek Corporation, 209 West Central Street, Natick, MA. Contract No. DAAK6091P2517.

Bailey, R.G. 1976. Ecoregions of the United States. U.S. Forest Service, Ogdon, Utah.

Bailey, R.G. 1978. Ecoregions of the United States. U.S. Forest Service, InterMountain Region, Ogdon, Utah.

Boucher, P.M., Maughen, J.T., and Downing, J. 1992. Ecological Exposure Assessment of a PCB-contaminated wetland in Massachusetts. Natural Resources Damages.

Butler, Brian O. 1992. Fort Devens Sudbury Annex inventory summary report - 1992. Small Research Contract MA HP 92SR-04.

Chaney, R.L., Sterrett, S.B., and Mielke, H.W. 1984. The potential for heavy metal exposure from urban gardens and soils. In: Proc. Symp. Heavy Metals in Urban Gardens (J.J. Preer, ed.) pp.37-84, U. D.C., Columbia Extension Service, Washington, D.C.

Gambrell, R.P. 1994. Trace and toxic metals in wetlands - A review.

Harrington, S. and Gouchoe, S. 1991. Site investigation at the Fort Devens Annex. An unpublished study.

Hunt, David M. 1992. Floristic survey, with emphasis on rare species, of the Sudbury Annex of Ft. Devens, Massachusetts. Contract No. DACA88-91-M-0873. U.S. Army Construction Engineering Research Laboratories, Champaign, Illinois.

Magee, B.H., Bradley, L.N.J., and Allen, S.L. 1994. Background levels of polycyclic aromatic hydrocarbons (PAH) and selected metals in New England urban soils. (Unpublished Manuscript)

Menzie, C.A., Potocki,B.B., and Santodonato. J. Exposure to carcinogenic PAHs in the environment. Environ. Sci. Technol. 26: 1278-1284

Menzie, C.A., Burmaster, D.E., Freshman, J.S., and Callahan, C.A. 1992. Assessment of methods for estimating ecological risk in the terrestrial component: A case study at the Baird & McGuire Superfund Site in Holbrook, Massachusetts. Environ. Toxicol. Chem. 11: 245-260

Moriarty, F. and Walker, C.H. 1987. Bioaccumulation in food chains-a rational approach. Ecotoxicology and Environmental Safety 13: 208-215

Nisbet, I.C.T. and Reynolds, L.M. 1984. Organochlorine residues in common terns and associated estuarine organisms, Massachusetts, USA, 1971-1981. Environmental Research 11: 33-66

Odum, E.P., 1953. Fundamentals of Ecology. W.B. Saunders Company, Philadelphia. 383 p.

Ohlendorf, H.M., Swineford, D.M., and Locke, L.N. 1981. Organochlorine residues and mortality of herons. Pesticides Monitoring Journal. 14: 125-135.

Opresko, D.M., Sample, B.E., and Suter, G.W. (1994) Toxicological Benchmarks for Wildlife: 1994 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. Report Number: ES/ER/TM-86/RI. September 1994

Plafkin, James L., Michael T. Barbour, Kimberly D. Porter, Sharon K. Gross, and Robert M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. USEPA Assessment and Watershed Protection Division, Washington, DC.

Poirier, K.A. 1992. Letter to S.A. Levinson, USEPA Region I, January 23, 1992. Cincinnati, OH: USEPA Office of Research and Development.

U.S. Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station, Vicksburg, Ms. Technical Report Y-87-1.

USEPA. 1979. Water-related environmental fate of 129 priority pollutants. EPA 440-4-79-029a.

USEPA. 1989(a). Risk Assessment Guidance for Superfund. Volume II: Environmental Evaluation Manual. Interim Final. Office of Emergency and Remedial Response, Washington, DC. USEPA 540/1-89/001.

USEPA. 1992(a). Peer review workshop report on a framework for ecological risk assessment. Risk Assessment Forum, Washington, DC. EPA/625/3-91/022.

USEPA. 1992(b). Framework for ecological risk assessment. Risk Assessment Forum, Washington, DC. EPA/630/R-92/001.

U.S. Environmental Protection Agency (USEPA) 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment (OHEA). Washington, D.C. EPA/600/R-93/187a. December 1993

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TABLES

Table 3-1
Area A4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4CD1 A4CD1A 28-May-92 0 feet	A4CD2 A4CD2A 28-May-92 0 feet	A4SO1 A4SO1A 21-Apr-92 0 feet	A4SO2 A4SO2A 21-Apr-92 0 feet	A4SO3 A4SO3A 21-Apr-92 0 feet	A4SO4 A4SO4A 21-Apr-92 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1				0.016	0.013	0.014
BNAs:									
Chrysene			0.7						
Di-n-butyl phthalate	3.801	9				5 S	6 S	7 S	
PCB/Pesticides:									
ppDDE	0.039	0.139	2	0.214	0.0809				
ppDDT	0.066	0.23	2	0.0861	0.162				
Metals:									
Aluminum	10834.976	18000				11000 B	11000 B	12000 B	
Antimony	0.822	0.578	10		9.43				
Barium	21.603	54.7		27.3	31.7		25.8		25
Beryllium	0.298	0.638	0.4				0.325	0.353	
Cadmium	0.563	1.79	30	7.42					
Calcium	554.016	1170		588	1110				
Chromium	18.666	62.5	1000						19
Cobalt	3.472	7.3					4.8	3.61	
Copper	9.521	19.5			12				
Iron	12806.693	28000							
Lead	51.432	110	300	53 B					
Magnesium	1793.596	5060				1910	2690	2260	3170
Manganese	263.698	1100			270				
Mercury	0.101	0.318	10						
Nickel	9.322	23.2	300				10.5		
Potassium	450.597	700		458	502	548	996	687	1710
Zinc	33.907	85.8	2500	1200					

Table 3-1
Area A4
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4SO5 A4SO5B 08-Nov-93 0 feet	A4SO5 DUPSO01C 08-Nov-93 0 feet
VOCs:					
Methylene chloride	0.008	0.018	0.1		
BNAs:					
Chrysene			0.7	0.91	*
Di-n-butyl phthalate	3.801	9			*
PCB/Pesticides:					
ppDDE	0.039	0.139	2	0.225	*
ppDDT	0.066	0.23	2	0.449	*
Metals:					
Aluminum	10834.976	18000			
Antimony	0.822	0.578	10		
Barium	21.603	54.7		100	91.7 D
Beryllium	0.298	0.638	0.4		
Cadmium	0.563	1.79	30	12.1	13.5 D
Calcium	554.016	1170		5890	5470 D
Chromium	18.666	62.5	1000		
Cobalt	3.472	7.3			
Copper	9.521	19.5		42.2	48.2 D
Iron	12806.693	28000		18000	20000 D
Lead	51.432	110	300	520	890 D
Magnesium	1793.596	5060		2060	
Manganese	263.698	1100			
Mercury	0.101	0.318	10	0.552	0.192 D
Nickel	9.322	23.2	300	12.1	10.6 D
Potassium	450.597	700		740	544 D
Zinc	33.907	85.8	2500	2420	2550 D

Table 3-2
Area A4
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A4CD1 A4CD1A 28-May-92 0 feet	A4CD2 A4CD2A 28-May-92 0 feet	A4SO1 A4SO1A 21-Apr-92 0 feet	A4SO3 A4SO3A 21-Apr-92 0 feet	A4SO5 A4SO5B 08-Nov-93 0 feet	A4SO5 DUPSO01C 08-Nov-93 0 feet
Metals:							
Antimony	8.8		9.43				
Arsenic	4.8	6.61		5.44	8.6	6.4	7.4 D
Cadmium	5	7.42				12.1	13.5 D
Lead	200					520	890 D
Zinc	350	1200				2420	2550 D

Table 3-3
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPA A4TPA1 11-Nov-92 0 feet	A4TPB A4TPB1 11-Nov-92 0 feet	A4TPC A4TPC1 11-Nov-92 0 feet	A4TPD A4TPD1 09-Nov-93 0 feet	A4TPD A4TPD2 09-Nov-93 2 feet	A4TPD A4TPD3 09-Nov-93 4 feet
PCB/Pesticides:									
Endosulfan, alpha	0.005	0.008			0.0185				
ppDDE	0.039	0.139	2		0.0455	0.0526			
ppDDT	0.066	0.23	2		0.0836				
Metals:									
Aluminum	10834.976	18000		15000		14000			
Arsenic	8.951	17	30						
Barium	21.603	54.7		31.5	29.3	41.9	22.7	47.3	40
Beryllium	0.298	0.638	0.4	0.407					
Cadmium	0.563	1.79	30	0.96	0.575	3.29			
Calcium	554.016	1170		1700	713	824			657
Chromium	18.666	62.5	1000						
Cobalt	3.472	7.3				4.09			
Copper	9.521	19.5		13.7		28.5			
Iron	12806.693	28000				23000			
Lead	51.432	110	300			570			
Magnesium	1793.596	5060		2270	2550	1810	3210	2460	2200
Nickel	9.322	23.2	300			12.9			
Potassium	450.597	700		784	1220	705	1160	1850	1530
Sodium	122.501	122							
Vanadium	27.081	51.2							
Zinc	33.907	85.8	2500	41		220			

Table 3-3
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPE A4TPE1 09-Nov-93 0 feet	A4TPE A4TPE2 09-Nov-93 2 feet	A4TPE A4TPE3 09-Nov-93 4 feet	A4TPF A4TPF1 09-Nov-93 0 feet	A4TPF A4TPF2 09-Nov-93 2 feet	A4TPF A4TPF3 09-Nov-93 4 feet
PCB/Pesticides:									
Endosulfan, alpha	0.005	0.008							
ppDDE	0.039	0.139	2						
ppDDT	0.066	0.23	2						
Metals:									
Aluminum	10834.976	18000		11000	14000	13000			
Arsenic	8.951	17	30						
Barium	21.603	54.7		46.7	55.3	69.5	36.8	55.4	72.2
Beryllium	0.298	0.638	0.4	0.415	0.639	0.489			
Cadmium	0.563	1.79	30						
Calcium	554.016	1170		1120	568	2790	744		801
Chromium	18.666	62.5	1000	18.7	20.5	43	45.5	31.7 B	25.7 B
Cobalt	3.472	7.3		4.59	7.38	7.76			
Copper	9.521	19.5		11.8	16.8	23.6	18.6	28.7	22.3
Iron	12806.693	28000		14000	17000	20000		13000	14000
Lead	51.432	110	300						
Magnesium	1793.596	5060		3190	3510	6800	2600	3610	3690
Nickel	9.322	23.2	300	10.4	11.8	25.7			16.3
Potassium	450.597	700		2330	2140	2570	2060	2150	3290
Sodium	122.501	122				274			
Vanadium	27.081	51.2			27.4	30.8			29
Zinc	33.907	85.8	2500			36.5			38.8

Table 3-3
Area A4
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4TPG A4TPG1 09-Nov-93 0 feet	A4TPG DUPTP01C 09-Nov-93 0 feet	A4TPG A4TPG2 09-Nov-93 2 feet	A4TPG A4TPG3 09-Nov-93 4 feet
PCB/Pesticides:							
Endosulfan, alpha	0.005	0.008			*		
ppDDE	0.039	0.139	2		*		
ppDDT	0.066	0.23	2		*		
Metals:							
Aluminum	10834.976	18000			11000 D	12000	12000
Arsenic	8.951	17	30				40
Barium	21.603	54.7		69.3	70.9 D	74.6	68.3
Beryllium	0.298	0.638	0.4	0.421	0.421 D	0.5	0.639
Cadmium	0.563	1.79	30				
Calcium	554.016	1170		1580	1490 D	1050	1110
Chromium	18.666	62.5	1000			19	19.7
Cobalt	3.472	7.3		6.77	8.36 D	7.33	8.58
Copper	9.521	19.5		13.7	15.6 D	15.2	21.6
Iron	12806.693	28000		14000	16000 D	18000	21000
Lead	51.432	110	300				
Magnesium	1793.596	5060		2950	3300 D	4030	3910
Nickel	9.322	23.2	300	13.7	15 D	21.6	21.4
Potassium	450.597	700		2040	2180 D	2700	2370
Sodium	122.501	122		124			123
Vanadium	27.081	51.2				27.7	28.2
Zinc	33.907	85.8	2500			37.7	38.3

Table 3-4
Area A4
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A4B1 A4SB1A 06-May-92 2 feet	A4B2 A4SB2A 06-May-92 2 feet	OHM-A4-4 A4SB4A1 05-May-92 4 feet	OHM-A4-4 A4SB4A2 05-May-92 10 feet	OHM-A4-5 A4SB5A 06-May-92 2 feet	OHM-A4-50 A4SB50B 26-Oct-93 8 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1	0.011	0.014	0.014	0.02	0.032	*
Metals:									
Aluminum	10834.976	18000				16000 B	*		
Arsenic	8.951	17	30			30	*		
Barium	21.603	54.7			25.9	83.7	*		47.8
Beryllium	0.298	0.638	0.4			0.408	*		
Cadmium	0.563	1.79	30			0.994	*		
Calcium	554.016	1170			966		*		1010
Chromium	18.666	62.5	1000			31.4	*		
Cobalt	3.472	7.3			4.09	5.7	*		4.27
Copper	9.521	19.5				22.6	*		
Iron	12806.693	28000				23000 B	*		
Magnesium	1793.596	5060		2190	2220	5370	*	2090	1990
Nickel	9.322	23.2	300			14.4	*		12.6
Potassium	450.597	700		1110	1450	4210	*	1330	1710
Vanadium	27.081	51.2				37.4	*		

Table 3-5
Areas A4 and A3/P5
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A3SW1 A3SW1A 24-Apr-92 0.25 feet	A4SW1 A4SW1A 30-Apr-92 0 feet	A4SW2 A4SW2A 01-May-92 0 feet	A4SW3 A4SW3A 30-Apr-92 0 feet	A4SW5 A4SW5B 02-Nov-93 0 feet	A4SW6 A4SW6B 03-Nov-93 0 feet
PCB/Pesticides:										
ppDDT			0.001	0.00059					0.0285 1	
Metals:										
Aluminum	400	87			724	285	820		24400	2030
Arsenic	3.15		190	0.14	9.19	7.38	5.52		21	6.4
Barium	10.4								85.7	47.4
Calcium	8520								16000	27900
Chromium	3.16	11	11						17.3	
Copper	10	3.6	3.6						89.4	
Iron	4810				4970				21000	
Lead	10.3	0.55	0.55		10.5	1.77	3.13	2.3	140	50
Magnesium	1890								2200	2120
Manganese	156									
Potassium	2060									2090
Vanadium	4.72								40.4	20.2
Zinc	13.3	33	33		25	13.4 B	17.9 B	14.8 B	532	713

Table 3-5
Areas A4 and A3/P5
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A4SW7 A4SW7B 03-Nov-93 0 feet	P5SW1 P5SW1A 24-Apr-92 0.25 feet	P5SW2 P5SW2B 01-Nov-93 0 feet	P5SW3 P5SW3B 01-Nov-93 0 feet	P5SW4 P5SW4B 01-Nov-93 0 feet
PCB/Pesticides:									
ppDDT			0.001	0.00059			*	*	*
Metals:									
Aluminum	400	87			1450		2350	174	1570
Arsenic	3.15		190	0.14	27		5.4		7.9
Barium	10.4				41.3		51.4		68.5
Calcium	8520				21000		22900	10200	11800
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Iron	4810				12000		7940		14000
Lead	10.3	0.55	0.55		18	3.76	28		21
Magnesium	1890				2710		2650		
Manganese	156				231				
Potassium	2060						2740		
Vanadium	4.72								
Zinc	13.3	33	33		632 B	23.6	455 B	453 B	474 B

Table 3-6
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	A3SD1 A3SD1A 24-Apr-92 1 foot	A4SD1 A4SD1A 30-Apr-92 2 feet	A4SD2 A4SD2A 01-May-92 0.5 feet	A4SD3 A4SD3A 30-Apr-92 2.5 feet	A4SD5 A4SD5B1 02-Nov-93 0 feet	A4SD5 A4SD5B2 02-Nov-93 1 foot	A4SD5 A4SD5B3 02-Nov-93 2 feet
PCB/Pesticides:									
ppDDD		0.002					0.0231 1		
ppDDE		0.002							
Metals:									
Aluminum	5020		9900 B	10000 B	8500 B	5900 B	5850	6700	
Arsenic	2.03	6	6.27	17	36	6.36		2.4	
Barium	23.9	20		30.9	26.8				
Beryllium	0.18		0.319						
Calcium	562		772 B		1500	943	1950	875	703
Chromium	9.66	26	14.2	13.9	13.4			10.2	
Cobalt	3.74				4.41				
Copper	6.33	16		7.26	9.77				
Iron	7590		8700 B	9900 B	11000 B				
Lead	4.48	31	5.3 B	9.9	15	9.1	18		
Magnesium	2140			2140					
Manganese	70.5			79.2	380				
Nickel	5.92	16	7.36	8.49	6.27				
Selenium	0.2	1					0.65		
Vanadium	17				18.1				
Zinc	20.8	120			38.4				

Table 3-6
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	A4SD6 A4SD6B1 03-Nov-93 0 feet	A4SD6 A4SD6B2 03-Nov-93 1 foot	A4SD6 A4SD6B3 03-Nov-93 2 feet	A4SD7 A4SD7B1 03-Nov-93 0 feet	A4SD7 A4SD7B2 03-Nov-93 1 foot	A4SD7 A4SD7B3 03-Nov-93 2 feet	P5SD1 P5SD1A 24-Apr-92 1.5 feet
PCB/Pesticides:									
ppDDD		0.002							
ppDDE		0.002	0.0983 1						
Metals:									
Aluminum	5020		6350	11200	5470	6350	9570	18400	15000
Arsenic	2.03	6				3.8	4.4	4.9	
Barium	23.9	20		44	28.3	79.5	102	231	
Beryllium	0.18			1.51				6.57	3.38
Calcium	562		24400	8090	1330	25900	28500	20500	8910 B
Chromium	9.66	26		13.8	11			25.4	16.1
Cobalt	3.74								
Copper	6.33	16						29.5	8.13
Iron	7590								
Lead	4.48	31	31	7.1		32		13	13 B
Magnesium	2140						2260	2180	
Manganese	70.5				72.2	84.5	123	91.8	
Nickel	5.92	16						59.1	
Selenium	0.2	1	2.1	1.6		3.2	6.1	3	4.83
Vanadium	17		17.7				25.5	37.5	
Zinc	20.8	120	34.7	21.1	32	40.3			

Table 3-6
Areas A4 and A3/P5
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	P5SD2 P5SD2B 01-Nov-93 0.5 feet	P5SD3 P5SD3B 01-Nov-93 0.5 feet	P5SD4 P5SD4B 01-Nov-93 0.5 feet
PCB/Pesticides:					
ppDDD		0.002			
ppDDE		0.002			
Metals:					
Aluminum	5020		8760	6390	17900
Arsenic	2.03	6			
Barium	23.9	20	41.6	51.7	44.1
Beryllium	0.18				
Calcium	562		13600	13000	4220
Chromium	9.66	26			17.4
Cobalt	3.74				
Copper	6.33	16			
Iron	7590				12000
Lead	4.48	31	22	68	33
Magnesium	2140				
Manganese	70.5				
Nickel	5.92	16			
Selenium	0.2	1	2.4	2.3	2
Vanadium	17			21.9	23.9
Zinc	20.8	120	26.9	52.5	35.8

Table 4-1
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7CD1 A7CD1A 18-May-92 0 feet	A7CD2 A7CD2A 18-May-92 0 feet	A7SO1 A7SO1A 13-Apr-92 0 feet	A7SO2 A7SO2A 13-Apr-92 0 feet	A7SO3 A7SO3A 13-Apr-92 0 feet	A7SO4 A7SO4A 13-Apr-92 0 feet
VOCs:									
Acetone	0.03	0.046	3				0.3		
Methylene chloride	0.008	0.018	0.1		0.0086	0.01		0.0085	0.018
BNAs:									
2-Methylnaphthalene			0.7						
Benzo(a)anthracene			0.7						
Benzo(a)pyrene			0.7						
PCB/Pesticides:									
Benzenehexachloride, beta	0.005	0.004							
Chlordane, alpha	0.004	0.004		0.209					
Chlordane, gamma	0.019	0.005		0.096					
Chlordane, total	0.023	0.009	1	0.305					
Dieldrin	0.010	0.023	0.03	0.262			0.0118		
Endosulfan, beta	0.007	0.005		0.0914					
Endosulfan, total	0.012	0.013	0.2	0.0914					
Endosulfan sulfate	0.013	0.008		0.0784					
Heptachlor	0.009	0.002	0.1	0.0554					
ppDDD	0.019	0.063	2						
ppDDE	0.039	0.139	2	0.112	86		0.0855		
ppDDT	0.066	0.23	2	0.645	380		0.111		
Metals:									
Barium	21.60	54.7		26.5	36.8	45.5	34.9	32.6	353
Cadmium	0.56	1.79	30	1.18	2.03				
Calcium	554.02	1170			778	558	602	1210	
Chromium	18.67	62.5	1000	200	24.3				
Cobalt	3.47	7.3			5.78			3.85	3.71
Copper	9.52	19.5		11.5	24.8		12.8	14.9	11.6
Iron	12806.69	28000		14000 B	21000 B				
Lead	51.43	110	300	400			52		82
Magnesium	1793.60	5060		2730	3580	2310	1890	3010	2200
Manganese	263.70	1100							
Mercury	0.10	0.318	10	0.221			0.109		
Nickel	9.32	23.2	300		15.2			10.7	
Potassium	450.60	700		1810	2040	1680	1130	1740	1320
Zinc	33.91	85.8	2500		41.8		44		210

Table 4-1
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7SO5 A7SO5A 13-Apr-92 0 feet	A7SO6 A7SO6A 13-Apr-92 0 feet	A7SO7 A7SO7A 13-Apr-92 0 feet	A7SO8 A7SO8A 13-Apr-92 0 feet	A7SO9 A7SO9A 13-Apr-92 0 feet	A7SO10 A7SO10A 13-Apr-92 0 feet
VOCs:									
Acetone	0.03	0.046	3						
Methylene chloride	0.008	0.018	0.1				0.0096		
BNAs:									
2-Methylnaphthalene			0.7		10				
Benzo(a)anthracene			0.7		3 S				
Benzo(a)pyrene			0.7		2				
PCB/Pesticides:									
Benzenehexachloride, beta	0.005	0.004			0.0194				
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005			0.03				
Chlordane, total	0.023	0.009	1		0.03				
Dieldrin	0.010	0.023	0.03						
Endosulfan, beta	0.007	0.005			0.192				
Endosulfan, total	0.012	0.013	0.2		0.192				
Endosulfan sulfate	0.013	0.008							
Heptachlor	0.009	0.002	0.1						
ppDDD	0.019	0.063	2				0.106	0.892	
ppDDE	0.039	0.139	2				0.0499	0.96	
ppDDT	0.066	0.23	2				0.0786	6	
Metals:									
Barium	21.60	54.7			24.2	34.9	25	57.8	39.6
Cadmium	0.56	1.79	30					1.15	0.718
Calcium	554.02	1170		868		602	650	1160	2460
Chromium	18.67	62.5	1000					30.6	34.6
Cobalt	3.47	7.3					4.83	5.64	3.69
Copper	9.52	19.5			21.3		16.5	31.1	11.6
Iron	12806.69	28000					15000	17000 X	13000
Lead	51.43	110	300			65	86	55	
Magnesium	1793.60	5060			1910	2600	2570	3520	3130
Manganese	263.70	1100					270	270	
Mercury	0.10	0.318	10					0.116	
Nickel	9.32	23.2	300				9.79	16.3	15.8
Potassium	450.60	700		1120	1100	2140	1430	1980	1530
Zinc	33.91	85.8	2500		90.5			102	88

Table 4-1
Area A7
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7SO11 A7SO11A 13-Apr-92 0 feet	A7SO12 A7SO12A 13-Apr-92 0 feet
VOCs:					
Acetone	0.03	0.046	3		
Methylene chloride	0.008	0.018	0.1		
BNAs:					
2-Methylnaphthalene			0.7		
Benzo(a)anthracene			0.7		
Benzo(a)pyrene			0.7		
PCB/Pesticides:					
Benzenehexachloride, beta	0.005	0.004			
Chlordane, alpha	0.004	0.004			
Chlordane, gamma	0.019	0.005			
Chlordane, total	0.023	0.009	1		
Dieldrin	0.010	0.023	0.03		
Endosulfan, beta	0.007	0.005			
Endosulfan, total	0.012	0.013	0.2		
Endosulfan sulfate	0.013	0.008			
Heptachlor	0.009	0.002	0.1		
ppDDD	0.019	0.063	2		
ppDDE	0.039	0.139	2		
ppDDT	0.066	0.23	2		
Metals:					
Barium	21.60	54.7			36.5
Cadmium	0.56	1.79	30		
Calcium	554.02	1170		577	
Chromium	18.67	62.5	1000	18.9	
Cobalt	3.47	7.3			
Copper	9.52	19.5			11.5
Iron	12806.69	28000			
Lead	51.43	110	300		
Magnesium	1793.60	5060		3300	2680
Manganese	263.70	1100			
Mercury	0.10	0.318	10		
Nickel	9.32	23.2	300		
Potassium	450.60	700		573	1930
Zinc	33.91	85.8	2500		

Table 4-2
Area A7
Summary of Compounds Exceeding ESAT Soil Criteria
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A7CD1 A7CD1A 18-May-92 0 feet	A7CD2 A7CD2A 18-May-92 0 feet	A7SO2 A7SO2A 13-Apr-92 0 feet	A7SO4 A7SO4A 13-Apr-92 0 feet	A7SO5 A7SO5A 13-Apr-92 0 feet	A7SO6 A7SO6A 13-Apr-92 0 feet	A7SO7 A7SO7A 13-Apr-92 0 feet
BNAs:								
Benzo(a)anthracene	1						3 S	
Benzo(a)pyrene	1						2	
Phenanthrene	5						5	
PCB/Pesticides:								
PCBs, total	1	1.62						
ppDDD	0.5							
ppDDE	0.5		86					
ppDDT	0.5	0.645	380					
Metals:								
Arsenic	4.8	5.05	5.82	6.2		7.7	7.8	4.95
Barium	290				353			
Lead	200	400						

Table 4-2
Area A7
Summary of Compounds Exceeding
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A7SO8 A7SO8A 13-Apr-92 0 feet	A7SO9 A7SO9A 13-Apr-92 0 feet	A7SO10 A7SO10A 13-Apr-92 0 feet	A7SO11 A7SO11A 13-Apr-92 0 feet	A7SO12 A7SO12A 13-Apr-92 0 feet
BNAs:						
Benzo(a)anthracene	1					
Benzo(a)pyrene	1					
Phenanthrene	5					
PCB/Pesticides:						
PCBs, total	1					
ppDDD	0.5		0.892			
ppDDE	0.5		0.96			
ppDDT	0.5		6			
Metals:						
Arsenic	4.8	8.1	6.29	5.1	5.48	7.1
Barium	290					
Lead	200					

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPB A7TPB1 09-Dec-91 2 feet	A7TPC A7TPC1 06-Dec-91 2 feet	A7TPC A7TPC2 06-Dec-91 4 feet	A7TPC A7TPC3 06-Dec-91 6 feet	A7TPD A7TPD1 05-Dec-91 2 feet	A7TPD A7TPD2 05-Dec-91 4 feet	A7TPD A7TPD3 05-Dec-91 6 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1					0.012		
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7							
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		0.0832						
Chlordane, gamma	0.019	0.005		0.105						
Chlordane, total	0.023	0.009	1	0.1882						
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1	0.0189						
Heptachlor epoxide	0.004	0.006	0.06	0.0254						
Lindane	0.019	0.004	0.1							
PCBs, total			2							
ppDDD	0.019	0.063	2							
ppDDE	0.039	0.139	2							
ppDDT	0.066	0.23	2							
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30							
Barium	21.60	54.7			24.4			23.9	21.9	
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	9.23 @	13.4 @	9.54 @	8.39 @	11.1 @	8.51 @	6.62 @
Calcium	554.02	1170		560 B	691 B	624 B	579 B	831 B	972 B	1050 B
Chromium	18.67	62.5	1000							
Cobalt	3.47	7.3								
Copper	9.52	19.5		11.2	11.4			11.8		

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPB A7TPB1 09-Dec-91 2 feet	A7TPC A7TPC1 06-Dec-91 2 feet	A7TPC A7TPC2 06-Dec-91 4 feet	A7TPC A7TPC3 06-Dec-91 6 feet	A7TPD A7TPD1 05-Dec-91 2 feet	A7TPD A7TPD2 05-Dec-91 4 feet	A7TPD A7TPD3 05-Dec-91 6 feet
Iron	12806.69	28000								
Lead	51.43	110	300							
Magnesium	1793.60	5060			2220			2320		
Manganese	263.70	1100								
Mercury	0.10	0.318	10					0.212 B		
Nickel	9.32	23.2	300							
Potassium	450.60	700		1180	1710	1060	1130	1280	1050	716
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500					35.2	39.5	

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPE A7TPE1 05-Dec-91 2 feet	A7TPE A7TPE2 05-Dec-91 4 feet	A7TPE A7TPE3 05-Dec-91 6 feet	A7TPF A7TPF1 06-Dec-91 2 feet	A7TPG A7TPG1 09-Dec-91 2 feet	A7TPH A7TPH1 06-Dec-91 2 feet	A7TPH A7TPH2 06-Dec-91 4 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1							
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7	0.79						
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004								
Chlordane, gamma	0.019	0.005								
Chlordane, total	0.023	0.009	1							
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1							
Heptachlor epoxide	0.004	0.006	0.06							
Lindane	0.019	0.004	0.1							
PCBs, total			2							
ppDDD	0.019	0.063	2							
ppDDE	0.039	0.139	2	0.0504						
ppDDT	0.066	0.23	2	0.132						
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30	27					15	9.5
Barium	21.60	54.7		50.3						37.9
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	12.1 @	6.33 @	9.13 @	9.33 @	9.72 @	11.7 @	27.5 @
Calcium	554.02	1170		2430 B	927 B	838 B	910 B			5420 B
Chromium	18.67	62.5	1000							23.4
Cobalt	3.47	7.3		3.78					3.52	6.7
Copper	9.52	19.5		94 B				13.4	119	250

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPE A7TPE1 05-Dec-91 2 feet	A7TPE A7TPE2 05-Dec-91 4 feet	A7TPE A7TPE3 05-Dec-91 6 feet	A7TPF A7TPF1 06-Dec-91 2 feet	A7TPG A7TPG1 09-Dec-91 2 feet	A7TPH A7TPH1 06-Dec-91 2 feet	A7TPH A7TPH2 06-Dec-91 4 feet
Iron	12806.69	28000								22000 B
Lead	51.43	110	300	53						160 X
Magnesium	1793.60	5060		2110			1840			2310
Manganese	263.70	1100								
Mercury	0.10	0.318	10	0.148 B				0.213		
Nickel	9.32	23.2	300	9.96						18.7
Potassium	450.60	700		992	1160	1210	1390	1340	1030	1560
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500	840				35		60.5

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPI A7TPI1 09-Dec-91 2 feet	A7TPJ A7TPJ1 04-Dec-91 2 feet	A7TPK A7TPK1 04-Dec-91 2 feet	A7TPL A7TPL1 04-Dec-91 2 feet	A7TPL A7TPL2 04-Dec-91 4 feet	A7TPL A7TPL3 04-Dec-91 6 feet	A7TPM A7TPM1 12-Nov-92 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3			20				
1,2-Dichloroethane			0.05			1				
Chloroform			0.1			20				
Methylene chloride	0.008	0.018	0.1		0.014					0.0099
Tetrachloroethylene			0.5			20 X				
BNAs:										
2-Methylnaphthalene			0.7							
Chrysene			0.7							
Di-n-butyl phthalate	3.80	9								
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004				0.15		0.00568		
Chlordane, gamma	0.019	0.005				0.26				
Chlordane, total	0.023	0.009	1			0.41				
Dieldrin	0.010	0.023	0.03							
Endosulfan, beta	0.007	0.005								
Endosulfan, total	0.012	0.013	0.2							
Endrin	0.011	0.008	0.6							
Heptachlor	0.009	0.002	0.1			0.064				
Heptachlor epoxide	0.004	0.006	0.06			0.044				
Lindane	0.019	0.004	0.1			0.52 1				
PCBs, total			2			2 S				
ppDDD	0.019	0.063	2			2.4				
ppDDE	0.039	0.139	2			0.17				
ppDDT	0.066	0.23	2			4.5				
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000								
Arsenic	8.95	17	30							
Barium	21.60	54.7			32.8	27.6				
Beryllium	0.30	0.638	0.4							
Cadmium	0.56	1.79	30	10 @	10.6 @	24.4 @	12 @	8.51 @	9.08 @	0.956
Calcium	554.02	1170			648 B	555 B	590 B			
Chromium	18.67	62.5	1000			270				
Cobalt	3.47	7.3			3.91	6.01			4.64	4.28
Copper	9.52	19.5			12.9	27.9	11			

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPI A7TPI1 09-Dec-91 2 feet	A7TPJ A7TPJ1 04-Dec-91 2 feet	A7TPK A7TPK1 04-Dec-91 2 feet	A7TPL A7TPL1 04-Dec-91 2 feet	A7TPL A7TPL2 04-Dec-91 4 feet	A7TPL A7TPL3 04-Dec-91 6 feet	A7TPM A7TPM1 12-Nov-92 2 feet
Iron	12806.69	28000				20000 B				
Lead	51.43	110	300		61	93				
Magnesium	1793.60	5060			2590	1820	2240		2210	2090
Manganese	263.70	1100								
Mercury	0.10	0.318	10		0.328 B	0.384 B				
Nickel	9.32	23.2	300		10.5					
Potassium	450.60	700		892	1580	868	1210	791	1390	1040
Vanadium	27.08	51.2								
Zinc	33.91	85.8	2500		72.8	81.9				

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPM A7TPM3 12-Nov-92 6 feet	A7TPN A7TPN1 12-Nov-92 2 feet	A7TPN A7TPN2 12-Nov-92 4 feet	A7TPO A7TPO1 11-Nov-92 2 feet	A7TPO A7TPO2 11-Nov-92 4 feet	A7TPP A7TPP1 12-Nov-92 2 feet	A7TPP DUPTP01B 12-Nov-92 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3							
1,2-Dichloroethane			0.05							
Chloroform			0.1							
Methylene chloride	0.008	0.018	0.1	0.0087	0.0094	0.0091		0.012		
Tetrachloroethylene			0.5							
BNAs:										
2-Methylnaphthalene			0.7	*		*		*		
Chrysene			0.7	*		*		*		
Di-n-butyl phthalate	3.80	9		*		*		*		
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		*		*		*		
Chlordane, gamma	0.019	0.005		*		*		*		
Chlordane, total	0.023	0.009	1	*		*		*		
Dieldrin	0.010	0.023	0.03	*		*		*		
Endosulfan, beta	0.007	0.005		*		*		*		
Endosulfan, total	0.012	0.013	0.2	*		*		*		
Endrin	0.011	0.008	0.6	*		*		*		
Heptachlor	0.009	0.002	0.1	*		*		*		
Heptachlor epoxide	0.004	0.006	0.06	*		*		*		
Lindane	0.019	0.004	0.1	*		*		*		
PCBs, total			2	*		*		*		
ppDDD	0.019	0.063	2	*		*	0.031	*		
ppDDE	0.039	0.139	2	*		*	0.0684	*		
ppDDT	0.066	0.23	2	*		*	0.164	*		
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	*	*	*
Metals:										
Aluminum	10834.98	18000		*	12000	*	13000	*		
Arsenic	8.95	17	30	*		*		*		
Barium	21.60	54.7		*	38.8	*	32.9	*		
Beryllium	0.30	0.638	0.4	*		*		*		
Cadmium	0.56	1.79	30	*	2.38	*	1.2	*	0.78	0.774 D
Calcium	554.02	1170		*		*	847	*		
Chromium	18.67	62.5	1000	*	22.8	*		*		
Cobalt	3.47	7.3		*	4.63	*		*		
Copper	9.52	19.5		*	18.6	*	9.56	*		

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPM A7TPM3 12-Nov-92 6 feet	A7TPN A7TPN1 12-Nov-92 2 feet	A7TPN A7TPN2 12-Nov-92 4 feet	A7TPO A7TPO1 11-Nov-92 2 feet	A7TPO A7TPO2 11-Nov-92 4 feet	A7TPP A7TPP1 12-Nov-92 2 feet	A7TPP DUPTP01B 12-Nov-92 2 feet
Iron	12806.69	28000		*	17000	*	13000	*		
Lead	51.43	110	300	*		*		*		
Magnesium	1793.60	5060		*	3610	*	2550	*	1950	
Manganese	263.70	1100		*		*		*		
Mercury	0.10	0.318	10	*		*		*		
Nickel	9.32	23.2	300	*	10.1	*	11.2	*		
Potassium	450.60	700		*	2400	*	1160	*	906	810 D
Vanadium	27.08	51.2		*	27.3	*		*		
Zinc	33.91	85.8	2500	*		*	35.5	*		

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPP A7TPP2 12-Nov-92 4 feet	A7TPQ A7TPQ1 12-Nov-93 0 feet	A7TPQ A7TPQ3 12-Nov-93 4 feet	A7TPQ A7TPQ4 12-Nov-93 5 feet	A7TPR A7TPR1 11-Nov-93 0 feet	A7TPR DUPTP02C 11-Nov-93 0 feet	A7TPR A7TPR2 11-Nov-93 2 feet
VOCs:										
1,1,2-Trichloroethane			0.3		*	*	*			
1,2-Dichloroethane			0.05		*	*	*			
Chloroform			0.1		*	*	*			
Methylene chloride	0.008	0.018	0.1	0.0081	*	*	*		0.0094 D	
Tetrachloroethylene			0.5		*	*	*			2.9 S
BNAs:										
2-Methylnaphthalene			0.7	*	*	*	*	2 1		3
Chrysene			0.7	*	*	*	*			
Di-n-butyl phthalate	3.80	9		*	*	*	*	10		
PCB/Pesticides:										
Chlordane, alpha	0.004	0.004		*					0.48 D	0.4
Chlordane, gamma	0.019	0.005		*						
Chlordane, total	0.023	0.009	1	*					0.48 D	0.4
Dieldrin	0.010	0.023	0.03	*				0.95	4.9 D	1.5
Endosulfan, beta	0.007	0.005		*						
Endosulfan, total	0.012	0.013	0.2	*						
Endrin	0.011	0.008	0.6	*						
Heptachlor	0.009	0.002	0.1	*						
Heptachlor epoxide	0.004	0.006	0.06	*						
Lindane	0.019	0.004	0.1	*						0.67
PCBs, total			2	*					3.1 D	2.4
ppDDD	0.019	0.063	2	*			210			
ppDDE	0.039	0.139	2	*	0.79	5.9	8			
ppDDT	0.066	0.23	2	*	20	350	610			
Phosphate:										
Phosphate	6.01	19.5		*	*	*	*	450	400 D	360
Metals:										
Aluminum	10834.98	18000		*	*	*	*			
Arsenic	8.95	17	30	*	*	*	*			
Barium	21.60	54.7		*	*	*	*	31.1	37.6 D	46.7
Beryllium	0.30	0.638	0.4	*	*	*	*	0.406		
Cadmium	0.56	1.79	30	*	*	*	*			
Calcium	554.02	1170		*	*	*	*			
Chromium	18.67	62.5	1000	*	*	*	*			33.2
Cobalt	3.47	7.3		*	*	*	*			
Copper	9.52	19.5		*	*	*	*		10.6 D	

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPP A7TPP2 12-Nov-92 4 feet	A7TPQ A7TPQ1 12-Nov-93 0 feet	A7TPQ A7TPQ3 12-Nov-93 4 feet	A7TPQ A7TPQ4 12-Nov-93 5 feet	A7TPR A7TPR1 11-Nov-93 0 feet	A7TPR DUPTP02C 11-Nov-93 0 feet	A7TPR A7TPR2 11-Nov-93 2 feet
Iron	12806.69	28000		*	*	*	*			
Lead	51.43	110	300	*	*	*	*			3900
Magnesium	1793.60	5060		*	*	*	*	1970	2460 D	2880
Manganese	263.70	1100		*	*	*	*			
Mercury	0.10	0.318	10	*	*	*	*			0.467
Nickel	9.32	23.2	300	*	*	*	*			
Potassium	450.60	700		*	*	*	*	912	1620 D	1980
Vanadium	27.08	51.2		*	*	*	*			
Zinc	33.91	85.8	2500	*	*	*	*			36.1

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPS A7TPS1 12-Nov-93 0 feet	A7TPS A7TPS2 12-Nov-93 2 feet	A7TPS A7TPS3 12-Nov-93 4 feet	A7TPT A7TPT1 12-Nov-93 0 feet	A7TPT A7TPT2 12-Nov-93 2 feet	A7TPT A7TPT3 12-Nov-93 4 feet
VOCs:									
1,1,2-Trichloroethane			0.3	*	*	*	*	*	*
1,2-Dichloroethane			0.05	*	*	*	*	*	*
Chloroform			0.1	*	*	*	*	*	*
Methylene chloride	0.008	0.018	0.1	*	*	*	*	*	*
Tetrachloroethylene			0.5	*	*	*	*	*	*
BNAs:									
2-Methylnaphthalene			0.7	*	*	*	*	*	*
Chrysene			0.7	*	*	*	*	*	*
Di-n-butyl phthalate	3.80	9		*	*	*	*	*	*
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004		10	1.1	0.0312	0.0704	0.038	0.0151
Chlordane, gamma	0.019	0.005		20	2.4	0.0597		0.055 1	
Chlordane, total	0.023	0.009	1	30	3.5	0.0909	0.0704	0.093 1	
Dieldrin	0.010	0.023	0.03						
Endosulfan, beta	0.007	0.005						0.012 1	
Endosulfan, total	0.012	0.013	0.2					0.012 1	
Endrin	0.011	0.008	0.6	4.1	0.46		0.0293		
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06	0.29 1	0.05 1		0.00724	0.011	
Lindane	0.019	0.004	0.1						
PCBs, total			2						
ppDDD	0.019	0.063	2						
ppDDE	0.039	0.139	2	1.1 1	0.21			0.049	
ppDDT	0.066	0.23	2				0.117	0.23	0.0954
Phosphate:									
Phosphate	6.01	19.5		*	*	*	*	*	*
Metals:									
Aluminum	10834.98	18000				13000	*	*	*
Arsenic	8.95	17	30				*	*	*
Barium	21.60	54.7		43.6	47	67.9	*	*	*
Beryllium	0.30	0.638	0.4		0.366	0.489	*	*	*
Cadmium	0.56	1.79	30				*	*	*
Calcium	554.02	1170		2440	1570	609	*	*	*
Chromium	18.67	62.5	1000		42.8 B	24.6	*	*	*
Cobalt	3.47	7.3					*	*	*
Copper	9.52	19.5		19.8	66.1	21.2	*	*	*

Table 4-3
Area A7
Summary of Compounds Exceeding Soil Criteria
Test Pit Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7TPS A7TPS1 12-Nov-93 0 feet	A7TPS A7TPS2 12-Nov-93 2 feet	A7TPS A7TPS3 12-Nov-93 4 feet	A7TPT A7TPT1 12-Nov-93 0 feet	A7TPT A7TPT2 12-Nov-93 2 feet	A7TPT A7TPT3 12-Nov-93 4 feet
Iron	12806.69	28000			16000	22000	*	*	*
Lead	51.43	110	300	330	520		*	*	*
Magnesium	1793.60	5060		2410	2720	4730	*	*	*
Manganese	263.70	1100			320		*	*	*
Mercury	0.10	0.318	10	0.372			*	*	*
Nickel	9.32	23.2	300	14.2	13.9	10.6	*	*	*
Potassium	450.60	700		1130	1190	4220	*	*	*
Vanadium	27.08	51.2		145	33.8	40.1	*	*	*
Zinc	33.91	85.8	2500	136	107	49.5	*	*	*

Table 4-4
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B1 A7SB1A 13-Mar-92 4 feet	A7B2 A7SB2B 11-May-92 2 feet	A7B3 A7SB3B 11-May-92 2 feet	A7B4 A7SB4B 12-May-92 4 feet	A7B5 A7SB5B 12-May-92 4 feet	A7B6 A7SB6B 12-May-92 6 feet
VOCs:									
Acetone	0.03	0.046	3			0.027			
Chloroform			0.1						
Methylene chloride	0.01	0.018	0.1	0.012	0.023	0.019			
Tetrachloroethylene			0.5						
BNAs:									
2-Methylnaphthalene			0.7						
Benzo(a)pyrene			0.7				0.85		
Benzo(b)fluoranthene			0.7				1.2		
Di-n-butyl phthalate	3.80	9						10 S	
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004					0.125		
Chlordane, gamma	0.019	0.005					0.167		
Chlordane, total	0.023	0.009	1				0.292		
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1				0.0278		
Heptachlor epoxide	0.004	0.006	0.06				0.016		
Lindane	0.019	0.004	0.1				0.294		
ppDDD	0.019	0.063	2				1.02	0.0282	0.0513
ppDDE	0.039	0.139	2				0.172		0.0467
ppDDT	0.066	0.23	2				2.15		0.104
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30					10	11
Barium	21.60	54.7		43.7	22.6	28.5	21.9		29.8
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30	0.785			0.974	0.774	
Calcium	554.02	1170						604	
Chromium	18.67	62.5	1000				19.4		
Cobalt	3.47	7.3							
Copper	9.52	19.5		15		9.79	14.7	10.2	
Iron	12806.69	28000		16000					
Magnesium	1793.60	5060		3190	2440	2190	1840	2630	
Manganese	263.70	1100							
Mercury	0.10	0.318	10				0.859		
Nickel	9.32	23.2	300						
Potassium	450.60	700		2910	1740	1610	1220	1340	
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500				60.2		

Table 4-4
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A7-7 A7SB7A 12-Mar-92 2 feet	OHM-A7-7A A7SB7AA 14-May-92 4 feet	A7B7 A7SB7B 12-May-92 6 feet	OHM-A7-8 A7SB8A 12-Mar-92 8 feet	A7B8 A7SB8B 11-May-92 4 feet	A7B9 A7SB9B 12-May-92 4 feet
VOCs:									
Acetone	0.03	0.046	3						
Chloroform			0.1				0.3		
Methylene chloride	0.01	0.018	0.1	0.0086					
Tetrachloroethylene			0.5				0.6		
BNAs:									
2-Methylnaphthalene			0.7					1.8	
Benzo(a)pyrene			0.7						
Benzo(b)fluoranthene			0.7						
Di-n-butyl phthalate	3.80	9							
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005							
Chlordane, total	0.023	0.009	1						
Dieldrin	0.010	0.023	0.03				0.0192		
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06						
Lindane	0.019	0.004	0.1				0.51		
ppDDD	0.019	0.063	2				2.6	64	
ppDDE	0.039	0.139	2				0.195	1.6 1	
ppDDT	0.066	0.23	2				4.5	49	
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7			22.7	24.8	40.6	44.8	
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30		0.787	0.744		0.819	0.585
Calcium	554.02	1170			737	861	572	923	657
Chromium	18.67	62.5	1000					21.2	
Cobalt	3.47	7.3					5.86	5.02	
Copper	9.52	19.5					22.6	17.1	
Iron	12806.69	28000					14000 X	18000 B	
Magnesium	1793.60	5060		2420	2390	2420	2340	3500	1930
Manganese	263.70	1100							
Mercury	0.10	0.318	10				0.919		
Nickel	9.32	23.2	300	9.7				12.4	
Potassium	450.60	700		869	1760	1780	1560	2750	1460
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500				46.1		

Table 4-4
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B10 A7SB10B 11-May-92 0 feet	A7B11 A7SB11B 14-May-92 2 feet	A7B12 A7SB12B 14-May-92 2 feet	OHM-A7-13 A7SB13A 06-Mar-92 6 feet	A7B16 A7SB16B 12-Nov-93 10 feet	A7B18 A7SB18B 12-Nov-93 4 feet
VOCs:									
Acetone	0.03	0.046	3					*	*
Chloroform			0.1					*	*
Methylene chloride	0.01	0.018	0.1		0.013			*	*
Tetrachloroethylene			0.5					*	*
BNAs:									
2-Methylnaphthalene			0.7					*	*
Benzo(a)pyrene			0.7					*	*
Benzo(b)fluoranthene			0.7					*	*
Di-n-butyl phthalate	3.80	9						*	*
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004				0.91			
Chlordane, gamma	0.019	0.005				1.7			
Chlordane, total	0.023	0.009	1			2.61			
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06			0.055			
Lindane	0.019	0.004	0.1						
ppDDD	0.019	0.063	2					0.0231	0.228
ppDDE	0.039	0.139	2			0.12 1			0.0639
ppDDT	0.066	0.23	2			0.16			1.4
Metals:									
Aluminum	10834.98	18000				18000 B		*	*
Arsenic	8.95	17	30					*	*
Barium	21.60	54.7		42.5	45.5	89.3	40.1	*	*
Beryllium	0.30	0.638	0.4			0.355		*	*
Cadmium	0.56	1.79	30	0.572	1.25	3.06	0.822	*	*
Calcium	554.02	1170				771		*	*
Chromium	18.67	62.5	1000		20.2	35.9	20.5	*	*
Cobalt	3.47	7.3			4.06 7	11.9		*	*
Copper	9.52	19.5		10.1	18.1	31.2	14.3	*	*
Iron	12806.69	28000				16000 B	17000	*	*
Magnesium	1793.60	5060		3160	3280	6670	3640	*	*
Manganese	263.70	1100				480		*	*
Mercury	0.10	0.318	10			0.621		*	*
Nickel	9.32	23.2	300		10.7	16.5		*	*
Potassium	450.60	700		3070	3180	6720	3510	*	*
Vanadium	27.08	51.2				63.4	30.7	*	*
Zinc	33.91	85.8	2500			260		*	*

Table 4-4
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7B19 A7SB19B 12-Nov-93 4 feet	OHM-A7-45 A7SB45A 11-May-92 6 feet	OHM-A7-46 A7SB46A 08-May-92 8 feet	OHM-A7-51 A7SB51B 28-Oct-93 8 feet	A7HA1 A7HA1A 11-Aug-92 1.5 feet	A7HA1 DUPHA01A 11-Aug-92 1.5 feet
VOCs:									
Acetone	0.03	0.046	3	*					
Chloroform			0.1	*					
Methylene chloride	0.01	0.018	0.1	*	0.026	0.023			
Tetrachloroethylene			0.5	*					
BNAs:									
2-Methylnaphthalene			0.7	*					
Benzo(a)pyrene			0.7	*					
Benzo(b)fluoranthene			0.7	*					
Di-n-butyl phthalate	3.80	9		*					
PCB/Pesticides:									
Chlordane, alpha	0.004	0.004							
Chlordane, gamma	0.019	0.005							
Chlordane, total	0.023	0.009	1						
Dieldrin	0.010	0.023	0.03						
Heptachlor	0.009	0.002	0.1						
Heptachlor epoxide	0.004	0.006	0.06						
Lindane	0.019	0.004	0.1						
ppDDD	0.019	0.063	2	1.2					
ppDDE	0.039	0.139	2	0.0646					
ppDDT	0.066	0.23	2	3.8					
Metals:									
Aluminum	10834.98	18000		*			11000	13000	
Arsenic	8.95	17	30	*	12				
Barium	21.60	54.7		*			61.3	58.2	30 D
Beryllium	0.30	0.638	0.4	*			0.517		
Cadmium	0.56	1.79	30	*				3.73	3.34 D
Calcium	554.02	1170		*	585		568	600	
Chromium	18.67	62.5	1000	*			26.9	27.7	20.2 D
Cobalt	3.47	7.3		*			3.67	5.29	3.9 D
Copper	9.52	19.5		*			18.8	30.9	15.4 D
Iron	12806.69	28000		*			18000	18000	15000 D
Magnesium	1793.60	5060		*		1920	3910	4400	3310 D
Manganese	263.70	1100		*					
Mercury	0.10	0.318	10	*					
Nickel	9.32	23.2	300	*			12.3	11	11 D
Potassium	450.60	700		*	753	1070	2960	3970	2070 D
Vanadium	27.08	51.2		*			29.9	46.4	
Zinc	33.91	85.8	2500	*			39.6		

Table 4-4
Area A7
Summary of Compounds Exceeding Soil Criteria
Boring and Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A7HA2 A7HA2A 11-Aug-92 1 foot
VOCs:				
Acetone	0.03	0.046	3	
Chloroform			0.1	
Methylene chloride	0.01	0.018	0.1	
Tetrachloroethylene			0.5	
BNAs:				
2-Methylnaphthalene			0.7	
Benzo(a)pyrene			0.7	
Benzo(b)fluoranthene			0.7	
Di-n-butyl phthalate	3.80	9		
PCB/Pesticides:				
Chlordane, alpha	0.004	0.004		
Chlordane, gamma	0.019	0.005		
Chlordane, total	0.023	0.009	1	
Dieldrin	0.010	0.023	0.03	
Heptachlor	0.009	0.002	0.1	
Heptachlor epoxide	0.004	0.006	0.06	
Lindane	0.019	0.004	0.1	
ppDDD	0.019	0.063	2	
ppDDE	0.039	0.139	2	
ppDDT	0.066	0.23	2	
Metals:				
Aluminum	10834.98	18000		
Arsenic	8.95	17	30	
Barium	21.60	54.7		37
Beryllium	0.30	0.638	0.4	
Cadmium	0.56	1.79	30	3.13
Calcium	554.02	1170		583
Chromium	18.67	62.5	1000	20.1
Cobalt	3.47	7.3		4.88
Copper	9.52	19.5		19.6
Iron	12806.69	28000		14000
Magnesium	1793.60	5060		3600
Manganese	263.70	1100		
Mercury	0.10	0.318	10	
Nickel	9.32	23.2	300	11.4
Potassium	450.60	700		2200
Vanadium	27.08	51.2		
Zinc	33.91	85.8	2500	

Table 4-5
Area A7
Summary of Compounds Exceeding ESAT Soil Criteria
Hand Auger Samples (ug/g)

Analyte	ESAT Soil	A7HA1 A7HA1A 11-Aug-92 1.5 feet
Metals:		
Arsenic	4.8	6.35

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-8 A7GW8A 25-Jun-92 Filtered metals	OHM-A7-8 A7GW8B 04-Nov-92 Filtered metals	OHM-A7-8 A7GW8C1 01-Dec-93 Unfiltered pest	OHM-A7-9 A7GW9A 03-Oct-91 Filtered metals	OHM-A7-9 A7GW9B 25-Jun-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4			16 S		
Tetrachloroethylene		840		8.85	13	15	38 S		
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013		0.029 1	0.03 1		
Chlordane, total			0.0043	0.00059	0.032	0.032			
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011		0.0134			
Lindane			0.08	0.063	1.1	1.26	0.49		
ppDDD				0.00084	0.203	0.445	0.232		
ppDDT			0.001	0.00059		0.0761			
Metals:									
Aluminum	400	87					*	121	
Arsenic	3.15		190	0.14		2.98	*		
Calcium	8520					9050	*	9900	12000
Chromium	3.16	11	11				*		
Copper	10	3.6	3.6				*	4.56	
Lead	10.3	0.55	0.55			5.96	*		
Magnesium	1890					2800	*	2600	2400
Manganese	156				164	221	*		
Mercury		0.012	0.012	0.15			*		
Potassium	2060				3580	3210	*	4000 T	3600
Vanadium	4.72						*		
Zinc	13.3	33	33		91.9	68.8	*	24.6	20.1

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-9 A7GW9C 05-Nov-92 Filtered metals	OHM-A7-10 A7GW10A 03-Oct-91 Filtered metals	OHM-A7-10 A7GW10B 25-Jun-92 Filtered metals	OHM-A7-10 A7GW10C 04-Nov-92 Filtered metals	OHM-A7-11 A7GW11A 03-Oct-91 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					0.011 U
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063					
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87				640			
Arsenic	3.15		190	0.14					
Calcium	8520				11600				19000
Chromium	3.16	11	11						5.27
Copper	10	3.6	3.6		7.29	8.54			
Lead	10.3	0.55	0.55		4.35		3.2	4.11	
Magnesium	1890				2740				4700
Manganese	156								
Mercury		0.012	0.012	0.15					
Potassium	2060				3600	2080 T	2810		4900 T
Vanadium	4.72					5.09			
Zinc	13.3	33	33		24.7			20	

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-11 A7GW11B 25-Jun-92 Filtered metals	OHM-A7-11 A7GW11C 05-Nov-92 Filtered metals	OHM-A7-12 A7GW12A 03-Oct-91 Filtered metals	OHM-A7-12 A7GW12B 25-Jun-92 Filtered metals	OHM-A7-12 A7GW12C 04-Nov-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063					
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					
Calcium	8520				21200	24100			
Chromium	3.16	11	11						
Copper	10	3.6	3.6				7.02		
Lead	10.3	0.55	0.55		2.19	4.57	6.99	18.7	4.26
Magnesium	1890				5080	4990			
Manganese	156								
Mercury		0.012	0.012	0.15					
Potassium	2060				4880	4950		2610	
Vanadium	4.72								
Zinc	13.3	33	33			17.6			16.7

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-13 A7GW13A 25-Jun-92 Filtered metals	OHM-A7-13 A7GW13B 03-Nov-92 Filtered metals	OHM-A7-45 A7GW45A 25-Jun-92 Filtered metals	OHM-A7-45 A7GW45B 05-Nov-92 Filtered metals	OHM-A7-46 A7GW46A 25-Jun-92 Filtered metals
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11					
Carbon tetrachloride				4.4					
Tetrachloroethylene		840		8.85					12
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9		12			
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013					0.269
Chlordane, total			0.0043	0.00059			0.0637		
Dieldrin			0.0019	0.00014			0.101		
Endrin		0.0023	0.0023	0.81			0.144		0.0627
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011			0.171		
Lindane			0.08	0.063					2.8 X
ppDDD				0.00084					
ppDDT			0.001	0.00059			0.0374		
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					
Calcium	8520					9510			
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Lead	10.3	0.55	0.55		1.9	2.88	2.7		2.68
Magnesium	1890					2090			
Manganese	156					270			313
Mercury		0.012	0.012	0.15	0.205				
Potassium	2060				3210	5920	3170	2120	5620
Vanadium	4.72								
Zinc	13.3	33	33			35.1	15.7	18.9	

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-46 A7GW46C1 01-Dec-93 Unfiltered pest	OHM-A7-46 A7GW46C2 01-Dec-93 Filtered pest	OHM-A7-51 A7GW51A1 01-Dec-93 Unfiltered pest	OHM-A7-51 A7GW51A2 01-Dec-93 Filtered pest	OHM-A7-52 A7GW52A1 01-Dec-93 Unfiltered pest
VOCs:									
1,1,2,2-Tetrachloroethane		2400		11	*	*	200 S	*	*
Carbon tetrachloride				4.4	*	*		*	*
Tetrachloroethylene		840		8.85	*	*	130 S	*	*
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9	*	*		*	*
PCB/Pesticides:									
Benzene hexachloride, alpha				0.013	0.143	0.149			
Chlordane, total			0.0043	0.00059					
Dieldrin			0.0019	0.00014					
Endrin		0.0023	0.0023	0.81					
Heptachlor		0.0038	0.0038	0.00021					
Heptachlor epoxide		0.0038	0.0038	0.00011					
Lindane			0.08	0.063	3.1 1	2.8 1	3.5 1	3.6 1	0.0669
ppDDD				0.00084					
ppDDT			0.001	0.00059					
Metals:									
Aluminum	400	87			*	*	*	*	*
Arsenic	3.15		190	0.14	*	*	*	*	*
Calcium	8520				*	*	*	*	*
Chromium	3.16	11	11		*	*	*	*	*
Copper	10	3.6	3.6		*	*	*	*	*
Lead	10.3	0.55	0.55		*	*	*	*	*
Magnesium	1890				*	*	*	*	*
Manganese	156				*	*	*	*	*
Mercury		0.012	0.012	0.15	*	*	*	*	*
Potassium	2060				*	*	*	*	*
Vanadium	4.72				*	*	*	*	*
Zinc	13.3	33	33		*	*	*	*	*

Table 4-6
Area A7
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A7-52 A7GW52A2 01-Dec-93 Filtered pest
VOCs:					
1,1,2,2-Tetrachloroethane		2400		11	*
Carbon tetrachloride				4.4	*
Tetrachloroethylene		840		8.85	*
BNAs:					
Bis(2-ethylhexyl) phthalate		360		5.9	*
PCB/Pesticides:					
Benzene hexachloride, alpha				0.013	
Chlordane, total			0.0043	0.00059	
Dieldrin			0.0019	0.00014	
Endrin		0.0023	0.0023	0.81	
Heptachlor		0.0038	0.0038	0.00021	
Heptachlor epoxide		0.0038	0.0038	0.00011	
Lindane			0.08	0.063	0.0793
ppDDD				0.00084	
ppDDT			0.001	0.00059	
Metals:					
Aluminum	400	87			*
Arsenic	3.15		190	0.14	*
Calcium	8520				*
Chromium	3.16	11	11		*
Copper	10	3.6	3.6		*
Lead	10.3	0.55	0.55		*
Magnesium	1890				*
Manganese	156				*
Mercury		0.012	0.012	0.15	*
Potassium	2060				*
Vanadium	4.72				*
Zinc	13.3	33	33		*

Table 4-7
Areas A7 and P9
Summary of Compounds Exceeding Surface Water Criteria
Surface Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	A7SW1 A7SW1A 04-May-92 0 feet	A7SW2 A7SW2A 04-May-92 0 feet	A7SW3 A7SW3B 02-Nov-93 0 feet	A7SW3 DUPSW01C 02-Nov-93 0 feet	P9SW1 P9SW1A 29-Apr-92 0 feet	E3-BCK-D03 WXBCK031 17-Sept-93 0 feet
Metals:										
Aluminum	400	87				650	140	152 D		
Arsenic	3.15		190	0.14		9.44				1.52 J
Calcium	8520						13100	12200 D		8760
Lead	10.3	0.55	0.55		2.58	5.31			2.03	1.04 J
Magnesium	1890							1910 D		1950
Manganese	156					261	194	208 D		
Potassium	2060						2260	2260 D		4460
Zinc	13.3	33	33		15.8 B	18.1 B	600 B	497 B		17.3 J

Table 4-8
Areas A7 and P9
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Max Bkgrnd	ESAT Sed Value	A7SD1 A7SD1A 04-May-92 0.25 feet	A7SD2 A7SD2A 04-May-92 2 feet	A7SD3 A7SD3B 02-Nov-93 0.5 feet	A7SD3 DUPSD01C 02-Nov-93 0.5 feet	P9SD1 P9SD1A 29-Apr-92 0.5 feet	P9SD2 P9SD2A 29-Apr-92 0.5 feet
PCB/Pesticides:								
Chlordane, total		0.0005						0.287 1
ppDDD		0.002						0.0182
ppDDE		0.002						
ppDDT		0.001						0.0143
Metals:								
Aluminum	5020			15000 B	9020	9370 D	5400 B	
Arsenic	2.03	6	14	12	28	35 D	11	10
Barium	23.9	20	21.2	27.2	66.4	68.4 D	34.1	
Beryllium	0.18			0.379				
Calcium	562		663		5690	5370 D	702	895
Chromium	9.66	26		17.2	14.2	15.2 D	11.3	
Cobalt	3.74		5.27	11.6				
Copper	6.33	16		17				7.7
Iron	7590		11000 B	16000 B	14000	17000 D	11000 B	11000 B
Lead	4.48	31	12	6.1	12	16 D	5.9	11
Magnesium	2140			2230				
Manganese	70.5		1900	99.4	460	529 D	170	130
Nickel	5.92	16	7.75	25.7			6.14	7.6
Potassium	1520						1900	
Selenium	0.2	1			2.4	2.2 D		
Vanadium	17			17.9	17.3	20.2 D	17.4	
Zinc	20.8	120	23.6	29.9	44	50.8 D	27.3	21.4

Table 4-8
Areas A7 and P9
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Max Bkgrnd	ESAT Sed Value	P9SD3 P9SD3A 30-Apr-92 0.5 feet	P9SD4 P9SD4A 29-Apr-92 0.5 feet	E3-BCK-D03 DXBCK031 17-Sept-93 0 feet	SED8 10-Oct-84 0.49 feet
PCB/Pesticides:						
Chlordane, total		0.0005	0.085			
ppDDD		0.002	0.0152 1			
ppDDE		0.002	0.0156 1		0.038	
ppDDT		0.001	0.0155		0.003	
Metals:						
Aluminum	5020		5700 B	8300 B		
Arsenic	2.03	6	2.66	3.94	2.95	30
Barium	23.9	20	29.1	34.3		
Beryllium	0.18					
Calcium	562		1190			
Chromium	9.66	26	16.1	18.8		
Cobalt	3.74				4.81	
Copper	6.33	16	9.39	10.2	13.1 L	
Iron	7590		11000 B	13000 B	9030	
Lead	4.48	31	13	8.9	18 J	15.5
Magnesium	2140		2840	3230		
Manganese	70.5		110	140	108	
Nickel	5.92	16	10.1	9.61	7.8	
Potassium	1520		1800	2360		
Selenium	0.2	1				
Vanadium	17		17.5	20.5		
Zinc	20.8	120	25.4	22.9	28.3 J	32.4

Table 5-1
Area A9
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9CD1 A9CD1A 18-May-92 0 feet	A9SO1 A9SO1A 15-Apr-92 0 feet	A9SO2 A9SO2A 15-Apr-92 0 feet	A9SO3 A9SO3A 15-Apr-92 0 feet	A9SO4 A9SO4A 15-Apr-92 0 feet	A9SO5 A9SO5A 15-Apr-92 0 feet
VOCs:									
Methylene chloride	0.008	0.018	0.1		0.012	0.011			0.011
BNAs:									
Di-n-butyl phthalate	3.80	9					4 S		
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30		46		18		
Barium	21.60	54.7		22.8	22.5	50.6	22.3	28.4	21.9
Beryllium	0.30	0.638	0.4						
Cadmium	0.56	1.79	30	1.44		0.671			
Calcium	554.02	1170				647			566
Chromium	18.67	62.5	1000	22.7		24.5			
Cobalt	3.47	7.3				6.1			
Copper	9.52	19.5		10.7		10.9		11.2	
Iron	12806.69	28000		13000 B		15000 X			
Lead	51.43	110	300	450					
Magnesium	1793.60	5060		2120	2260	4070	1960	2660	1930
Nickel	9.32	23.2	300			13.9			
Potassium	450.60	700		987	1080	2870	1050	1660	1210
Selenium	0.37	0.571	300						
Sodium	122.50	122							
Thallium			8						
Vanadium	27.08	51.2							
Zinc	33.91	85.8	2500		109	95.5	35.1		

Table 5-1
Area A9
Summary of Compounds Exceeding Soil Criteria
Surface Soil Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9SO6 A9SO6A 15-Apr-92 0 feet	A9SO7 A9SO7B 15-Nov-93 0 feet	A9SO8 A9SO8B 15-Nov-93 0 feet	A9SO9 A9SO9B 15-Nov-93 0 feet	A9SO10 A9SO10B 15-Nov-93 0 feet
VOCs:								
Methylene chloride	0.008	0.018	0.1	0.01	*	*	*	*
BNAs:								
Di-n-butyl phthalate	3.80	9			*	*	*	*
Metals:								
Aluminum	10834.98	18000			14000	11000		11000
Arsenic	8.95	17	30		20			9.3
Barium	21.60	54.7		23.8	32.8	75.8	38.5	31.5
Beryllium	0.30	0.638	0.4		0.547			0.547
Cadmium	0.56	1.79	30					
Calcium	554.02	1170				2010	926	
Chromium	18.67	62.5	1000			53.9		
Cobalt	3.47	7.3			3.76	3.96		3.76
Copper	9.52	19.5				11.7		
Iron	12806.69	28000				16000		
Lead	51.43	110	300					270
Magnesium	1793.60	5060		2600	2020	5720	2260	1830
Nickel	9.32	23.2	300			12		
Potassium	450.60	700		1540	766	2990	1020	608
Selenium	0.37	0.571	300		0.45			0.51
Sodium	122.50	122				280		
Thallium			8		304			
Vanadium	27.08	51.2				48.7		
Zinc	33.91	85.8	2500			42.3		

Table 5-2
Area A9
Summary of Compounds Exceeding ESAT Soil Values
Surface Soil Samples (ug/g)

Analyte	ESAT Soil	A9CD1 A9CD1A 18-May-92 0 feet	A9SO1 A9SO1A 15-Apr-92 0 feet	A9SO2 A9SO2A 15-Apr-92 0 feet	A9SO3 A9SO3A 15-Apr-92 0 feet	A9SO4 A9SO4A 15-Apr-92 0 feet	A9SO5 A9SO5A 15-Apr-92 0 feet	A9SO6 A9SO6A 15-Apr-92 0 feet	A9SO7 A9SO7B 15-Nov-93 0 feet	A9SO9 A9SO9B 15-Nov-93 0 feet	A9SO10 A9SO10B 15-Nov-93 0 feet
Metals:											
Arsenic	4.8	8.1	46	5.7	18	5.95	5.68	8	20	6.9	9.3
Lead	200	450									270

Table 5-3
Area A9
Summary of Compounds Exceeding Soil Criteria
Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9HA1 A9HA1A 15-Oct-92 0 feet	A9HA2 A9HA2A 15-Oct-92 0.5 feet	A9HA3 A9HA3A 15-Oct-92 0.5 feet	A9HA4 A9HA4A 15-Oct-92 0.5 feet	A9HA5 A9HA5B 15-Nov-93 0.5 feet	A9HA6 A9HA6B 15-Nov-93 0.5 feet
Metals:									
Aluminum	10834.98	18000		11000 B		11000 B	12000 B	15000	17000
Arsenic	8.95	17	30	56	59	70	65	140	14
Barium	21.60	54.7						42.7	31.5
Beryllium	0.30	0.638	0.4			0.305	0.336	0.676	0.692
Cadmium	0.56	1.79	30	1.64	1.39	1.63	1.13	0.774	
Calcium	554.02	1170							
Chromium	18.67	62.5	1000						19.3
Cobalt	3.47	7.3						4.86	4.85
Copper	9.52	19.5		10.1					
Iron	12806.69	28000						13000	15000
Magnesium	1793.60	5060		2370	2170	2180	1990	2030	2170
Nickel	9.32	23.2	300					9.45	10.3
Potassium	450.60	700		939	938	962	708	547	
Selenium	0.37	0.571	300					0.54	0.49
Zinc	33.91	85.8	2500	44.5				34.3	

Table 5-3
Area A9
Summary of Compounds Exceeding Soil Criteria
Hand Auger Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9HA7 A9HA7B 15-Nov-93 0.5 feet	A9HA8 A9HA8B 15-Nov-93 0.5 feet
Metals:					
Aluminum	10834.98	18000			
Arsenic	8.95	17	30		
Barium	21.60	54.7			
Beryllium	0.30	0.638	0.4		
Cadmium	0.56	1.79	30		
Calcium	554.02	1170		601	
Chromium	18.67	62.5	1000		
Cobalt	3.47	7.3			
Copper	9.52	19.5			
Iron	12806.69	28000			
Magnesium	1793.60	5060		2150	2730
Nickel	9.32	23.2	300		10.6
Potassium	450.60	700		1110	1250
Selenium	0.37	0.571	300		
Zinc	33.91	85.8	2500		

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B1 A9SB1A 27-Feb-92 4 feet	A9B1 A9SB1B 27-Feb-92 14 feet	A9B1 A9SB1C 27-Feb-92 20 feet	A9B2 A9SB2A 27-Feb-92 8 feet	A9B2 A9SB2B 27-Feb-92 16 feet	A9B2 A9SB2C 27-Feb-92 18 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1	0.0086		0.016	0.01	0.013	
BNAs:									
2-Methylnaphthalene			0.7						10
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						0.0156
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30	17					
Barium	21.60	54.7		23.7		29.8	29.3		
Cadmium	0.56	1.79	30						
Calcium	554.02	1170			556	1450			743
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5					9.89		
Iron	12806.69	28000							
Magnesium	1793.60	5060		2110	1870	2510	2520	1900	
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		1040	1020	1920	1580	1160	1080
Selenium	0.37	0.571	300						

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B3 A9SB3A 28-Feb-92 10 feet	A9B3 A9SB3B 28-Feb-92 16 feet	A9B3 A9SB3C 28-Feb-92 18 feet	A9B4 A9SB4A 28-Feb-92 4 feet	A9B4 A9SB4B 28-Feb-92 12 feet	A9B4 A9SB4C 28-Feb-92 18 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1	0.0099		0.011			0.0087
BNAs:									
2-Methylnaphthalene			0.7						
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7				25	22	23.5	32.5
Cadmium	0.56	1.79	30						
Calcium	554.02	1170		957		1360		1160	1310
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							10.7
Iron	12806.69	28000							
Magnesium	1793.60	5060				2210	2280	1990	2810
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						11.1
Potassium	450.60	700		719	812	1550	1790	1270	1640
Selenium	0.37	0.571	300						

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B5 A9SB5A 28-Feb-92 8 feet	A9B5 A9SB5B 28-Feb-92 14 feet	A9B5 A9SB5C 28-Feb-92 20 feet	A9B6 A9SB6A 19-May-92 8 feet	A9B6 A9SB6B 19-May-92 12 feet	A9B7 A9SB7A 19-May-92 2 feet
VOCs:									
Acetone	0.026	0.046	3						0.032
Methylene chloride	0.008	0.018	0.1			0.0099			
BNAs:									
2-Methylnaphthalene			0.7						
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005							
Heptachlor epoxide	0.004	0.006	0.06						
ppDDD	0.019	0.063	2						
Metals:									
Aluminum	10834.98	18000							12000 B
Arsenic	8.95	17	30		9.5				
Barium	21.60	54.7				25.8			30.5
Cadmium	0.56	1.79	30					0.902	0.586
Calcium	554.02	1170		848	1280	1190	960	1040	557
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							17000 B
Magnesium	1793.60	5060				2470		1860	
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300			12.3			
Potassium	450.60	700		1070	1070	1490	774	1120	578
Selenium	0.37	0.571	300						

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B7 A9SB7B 19-May-92 14 feet	A9B8 A9SB8A 19-May-92 2 feet	A9B8 A9SB8B 19-May-92 8 feet	A9B9 A9SB9A 18-May-92 10 feet	A9B9 A9SB9B 18-May-92 18 feet	A9B10 A9SB10B 15-Nov-93 4 feet
VOCs:									
Acetone	0.026	0.046	3						*
Methylene chloride	0.008	0.018	0.1						*
BNAs:									
2-Methylnaphthalene			0.7						*
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005						*	*
Heptachlor epoxide	0.004	0.006	0.06					*	*
ppDDD	0.019	0.063	2		0.0891			*	*
Metals:									
Aluminum	10834.98	18000			11000 B				
Arsenic	8.95	17	30						
Barium	21.60	54.7			35.6				
Cadmium	0.56	1.79	30		0.827	0.942			
Calcium	554.02	1170		799	684	643	1190	1380	
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060							1820
Manganese	263.70	1100				410			
Mercury	0.10	0.318	10		0.112				
Nickel	9.32	23.2	300						
Potassium	450.60	700		1410	498	1030	814	696	1100
Selenium	0.37	0.571	300						

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	A9B11 A9SB11B 15-Nov-93 4 feet	OHM-A9-16 A9SB16A 11-Feb-92 14 feet	OHM-A9-17 A9SB17A 25-Feb-92 28 feet	OHM-A9-18 A9SB18A 19-Feb-92 20 feet	OHM-A9-47 A9SB47A 15-May-92 10 feet	OHM-A9-48 A9SB48A 15-May-92 12 feet
VOCs:									
Acetone	0.026	0.046	3	*					
Methylene chloride	0.008	0.018	0.1	*		0.02			
BNAs:									
2-Methylnaphthalene			0.7	*					
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005		*					
Heptachlor epoxide	0.004	0.006	0.06	*					
ppDDD	0.019	0.063	2	*					
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30				13		
Barium	21.60	54.7		22.7		27.6			
Cadmium	0.56	1.79	30					0.784	0.787
Calcium	554.02	1170		865	912	1130	844	712	1550
Chromium	18.67	62.5	1000						
Cobalt	3.47	7.3							
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060		1810		2390			
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		1020	939	1390	867	1120	1180
Selenium	0.37	0.571	300						

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A9-49 A9SB49A 14-May-92 8 feet	OHM-A9-53 A9SB53B 09-Nov-93 32 feet	OHM-A9-53 DUPSB01C 09-Nov-93 32 feet	OHM-A9-54 A9SB54B 01-Nov-93 24 feet	OHM-A9-55 A9SB55B 02-Nov-93 18 feet	OHM-A9-56 A9SB56B 03-Nov-93 24 feet
VOCs:									
Acetone	0.026	0.046	3						
Methylene chloride	0.008	0.018	0.1						
BNAs:									
2-Methylnaphthalene			0.7			*		2.2	
PCB/Pesticides:									
Endosulfan, beta	0.007	0.005				*		0.0102 1	
Heptachlor epoxide	0.004	0.006	0.06			*			
ppDDD	0.019	0.063	2			*			
Metals:									
Aluminum	10834.98	18000							
Arsenic	8.95	17	30						
Barium	21.60	54.7		30.1			27.1	22.9	
Cadmium	0.56	1.79	30	0.791					
Calcium	554.02	1170		1040	707	828 D	1140	1100	1060
Chromium	18.67	62.5	1000					99.1	
Cobalt	3.47	7.3						3.54	
Copper	9.52	19.5							
Iron	12806.69	28000							
Magnesium	1793.60	5060		2740					
Manganese	263.70	1100							
Mercury	0.10	0.318	10						
Nickel	9.32	23.2	300						
Potassium	450.60	700		2020	898	727 D	1040	1260	1050
Selenium	0.37	0.571	300					2.8	

Table 5-4
Area A9
Summary of Compounds Exceeding Soil Criteria
Boring Samples (ug/g)

Analyte	95% UCL	Maximum Bkgrd	MCP S-1/GW-1	OHM-A9-57 A9SB57B 04-Nov-93 24 feet	OHM-A9-58 A9SB58B 08-Nov-93 30 feet	OHM-BW-5 FWSB5B 11-Nov-93 30 feet
VOCs:						
Acetone	0.026	0.046	3			
Methylene chloride	0.008	0.018	0.1			
BNAs:						
2-Methylnaphthalene			0.7			
PCB/Pesticides:						
Endosulfan, beta	0.007	0.005				
Heptachlor epoxide	0.004	0.006	0.06			
ppDDD	0.019	0.063	2			
Metals:						
Aluminum	10834.98	18000				
Arsenic	8.95	17	30			10
Barium	21.60	54.7		22.1		36.5
Cadmium	0.56	1.79	30			
Calcium	554.02	1170		1190	1100	1690
Chromium	18.67	62.5	1000			
Cobalt	3.47	7.3				
Copper	9.52	19.5				
Iron	12806.69	28000				
Magnesium	1793.60	5060		1930	1950	2350
Manganese	263.70	1100				
Mercury	0.10	0.318	10			
Nickel	9.32	23.2	300			
Potassium	450.60	700		1240	851	1750
Selenium	0.37	0.571	300			

Table 5-5
Area A9
Summary of Compounds Exceeding ESAT Soil Values
Hand Auger Samples (ug/g)

Analyte	ESAT Soil	A9HA1 A9HA1A 15-Oct-92 0.5 feet	A9HA2 A9HA2A 15-Oct-92 0.5 feet	A9HA3 A9HA3A 15-Oct-92 0.5 feet	A9HA4 A9HA4A 15-Oct-92 0.5 feet	A9HA5 A9HA5B 15-Nov-93 0.5 feet	A9HA6 A9HA6B 15-Nov-93 0.5 feet	A9HA7 A9HA7B 15-Nov-93 0.5 feet	A9HA8 A9HA8B 15-Nov-93 0.5 feet
Metals:									
Arsenic	4.8	56	59	70	65	140	14	6.4	7.6
Beryllium	0.55					0.676	0.692		

Table 5-6
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	DM8 DMGW8A 29-Jun-92 Filtered metals	DM8 DMGW8C 07-Dec-93 Unfilt. metals	DM9A DMGW9AA 30-Jun-92 Filtered metals	DM9A DMGW9AB 05-Nov-92 Filtered metals	DM9A DMGW9AC 07-Dec-93 Unfilt. metals	DM10 DMGW10A 30-Jun-92 Filtered metals
VOCs:										
1,1-Dichloroethene				3.2						
Ethylbenzene		1600		29000						
Toluene		875		200000						
BNAs:										
Bis(2-ethylhexyl) phthalate		360		5.9						40
PCB/Pesticides:										
Chlordane, total			0.0043	0.00059						
Heptachlor epoxide		0.0038	0.0038	0.00011						
PCB 1254			0.014	4.5E-05						
Metals:										
Aluminum	400	87				371			880	
Arsenic	3.15		190	0.14						
Barium										
Calcium	8520					11000 G			14600 G	
Chromium	3.16	11	11							
Copper	10	3.6	3.6					7.29		7.19
Iron	4810									
Lead	10.3	0.55	0.55		4.3		2.52			2.05
Magnesium	1890									
Manganese	156						533	485	478	
Potassium	2060				2510		2270			2450
Sodium	14000									
Zinc	13.3	33	33			575 B		20.2	969 BG	14.4

Table 5-6
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	DM10 DMGW10B 04-Nov-92 Filtered metals	OHM-A9-16 A9GW16A 29-Jun-92 Filtered metals	OHM-A9-16 A9GW16B 04-Nov-92 Filtered metals	OHM-A9-17 A9GW17A 30-Jun-92 Filtered metals	OHM-A9-17 A9GW17B 04-Nov-92 Filtered metals
VOCs:									
1,1-Dichloroethene				3.2					
Ethylbenzene		1600		29000					
Toluene		875		200000					
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Chlordane, total			0.0043	0.00059					
Heptachlor epoxide		0.0038	0.0038	0.00011					
PCB 1254			0.014	4.5E-05					
Metals:									
Aluminum	400	87							
Arsenic	3.15		190	0.14					4.11
Barium									
Calcium	8520							9080	
Chromium	3.16	11	11			14.4 7			
Copper	10	3.6	3.6						
Iron	4810								
Lead	10.3	0.55	0.55		3.35	4.78	3.53	3.55	9.54
Magnesium	1890							2690	2310
Manganese	156							328	274
Potassium	2060					2940		3570	2890
Sodium	14000								
Zinc	13.3	33	33			64.1	25.2		

Table 5-6
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-47 A9GW47A 30-Jun-92 Filtered metals	OHM-A9-47 A9GW47B 04-Nov-92 Filtered metals	OHM-A9-47 A9GW47C 06-Dec-93 Unfilt. metals	OHM-A9-48 A9GW48A 30-Jun-92 Filtered metals	OHM-A9-48 A9GW48B 04-Nov-92 Filtered metals	OHM-A9-49 A9GW49A 29-Jun-92 Filtered metals
VOCs:										
1,1-Dichloroethene				3.2	5.1		17 S			
Ethylbenzene		1600		29000						
Toluene		875		200000						
BNAs:										
Bis(2-ethylhexyl) phthalate		360		5.9						
PCB/Pesticides:										
Chlordane, total			0.0043	0.00059						0.0287
Heptachlor epoxide		0.0038	0.0038	0.00011						0.0463
PCB 1254			0.014	4.5E-05		0.104 T				
Metals:										
Aluminum	400	87					2220			
Arsenic	3.15		190	0.14						
Barium							27.2			
Calcium	8520						16700			9080
Chromium	3.16	11	11							
Copper	10	3.6	3.6							
Iron	4810									
Lead	10.3	0.55	0.55		2.07	1.54		1.91	1.67	4.22
Magnesium	1890									
Manganese	156				232	542	701			
Potassium	2060				2630	2450	3150	2800		2680
Sodium	14000									26400
Zinc	13.3	33	33				863 B			15.5

Table 5-6
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-53 A9GW53A 03-Dec-93 Filtered metals	OHM-A9-54 A9GW54A 06-Dec-93 Filtered metals	OHM-A9-55 A9GW55A 06-Dec-93 Filtered metals	OHM-A9-56 A9GW56A 02-Dec-93 Filtered metals	OHM-A9-57 A9GW57A 02-Dec-93 Filtered metals
VOCs:									
1,1-Dichloroethene				3.2			20 S	70 S	
Ethylbenzene		1600		29000		2000 S			
Toluene		875		200000		2000 S			
BNAs:									
Bis(2-ethylhexyl) phthalate		360		5.9					
PCB/Pesticides:									
Chlordane, total			0.0043	0.00059		*	*	*	*
Heptachlor epoxide		0.0038	0.0038	0.00011		*	*	*	*
PCB 1254			0.014	4.5E-05		*	*	*	*
Metals:									
Aluminum	400	87			173	113			
Arsenic	3.15		190	0.14	20				
Barium									
Calcium	8520				18400	11200	11100	10300	11800
Chromium	3.16	11	11						
Copper	10	3.6	3.6						
Iron	4810				7010				
Lead	10.3	0.55	0.55			41			
Magnesium	1890								
Manganese	156				1660	709	222	1280	
Potassium	2060				2080			2800	2830
Sodium	14000								
Zinc	13.3	33	33		1070 B	629 B	549 B	373	564

Table 5-6
Area A9
Summary of Compounds Exceeding Surface Water Criteria
Ground Water Samples (ug/L)

Analyte	Maximum Bkgrd	ESAT Surface Water	AWQC Chronic	AWQC Human Health	OHM-A9-57 DUPGW01C 02-Dec-93 Filtered metals	OHM-A9-58 A9GW58A 03-Dec-93 Filtered metals	OHM-BW-5 FWGW5A 03-Dec-93 Filtered metals
VOCs:							
1,1-Dichloroethene				3.2			
Ethylbenzene		1600		29000			
Toluene		875		200000			
BNAs:							
Bis(2-ethylhexyl) phthalate		360		5.9			
PCB/Pesticides:							
Chlordane, total			0.0043	0.00059			
Heptachlor epoxide		0.0038	0.0038	0.00011			
PCB 1254			0.014	4.5E-05			
Metals:							
Aluminum	400	87				147	
Arsenic	3.15		190	0.14			
Barium							
Calcium	8520				11700 D	13700	
Chromium	3.16	11	11				
Copper	10	3.6	3.6				
Iron	4810						
Lead	10.3	0.55	0.55				
Magnesium	1890						
Manganese	156						
Potassium	2060				3150 D		
Sodium	14000						
Zinc	13.3	33	33		541 B	837 B	436 B

Table 6-1
Assabet River
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	FWISD14 FWSD14A1 13-May-92 0 feet	FWISD14 FWSD14A2 13-May-92 1 foot	FWISD14 FWSD14A3 13-May-92 3 feet	FWISD15 FWSD15A1 13-May-92 0 feet	FWISD15 FWSD15A2 13-May-92 1 foot	FWISD15 FWSD15A3 13-May-92 3 feet	FWISD16 FWSD16A1 13-May-92 0 feet
BNAs:									
Benzo(a)pyrene		0.4	1.4						
PCB/Pesticides:									
Chlordane, total		0.0005				0.0497	0.356		
PCBs, total		0.05						0.49 T	
ppDDD		0.002					0.254	0.0885	
ppDDE		0.002					0.112		
ppDDT		0.001					0.0763		
Metals:									
Aluminum	5020		6800 B	8100 B	5500 B	13000 B	11000 B	12000 B	13000 B
Arsenic	2.03	6	18	88	34	140	120	140	20
Barium	23.9	20	26.7	175	28.8	107	88.2	97.1	28.5
Cadmium	0.5	0.6	0.664	1.61	0.92	4.46	2.47	3.48	
Calcium	562		781	669		7690	6900	6630	1000
Chromium	9.66	26	17.5	16.7	13		24.6	24.1	20.2
Cobalt	3.74		4.13 7	320 B	33.9 7		15.5 7	20.5 7	
Copper	6.33	16		21.4	11.2	28.1	26.5	29.2	9.5
Iron	7590		7800 B	9700 B	14000 B	42000 B	35000 B	36000 B	16000 B
Lead	4.48	31				8.2	5.42		
Magnesium	2140		2500	2520					
Manganese	70.5		160	3500	700	1100	990	800	157
Mercury		0.15				0.414	0.372	0.438	
Nickel	5.92	16	16.4	101	22.2	26.3	31.5	31.1	11.2
Potassium	1520			1530					
Vanadium	17					22.8	20.8	24.9	21.4
Zinc	20.8	120	23.2	56.8	27	248	183	237	34.8

Table 6-1
Assabet River
Summary of Compounds Exceeding Sediment Criteria
Sediment Samples (ug/g)

Analyte	Maximum Bkgrd	ESAT Sediment	FWISD16 DUPSD05A 13-May-92 0 feet	FWISD16 FWSD16A2 13-May-92 1 foot	FWISD16 FWSD16A3 13-May-92 3 feet
BNAs:					
Benzo(a)pyrene		0.4			
PCB/Pesticides:					
Chlordane, total		0.0005			
PCBs, total		0.05			
ppDDD		0.002			
ppDDE		0.002			
ppDDT		0.001			
Metals:					
Aluminum	5020		17000 B		15000 B
Arsenic	2.03	6	19 D	25	12
Barium	23.9	20	31.4 D	49	36.4
Cadmium	0.5	0.6	1.13 D	1.3	
Calcium	562		1310 D	2020	770
Chromium	9.66	26	29.1 D	41.1	25.9
Cobalt	3.74		7.33 7	11.8 7	7.18 7
Copper	6.33	16	14.7 D	23.3	9.91
Iron	7590		15000 B	21000 B	11000 B
Lead	4.48	31			
Magnesium	2140		2410 D	3430	3000
Manganese	70.5		208 D	288	138
Mercury		0.15	0.23 D	0.246	
Nickel	5.92	16	16.9 D	22.7	25.1
Potassium	1520				
Vanadium	17		25.5 D	34.9	20.3
Zinc	20.8	120	85.3 D	118	82.1

EXPLANATION OF ABBREVIATIONS AND SYMBOLS USED IN APPENDIX D TABLES

--	Analyte was not detected
*	Not analyzed
@	Actual cadmium concentration may be lower than the concentration reported due to interelement interferences
1	Result was less than the CRL but greater than the COD
2	Ending calibration was not within acceptable limits
7	Low spike recovery was not within control limits
B	Analyte was found in the method blank or QC blank as well as the sample
C	Analysis was confirmed
D	Duplicate analysis (field duplicate)
G	Analyte was found in the rinsate blank as well as the field sample
I	Interferences in sample make quantification and/or identification suspect
J	Value is estimated
S	Non-target compound analyzed for and detected (GC/MS methods)
U	Analysis was unconfirmed
X	Analyte recovery was outside of the certified range but within acceptable limits
Z	Non-target compound analyzed for and detected

Due to laboratory error, the sample collected from A4SD4 was not analyzed. Therefore, sample A4SD4B results do not appear in Table D-6.

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Table D-1
Area A4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A4CD1	A4CD2	A4SO1	A4SO2	A4SO3	A4SO4
Field Sample No.	A4CD1A	A4CD2A	A4SO1A	A4SO2A	A4SO3A	A4SO4A
Sample Date	28-May-92	28-May-92	21-Apr-92	21-Apr-92	21-Apr-92	21-Apr-92
Depth (ft.)	0	0	0	0	0	0
VOCs:						
Acetone	--	0.015	--	--	--	--
Methylene chloride	--	--	--	0.016	0.013	0.014
BNAs:						
Anthracene	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--
Benzo(ghi)perylene	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--
Di-n-butyl phthalate	--	0.55 S	5 S	6 S	7 S	0.7 S
Fluoranthene	4	--	--	--	--	--
Indeno[1,2,3-C,D]pyrene	--	--	--	--	--	--
Phenanthrene	4	--	--	--	--	--
PCB/Pesticides:						
ppDDE	0.214	0.0809	--	--	--	--
ppDDT	0.0861	0.162	0.035	0.0144	--	--
Explosives:						
Cyclotetramethylenetetranitramine (HMX)	--	--	--	--	--	--
RDX (Cyclonite)	--	--	--	--	0.954 U	--
Metals:						
Aluminum	9200 B	9300 B	11000 B	11000 B	12000 B	8600 B
Antimony	--	9.43	--	--	--	--
Arsenic	6.61	4.6	5.44	4.2	8.6	3.18
Barium	27.3	31.7	14.9	25.8	16.3	25
Beryllium	--	--	--	0.325	0.353	--

Table D-1
Area A4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A4CD1	A4CD2	A4SO1	A4SO2	A4SO3	A4SO4
Field Sample No.	A4CD1A	A4CD2A	A4SO1A	A4SO2A	A4SO3A	A4SO4A
Sample Date	28-May-92	28-May-92	21-Apr-92	21-Apr-92	21-Apr-92	21-Apr-92
Depth (ft.)	0	0	0	0	0	0
Cadmium	7.42	--	--	0.474	--	0.547
Calcium	588	1110	--	483 B	--	475 B
Chromium	12.9	12.8	15.2	17.9	16.8	19
Cobalt	--	--	--	4.8	3.61	3.24
Copper	7.21	12	6.33	8.35	6.86	8.02
Iron	11000 B	12000 B	12000 B	11000 B	11000 B	12000 B
Lead	53 B	30 B	16 B	8 B	6 B	5 B
Magnesium	1450	1470	1910	2690	2260	3170
Manganese	190	270	80	130	95.8	110
Mercury	0.0827	0.0756	--	--	0.0929	--
Nickel	5.97	7.27	8.43	10.5	8.74	9.03
Potassium	458	502	548	996	687	1710
Sodium	--	--	--	--	--	--
Vanadium	20.5	18.7	22.5	19.6	17.8	22
Zinc	1200	29.6	21.7	22.3	21.4	20

Table D-1
Area A4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A4SO5	A4SO5
Field Sample No.	A4SO5B	DUPSO01C
Sample Date	08-Nov-93	08-Nov-93
Depth (ft.)	0	0
VOCs:		
Acetone	--	--
Methylene chloride	--	--
BNAs:		
Anthracene	0.28	*
Benzo(a)anthracene	0.48	*
Benzo(a)pyrene	0.49	*
Benzo(ghi)perylene	0.51	*
Bis(2-ethylhexyl) phthalate	0.4	*
Chrysene	0.91	*
Di-n-butyl phthalate	--	*
Fluoranthene	1.7	*
Indeno[1,2,3-C,D]pyrene	0.43	*
Phenanthrene	0.8	*
PCB/Pesticides:		
ppDDE	0.225	*
ppDDT	0.449	*
Explosives:		
Cyclotetramethylenetetranitramine (HMX)	0.892 U	--
RDX (Cyclonite)	--	--
Metals:		
Aluminum	5610	5090 D
Antimony	--	--
Arsenic	6.4	7.4 D
Barium	100	91.7 D
Beryllium	--	--

Table D-1
Area A4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A4SO5	A4SO5	
Field Sample No.	A4SO5B	DUPSO01C	
Sample Date	08-Nov-93	08-Nov-93	
Depth (ft.)	0	0	
Cadmium	12.1	13.5	D
Calcium	5890	5470	D
Chromium	17.5	15.4	D
Cobalt	--	--	
Copper	42.2	48.2	D
Iron	18000	20000	D
Lead	520	890	D
Magnesium	2060	1700	D
Manganese	118	118	D
Mercury	0.552	0.192	D
Nickel	12.1	10.6	D
Potassium	740	544	D
Sodium	77.8	78.7	D
Vanadium	18.9	17.2	D
Zinc	2420	2550	D

Table D-2
Area A4
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A4TPA	A4TPB	A4TPC	A4TPD	A4TPD	A4TPD	A4TPE
Field Sample No.	A4TPA1	A4TPB1	A4TPC1	A4TPD1	A4TPD2	A4TPD3	A4TPE1
Sample Date	11-Nov-92	11-Nov-92	11-Nov-92	09-Nov-93	09-Nov-93	09-Nov-93	09-Nov-93
Depth (ft.)	0	0	0	0	2	4	0
VOCs:							
Pinene-alpha	0.27 S	--	--	*	*	*	*
BNAs:							
Di-n-butyl phthalate	0.42 S	--	0.38 S	*	*	*	--
PCB/Pesticides:							
Endosulfan, alpha	--	0.0185	--	--	--	--	--
Endosulfan, total	--	0.0185	--	--	--	--	--
ppDDE	0.0334	0.0455	0.0526	--	--	--	--
ppDDT	0.0593	0.0836	0.065	--	--	--	0.00678 1
TPH:							
Total petroleum hydrocarbons	*	*	*	*	*	*	--
Metals:							
Aluminum	15000	10000	14000	9400	6900	5470	11000
Arsenic	5.75	3.78	4.5	4.2	2.3	3	4.6
Barium	31.5	29.3	41.9	22.7	47.3	40	46.7
Beryllium	0.407	--	0.297	--	--	--	0.415
Cadmium	0.96	0.575	3.29	--	--	--	--
Calcium	1700	713	824	337	463	657	1120
Chromium	16.7	15.8	17.6	18.6 B	13.5 B	11.9 B	18.7
Cobalt	--	2.59	4.09	--	--	--	4.59
Copper	13.7	6.9	28.5	5.67	7.01	7.01	11.8
Iron	12000	10000	23000	12000	10000	9100	14000
Lead	30	13	570	4.3	2.3	2.9	6.3
Magnesium	2270	2550	1810	3210	2460	2200	3190
Manganese	140	110	170	84	123	104	121
Mercury	--	--	0.0977	--	--	--	--
Nickel	8.27	8.33	12.9	--	--	--	10.4
Potassium	784	1220	705	1160	1850	1530	2330
Sodium	--	--	--	--	--	--	101
Vanadium	25.8	18.5	20.5	20.9	18.5	15.4	26.1
Zinc	41	22.1	220	22.4	18.2	17.5	32.6

Table D-2
Area A4
Summary of Detected Compounds
Test Pits (ug/g)

Table
Area A4
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A4TPE	A4TPE	A4TPF	A4TPF	A4TPF	A4TPG	A4TPG
Field Sample No.	A4TPE2	A4TPE3	A4TPF1	A4TPF2	A4TPF3	A4TPG1	DUPTP01C
Sample Date	09-Nov-93	09-Nov-93	09-Nov-93	09-Nov-93	09-Nov-93	09-Nov-93	09-Nov-93
Depth (ft.)	2	4	0	2	4	0	0
VOCs:							
Pinene-alpha	*	*	*	*	*	*	*
BNAs:							
Di-n-butyl phthalate	--	--	--	--	--	--	*
PCB/Pesticides:							
Endosulfan, alpha	--	--	--	--	--	--	*
Endosulfan, total	--	--	--	--	--	--	*
ppDDE	--	--	--	--	--	--	*
ppDDT	--	--	--	--	--	--	*
TPH:							
Total petroleum hydrocarbons	--	--	34.9	--	--	--	26.8 D
Metals:							
Aluminum	14000	13000	7600	9900	8300	9900	11000 D
Arsenic	5.5	5.7	2.8	3.3	2.6	4.2	4.6 D
Barium	55.3	69.5	36.8	55.4	72.2	69.3	70.9 D
Beryllium	0.639	0.489	--	--	--	0.421	0.421 D
Cadmium	--	--	--	--	--	--	--
Calcium	568	2790	744	546	801	1580	1490 D
Chromium	20.5	43	45.5	31.7 B	25.7 B	16.9	17.7 D
Cobalt	7.38	7.76	3.16	--	--	6.77	8.36 D
Copper	16.8	23.6	18.6	28.7	22.3	13.7	15.6 D
Iron	17000	20000	9700	13000	14000	14000	16000 D
Lead	5.1	11	4.2	3.8	5	6.7	7.3 D
Magnesium	3510	6800	2600	3610	3690	2950	3300 D
Manganese	139	183	88.4	97.8	109	181	223 D
Mercury	--	--	--	--	--	--	--
Nickel	11.8	25.7	--	--	16.3	13.7	15 D
Potassium	2140	2570	2060	2150	3290	2040	2180 D
Sodium	93.8	274	63.7	--	68	124	119 D
Vanadium	27.4	30.8	20	25.6	29	24.4	25.6 D
Zinc	30.4	36.5	24.7	33.5	38.8	29.1	31.7 D

Table D-2
Area A4
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A4TPG	A4TPG
Field Sample No.	A4TPG2	A4TPG3
Sample Date	09-Nov-93	09-Nov-93
Depth (ft.)	2	4
VOCs:		
Pinene-alpha	*	*
BNAs:		
Di-n-butyl phthalate	--	--
PCB/Pesticides:		
Endosulfan, alpha	--	--
Endosulfan, total	--	--
ppDDE	--	--
ppDDT	--	--
TPH:		
Total petroleum hydrocarbons	--	--
Metals:		
Aluminum	12000	12000
Arsenic	4.6	40
Barium	74.6	68.3
Beryllium	0.5	0.639
Cadmium	--	--
Calcium	1050	1110
Chromium	19	19.7
Cobalt	7.33	8.58
Copper	15.2	21.6
Iron	18000	21000
Lead	9.2	5.6
Magnesium	4030	3910
Manganese	203	240
Mercury	--	--
Nickel	21.6	21.4
Potassium	2700	2370
Sodium	90.9	123
Vanadium	27.7	28.2
Zinc	37.7	38.3

Table D-3
Area A4
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A4B1	A4B2	OHM-A4-4	OHM-A4-4	OHM-A4-5	OHM-A4-50	OHM-A4-50
Field Sample No.	A4SB1A	A4SB2A	A4SB4A1	A4SB4A2	A4SB5A	A4SB50B	A4SB50C
Sample Date	06-May-92	06-May-92	05-May-92	05-May-92	06-May-92	26-Oct-93	15-Nov-93
Depth (ft.)	2	2	4	10	2	8	8
VOCs:							
Methylene chloride	0.011	0.014	0.014	0.02	0.032	*	--
BNAs:							
Bis(2-ethylhexyl) phthalate	--	0.48	0.57	*	0.46	*	--
Di-n-butyl phthalate	1.4 S	2.4 S	1.9 S	*	2.9 S	*	--
PCB/Pesticides:							
ppDDE	--	--	--	*	--	*	0.0126 1
Explosives:							
2-Nitrotoluene	--	--	0.562 U	*	--	*	*
Organic Carbon:							
Total organic carbon	*	*	*	1110	1880	3890	25600
Metals:							
Aluminum	7300 B	6500 B	16000 B	*	6500 B	5060	*
Arsenic	3.89	4.26	30	*	4.6	4.7	*
Barium	18.9	25.9	83.7	*	15.9	47.8	*
Beryllium	--	--	0.408	*	--	--	*
Cadmium	--	--	0.994	*	--	--	*
Calcium	--	966	549	*	--	1010	*
Chromium	14.4	7.39	31.4	*	12.9	12.4	*
Cobalt	3.26	4.09	5.7	*	--	4.27	*
Copper	7.67	7.13	22.6	*	8.36	7.05	*
Iron	8800 B	10000 B	23000 B	*	8600 B	12000	*
Lead	2.97	4.2	8.3	*	4.1	2.7	*
Magnesium	2190	2220	5370	*	2090	1990	*
Manganese	83.1	120	160	*	82.7	86.8	*
Nickel	8.02	4.26	14.4	*	7.37	12.6	*
Potassium	1110	1450	4210	*	1330	1710	*
Vanadium	15.4	13.6	37.4	*	12.5	15.5	*
Zinc	17.8	20.5	22.4	*	15.9	27.4	*

Table D-4
Area A4
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	DM4	DM4	DM4	DM4	DM5	DM5	EHA7	EHA7
Field Sample No.	DMGW4A	DMGW4B	DMGW4C	DMGW4C	DMGW5A	DMGW5B	EHAGW7A	EHAGW7B
Sample Date	23-Jun-92	28-Oct-92	30-Nov-93	30-Nov-93	23-Jun-92	28-Oct-92	23-Jun-92	29-Oct-92
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Filtered	Filtered
VOCs:								
Acetone	--	--	*	*	--	--	9	--
Toluene	--	--	*	*	--	--	--	--
BNAs:								
Bis(2-ethylhexyl) phthalate	--	7.8	--	*	--	--	--	--
N,N-Diethyl-3-methylbenzamide	--	--	--	*	--	--	22 S	--
PCB/Pesticides:								
Endosulfan, beta	--	--	*	*	--	--	--	--
Endosulfan, total	--	--	*	*	--	--	--	--
Heptachlor epoxide	--	--	*	*	--	--	--	--
Explosives:								
1,3,5-Trinitrobenzene	0.642 U	--	*	*	--	--	--	--
Metals:								
Aluminum	349	--	--	19800	--	--	--	--
Arsenic	--	2.74	--	7.6	--	--	--	--
Barium	--	--	--	107	--	--	--	--
Calcium	11200	10400	13200	14300	11200	7620	10700	8960
Chromium	--	--	--	33.6	--	--	--	--
Copper	--	--	--	30.1	--	--	--	--
Iron	2660	2720	2190	37000	387	231	1950	--
Lead	1.56	2.03	--	13	--	7.8	--	1.8
Magnesium	--	--	1720	5650	--	--	5870	3820
Manganese	101	72	76.3	225	320	381	295	154
Mercury	--	--	--	--	--	--	--	--
Potassium	3830	2730	2630	6120	5160	2520	69300	33600
Sodium	5340	5120	4760	5400	9490	7480	7600	2910
Vanadium	--	--	--	43.5	--	--	--	--
Zinc	17.9	17.1	373 B	407 B	20.9	11.7	20.4	14.6

Table D-4
Area A4
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A4-4	OHM-A4-4	OHM-A4-4	OHM-A4-4	OHM-A4-5	OHM-A4-5	OHM-A4-5
Field Sample No.	A4GW4A	A4GW4B	A4GW4C	A4GW4C	A4GW5A	A4GW5B	A4GW5C
Sample Date	23-Jun-92	29-Oct-92	02-Dec-93	02-Dec-93	23-Jun-92	28-Oct-92	30-Nov-93
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Filtered
VOCs:							
Acetone	--	--	--	*	--	--	--
Toluene	3.2	--	--	*	--	1.8	--
BNAs:							
Bis(2-ethylhexyl) phthalate	--	*	--	*	--	--	--
N,N-Diethyl-3-methylbenzamide	--	*	--	*	--	--	--
PCB/Pesticides:							
Endosulfan, beta	--	*	--	*	0.0468	--	--
Endosulfan, total	--	*	--	*	0.0468	--	--
Heptachlor epoxide	0.0107	*	--	*	0.0198	--	--
Explosives:							
1,3,5-Trinitrobenzene	--	*	*	*	--	--	*
Metals:							
Aluminum	--	*	--	2870	--	--	--
Arsenic	--	*	--	--	--	--	--
Barium	--	*	--	28.2	--	--	--
Calcium	11300	*	29500	27700	5740	4700	6250
Chromium	--	*	--	--	--	--	--
Copper	--	*	--	--	--	--	--
Iron	--	*	--	2810	--	--	--
Lead	--	*	--	--	--	190	--
Magnesium	--	*	3120	3570	--	--	734
Manganese	227	*	71.3	121	48.6	16.6	13.1
Mercury	0.881	*	--	--	--	--	--
Potassium	5430	*	5710	6040	3240	--	1430
Sodium	6820	*	7170	7130	8470	6920	5440
Vanadium	--	*	--	--	--	--	--
Zinc	39.3	*	518 B	487 B	24	12.6	312 B

Table D-4
Area A4
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A4-5	OHM-A4-50
Field Sample No.	A4GW5C	A4GW50A
Sample Date	30-Nov-93	30-Nov-93
Filtered/Unfiltered Metals	Unfiltered	Filtered
VOCs:		
Acetone	*	--
Toluene	*	--
BNAs:		
Bis(2-ethylhexyl) phthalate	*	--
N,N-Diethyl-3-methylbenzamide	*	--
PCB/Pesticides:		
Endosulfan, beta	*	--
Endosulfan, total	*	--
Heptachlor epoxide	*	--
Explosives:		
1,3,5-Trinitrobenzene	*	*
Metals:		
Aluminum	10900	--
Arsenic	--	--
Barium	61.5	--
Calcium	8250	18800
Chromium	19.3	--
Copper	--	--
Iron	14000	--
Lead	5.2	--
Magnesium	3810	2520
Manganese	201	983
Mercury	--	--
Potassium	4010	4210
Sodium	6110	7080
Vanadium	24.3	--
Zinc	345 B	305 B

Table D-5
Area A4
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	A4SW1	A4SW2	A4SW3	A4SW4	A4SW5	A4SW6	A4SW7
Field Sample No.	A4SW1A	A4SW2A	A4SW3A	A4SW4B	A4SW5B	A4SW6B	A4SW7B
Sample Date	30-Apr-92	01-May-92	30-Apr-92	03-Nov-93	02-Nov-93	03-Nov-93	03-Nov-93
Depth (ft.)	0	0	0	0	0	0	0
PCB/Pesticides:							
Endrin aldehyde	--	--	--	*	--	0.161	--
ppDDT	--	--	--	*	0.0285 1	--	--
Herbicides:							
Dacthal	--	--	0.437	*	*	*	*
Explosives:							
3-Nitrotoluene	0.564 U	--	0.647 U	--	--	--	--
Metals:							
Aluminum	285	820	--	*	24400	2030	1450
Arsenic	7.38	5.52	--	*	21	6.4	27
Barium	--	--	--	*	85.7	47.4	41.3
Beryllium	--	--	--	*	3.22	--	--
Calcium	6210	6170	3650	*	16000	27900	21000
Chromium	--	--	--	*	17.3	--	--
Copper	--	--	--	*	89.4	--	--
Iron	973	968	282	*	21000	4680	12000
Lead	1.77	3.13	2.3	*	140	50	18
Magnesium	--	--	--	*	2200	2120	2710
Manganese	24.2	39.1	--	*	70.3	123	231
Potassium	--	--	--	*	1480	2090	1500
Sodium	3040	2980	5840	*	8520	11800	4760
Vanadium	--	--	--	*	40.4	20.2 1	--
Zinc	13.4 B	17.9 B	14.8 B	*	532 B	713 B	632 B

Table D-6
Area A4
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A4SD1	A4SD2	A4SD3	A4SD5	A4SD5	A4SD5
Field Sample No.	A4SD1A	A4SD2A	A4SD3A	A4SD5B1	A4SD5B2	A4SD5B3
Sample Date	30-Apr-92	01-May-92	30-Apr-92	02-Nov-93	02-Nov-93	02-Nov-93
Depth (ft.)	2	0.5	2.5	0	1	2
VOCs:						
Acetone	--	--	0.1	--	0.063	--
Benzene	--	--	--	0.0081	--	--
Methyl ethyl ketone	--	--	--	--	0.028	--
Methylene chloride	0.014	0.015	0.05	--	--	--
BNAs:						
Bis(2-ethylhexyl) phthalate	--	--	--	--	0.74	--
Di-n-butyl phthalate	2 S	3 S	2 S	--	--	--
PCB/Pesticides:						
ppDDD	--	--	--	0.0231 1	--	--
ppDDE	--	--	--	--	--	--
Explosives:						
Cyclotetramethylenetetranitramine (HMX)	--	0.912 C	*	--	--	--
Organic Carbon:						
Total organic carbon	17100	44100	40200	*	*	*
Metals:						
Aluminum	10000 B	8500 B	5900 B	5850	6700	4630
Arsenic	17	36	6.36	--	2.4	--
Barium	30.9	26.8	--	19.4	13	16.1
Beryllium	--	--	--	--	--	--
Calcium	467	1500	943	1950	875	703
Chromium	13.9	13.4	--	6.61	10.2	8.29
Cobalt	3.44	4.41	--	--	--	--
Copper	7.26	9.77	--	--	--	--
Iron	9900 B	11000 B	5000 B	4100	5100	4500
Lead	9.9	15	9.1	18	4.1	3.6

Table D-6
Area A4
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A4SD1	A4SD2	A4SD3	A4SD5	A4SD5	A4SD5
Field Sample No.	A4SD1A	A4SD2A	A4SD3A	A4SD5B1	A4SD5B2	A4SD5B3
Sample Date	30-Apr-92	01-May-92	30-Apr-92	02-Nov-93	02-Nov-93	02-Nov-93
Depth (ft.)	2	0.5	2.5	0	1	2
Magnesium	2140	1610	787	414	1520	1520
Manganese	79.2	380	50.2	15.1	45.5	49.1
Nickel	8.49	6.27	3.5	--	--	--
Potassium	1180	532	--	--	374	751
Selenium	--	--	--	0.65	--	--
Sodium	--	--	--	--	--	--
Vanadium	16.1	18.1	6.07	8.86	10.8	9.36
Zinc	19.7	38.4	16.2	13.6	13.8	15.2

Table D-6
Area A4
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A4SD6	A4SD6	A4SD6	A4SD7	A4SD7	A4SD7
Field Sample No.	A4SD6B1	A4SD6B2	A4SD6B3	A4SD7B1	A4SD7B2	A4SD7B3
Sample Date	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93
Depth (ft.)	0	1	2	0	1	2
VOCs:						
Acetone	--	--	--	0.6	0.59	--
Benzene	--	--	--	--	--	--
Methyl ethyl ketone	--	0.0068	--	0.13	0.077	--
Methylene chloride	--	--	--	--	--	--
BNAs:						
Bis(2-ethylhexyl) phthalate	3.3	2.1	--	3.3	--	4.6
Di-n-butyl phthalate	--	--	--	--	--	--
PCB/Pesticides:						
ppDDD	--	--	--	--	--	--
ppDDE	0.0983 1	--	--	--	--	--
Explosives:						
Cyclotetramethylenetetranitramine (HMX)	--	--	--	--	--	--
Organic Carbon:						
Total organic carbon	5370000	537000	16300	2040000	3170000	1900000
Metals:						
Aluminum	6350	11200	5470	6350	9570	18400
Arsenic	--	1.4	1.4	3.8	4.4	4.9
Barium	--	44	28.3	79.5	102	231
Beryllium	--	1.51	--	--	--	6.57
Calcium	24400	8090	1330	25900	28500	20500
Chromium	--	13.8	11	--	7.12	25.4
Cobalt	--	--	--	--	--	--
Copper	--	--	--	--	--	29.5
Iron	4640	3900	5600	4710	5370	6700
Lead	31	7.1	2.4	32	1.4	13

Table D-6
Area A4
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A4SD6	A4SD6	A4SD6	A4SD7	A4SD7	A4SD7
Field Sample No.	A4SD6B1	A4SD6B2	A4SD6B3	A4SD7B1	A4SD7B2	A4SD7B3
Sample Date	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93	03-Nov-93
Depth (ft.)	0	1	2	0	1	2
Magnesium	1220	1290	1950	1880	2260	2180
Manganese	17.8	42.5	72.2	84.5	123	91.8
Nickel	--	--	--	--	--	59.1
Potassium	--	549	741	--	--	982
Selenium	2.1	1.6	--	3.2	6.1	3
Sodium	436	174	72.8	--	--	--
Vanadium	17.7	13.5	12.1	--	--	37.5
Zinc	34.7	21.1	32	40.3	25.5	--

Table D-7
Area A3/P5
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	A3SW1	P5SW1	P5SW2	P5SW3	P5SW4
Field Sample No.	A3SW1A	P5SW1A	P5SW2B	P5SW3B	P5SW4B
Sample Date	24-Apr-92	24-Apr-92	01-Nov-93	01-Nov-93	01-Nov-93
Depth (ft.)	0.25	0.25	0	0	0
Explosives:					
3-Nitrotoluene	2.8 U	1.14 U	*	*	*
Metals:					
Aluminum	724	--	2350	174	1570
Arsenic	9.19	--	5.4	--	7.9
Barium	--	--	51.4	--	68.5
Calcium	4610	4760	22900	10200	11800
Iron	4970	1390	7940	726	14000
Lead	10.5	3.76	28	--	21
Magnesium	--	--	2650	1180	1400
Manganese	124	62.7	104	14.1	68.3
Potassium	--	--	2740	--	--
Sodium	4900	2660	3110	2910	3710
Zinc	25	23.6	455 B	453 B	474 B

Table D-8
Area A3/P5
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A3SD1	P5SD1	P5SD2	P5SD3	P5SD4
Field Sample No.	A3SD1A	P5SD1A	P5SD2B	P5SD3B	P5SD4B
Sample Date	24-Apr-92	24-Apr-92	01-Nov-93	01-Nov-93	01-Nov-93
Depth (ft.)	1	1.5	0.5	0.5	0.5
VOCs:					
Acetone	0.021	--	*	*	*
Methylene chloride	0.015	0.04	*	*	*
BNAs:					
Di-n-butyl phthalate	3 S	10 S	*	*	*
Organic Carbon:					
Total organic carbon	9200	296000	*	*	*
Metals:					
Aluminum	9900 B	15000	8760	6390	17900
Arsenic	6.27	--	--	--	--
Barium	--	--	41.6	51.7	44.1
Beryllium	0.319	3.38	--	--	--
Calcium	772 B	8910 B	13600	13000	4220
Chromium	14.2	16.1	6.53	--	17.4
Copper	--	8.13	--	--	--
Iron	8700 B	2100 B	4300	5000	12000
Lead	5.3 B	13 B	22	68	33
Magnesium	2010	1000	1100	--	1500
Manganese	64.7	18.7	18.4	22.4	48.9
Nickel	7.36	--	--	--	--
Potassium	358	--	--	--	--
Selenium	--	4.83	2.4	2.3	2
Vanadium	16.2	--	--	21.9	23.9
Zinc	16	--	26.9	52.5	35.8

Table D-9
Area A4
Summary of Detected Compounds
Liquid Sample - Tank (ug/L)

Site ID	A4AT1	
Field Sample No.	A4AT1B	
Sample Date	08-Nov-93	
Depth (ft.)	0.0	
Metals:		
Aluminum	51000	
Antimony	577	
Barium	776	
Beryllium	6.44	
Cadmium	4120	
Calcium	61000	
Chromium	1250	
Cobalt	513	
Copper	8710	
Iron	3500000	
Lead	33000	
Magnesium	29800	
Manganese	17000	
Mercury	12	
Nickel	1380	
Potassium	10200	
Selenium	2.1	
Sodium	4020	
Vanadium	315	
Zinc	660000	B

Table D-10
Area A7
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A7CD1	A7CD2	A7SO1	A7SO2	A7SO3	A7SO4	A7SO5
Field Sample No.	A7CD1A	A7CD2A	A7SO1A	A7SO2A	A7SO3A	A7SO4A	A7SO5A
Sample Date	18-May-92	18-May-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92
Depth (ft.)	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet
VOCs:							
1,3-Dimethylbenzene	--	--	--	--	--	--	--
Acetone	--	0.01	--	0.3	--	--	--
Methylene chloride	--	0.0086	0.01	--	0.0085	0.018	0.0079
n-Propylbenzene	--	--	--	--	--	--	--
Pinene-alpha	--	0.16 S	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--
BNAs:							
1,2,3,4-Tetramethylbenzene	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--
1,5-Dimethylnaphthalene	--	--	--	--	--	--	--
1-Ethyl-2-methylbenzene	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--
Benzo(a)anthracene	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--
Benzo[def]phenanthrene	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	6	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--
PCB/Pesticides:							
Benzenehexachloride, beta	--	--	--	--	--	--	--
Chlordane, alpha	0.209	--	--	--	--	--	--
Chlordane, gamma	0.096	--	--	--	--	--	--
Chlordane, total	0.305	--	--	--	--	--	--
Dieldrin	0.262	--	--	0.0118	--	--	--
Endosulfan, beta	0.0914	--	--	--	--	--	--
Endosulfan, total	0.0914	--	--	--	--	--	--
Endosulfan sulfate	0.0784	--	--	--	--	--	--
Heptachlor	0.0554	--	--	--	--	--	--

Table D-10
Area A7
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A7CD1	A7CD2	A7SO1	A7SO2	A7SO3	A7SO4	A7SO5
Field Sample No.	A7CD1A	A7CD2A	A7SO1A	A7SO2A	A7SO3A	A7SO4A	A7SO5A
Sample Date	18-May-92	18-May-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92
Depth (ft.)	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet
PCB 1260	1.62	--	--	--	--	--	--
PCBs, total	1.62	--	--	--	--	--	--
ppDDD	--	--	--	0.0187	--	--	--
ppDDE	0.112	86	--	0.0855	--	--	--
ppDDT	0.645	380	--	0.111	0.046	--	0.0138
Herbicides:							
245TP (Silvex)	--	--	--	--	--	--	--
Dacthal	0.0794	--	--	--	--	--	--
Metals:							
Aluminum	7600 B	8000 B	6100	6400	8200	4900	4200
Arsenic	5.05	5.82	3.64	6.2	4.62	4.03	7.7
Barium	26.5	36.8	45.5	34.9	32.6	353	19.1
Cadmium	1.18	2.03	--	--	--	--	--
Calcium	481	778	558	602	1210	464	868
Chromium	200	24.3	13.5	13	17.5	12	8.53
Cobalt	2.8	5.78	2.86	--	3.85	3.71	--
Copper	11.5	24.8	9.03	12.8	14.9	11.6	7.49
Iron	14000 B	21000 B	9900	9900	12000	9100	7000
Lead	400	51	5.9	52	43	82	14
Magnesium	2730	3580	2310	1890	3010	2200	1700
Manganese	99.1	210	87.5	140	120	160	120
Mercury	0.221	--	--	0.109	--	0.0919	--
Nickel	7.1	15.2	8.48	8.17	10.7	8.03	5.61
Potassium	1810	2040	1680	1130	1740	1320	1120
Silver	--	--	--	--	--	2.84	--
Vanadium	19.3	23.8	16	20.9	21.2	13.7	11.1
Zinc	23.4	41.8	16.2	44	31.3	210	19.7

Table D-10
Area A7
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A7SO6		A7SO7	A7SO8	A7SO9	A7SO10	A7SO11	A7SO12
Field Sample No.	A7SO6A		A7SO7A	A7SO8A	A7SO9A	A7SO10A	A7SO11A	A7SO12A
Sample Date	13-Apr-92		13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92
Depth (ft.)	0 feet		0 feet	0 feet	0 feet	0 feet	0 feet	0 feet
VOCs:								
1,3-Dimethylbenzene	0.011	S	--	--	--	--	--	--
Acetone	--		--	--	--	--	--	--
Methylene chloride	--		--	0.0096	--	--	--	--
n-Propylbenzene	0.011	S	--	--	--	--	--	--
Pinene-alpha	--		--	--	--	--	--	--
Xylenes, total	0.019		--	--	--	--	--	--
BNAs:								
1,2,3,4-Tetramethylbenzene	3	S	--	--	--	--	--	--
1,3,5-Trimethylbenzene	3	S	--	--	--	--	--	--
1,5-Dimethylnaphthalene	3	S	--	--	--	--	--	--
1-Ethyl-2-methylbenzene	2	S	--	--	--	--	--	--
2-Methylnaphthalene	10		--	--	--	--	--	--
Anthracene	2		--	--	--	--	--	--
Benzo(a)anthracene	3	S	--	--	--	--	--	--
Benzo(a)pyrene	2		--	--	--	--	--	--
Benzo[def]phenanthrene	4		--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	8		--	--	--	--	--	--
Fluoranthene	3		--	--	--	--	--	--
Phenanthrene	5		--	--	--	--	--	--
PCB/Pesticides:								
Benzenehexachloride, beta	0.0194		--	--	--	--	--	--
Chlordane, alpha	--		--	--	--	0.00229	--	--
Chlordane, gamma	0.03		--	--	--	--	--	--
Chlordane, total	0.03		--	--	--	0.00229	--	--
Dieldrin	--		--	--	0.00952	--	--	--
Endosulfan, beta	0.192		--	--	--	--	--	--
Endosulfan, total	0.192		--	--	--	--	--	--
Endosulfan sulfate	--		--	--	--	--	--	--
Heptachlor	--		--	--	--	--	--	--

Table D-10
Area A7
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A7SO6	A7SO7	A7SO8	A7SO9	A7SO10	A7SO11	A7SO12
Field Sample No.	A7SO6A	A7SO7A	A7SO8A	A7SO9A	A7SO10A	A7SO11A	A7SO12A
Sample Date	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92	13-Apr-92
Depth (ft.)	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet	0 feet
PCB 1260	--	--	--	--	--	--	--
PCBs, total	--	--	--	--	--	--	--
ppDDD	--	--	0.106	0.892	--	--	--
ppDDE	--	--	0.0499	0.96	--	--	--
ppDDT	--	--	0.0786	6	0.0592	0.0148	0.0146
Herbicides:							
245TP (Silvex)	0.0104	--	--	--	--	--	--
Dacthal	--	--	--	--	--	--	--
Metals:							
Aluminum	6800	5900	7900	9200	10000	5200	6700
Arsenic	7.8	4.95	8.1	6.29	5.1	5.48	7.1
Barium	24.2	34.9	25	57.8	39.6	--	36.5
Cadmium	--	--	--	1.15	0.718	--	--
Calcium	479	602	650	1160	2460	577	414
Chromium	11.9	13.5	16.4	30.6	34.6	18.9	16.2
Cobalt	3.11	3	4.83	5.64	3.69	--	2.93
Copper	21.3	9.02	16.5	31.1	11.6	7.64	11.5
Iron	10000	9700	15000	17000 X	13000	9200	12000
Lead	27	65	86	55	43	31	20
Magnesium	1910	2600	2570	3520	3130	3300	2680
Manganese	140	120	270	270	240	89.3	90.1
Mercury	--	--	0.0945	0.116	0.095	--	--
Nickel	7.64	8.02	9.79	16.3	15.8	9.14	7.28
Potassium	1100	2140	1430	1980	1530	573	1930
Silver	--	--	--	--	--	--	--
Vanadium	14.2	17.7	20.5	25	24.9	12.6	21.5
Zinc	90.5	21.8	22.2	102	88	17.3	18.2

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPB	A7TPB	A7TPB	A7TPC	A7TPC	A7TPC	A7TPD	A7TPD
Field Sample No.	A7TPB1	A7TPB2	A7TPB3	A7TPC1	A7TPC2	A7TPC3	A7TPD1	A7TPD2
Sample Date	09-Dec-91	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	05-Dec-91	05-Dec-91
Depth (ft.)	2	4	6	2	4	6	2	4
VOCs:								
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--
Acetone	--	--	--	0.022	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	0.012	--
Nonane	--	--	--	--	--	--	0.033 S	--
Octane	--	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	0.0017	--	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2-Methylnaphthalene	--	*	*	--	--	--	--	--
Anthracene	--	*	*	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.43	*	*	--	--	--	--	--
Chrysene	--	*	*	--	--	--	--	--
Di-n-butyl phthalate	0.49 S	*	*	0.22 S	0.5 S	0.51 S	0.56 S	0.55 S
Palmitic acid (Hexadecanoic acid)	--	*	*	--	--	--	--	--
Phenanthrene	--	*	*	--	--	--	--	--
Stearic acid	--	*	*	--	--	--	--	--
Sulfur	--	*	*	--	--	--	--	--
PCB/Pesticides:								
Chlordane, alpha	0.0832	*	*	--	--	--	--	--
Chlordane, gamma	0.105	*	*	--	--	--	--	--
Chlordane, total	0.1882	*	*	--	--	--	--	--
Dieldrin	0.0101	*	*	--	--	--	--	--

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPB	A7TPB	A7TPB	A7TPC	A7TPC	A7TPC	A7TPD	A7TPD
Field Sample No.	A7TPB1	A7TPB2	A7TPB3	A7TPC1	A7TPC2	A7TPC3	A7TPD1	A7TPD2
Sample Date	09-Dec-91	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	05-Dec-91	05-Dec-91
Depth (ft.)	2	4	6	2	4	6	2	4
Endosulfan, alpha	--	*	*	--	--	--	--	--
Endosulfan, beta	--	*	*	--	--	--	--	--
Endosulfan, total	--	*	*	--	--	--	--	--
Endrin	--	*	*	--	--	--	--	--
Heptachlor	0.0189	*	*	--	--	--	--	--
Heptachlor epoxide	0.0254	*	*	--	--	--	--	--
Lindane	--	*	*	--	--	--	--	--
PCB 1242	--	*	*	--	--	--	--	--
PCB 1248	--	*	*	--	--	--	--	--
PCB 1254	--	*	*	--	--	--	--	--
PCB 1260	--	*	*	--	--	--	--	--
PCBs, total	--	*	*	--	--	--	--	--
ppDDD	--	*	*	--	--	--	--	--
ppDDE	--	*	*	--	--	--	0.0246	--
ppDDT	0.0234	*	*	--	--	--	0.0512	--
Organophosphorus Pesticides:								
Demeton-O	*	*	*	*	*	*	*	*
Fenthion	*	*	*	*	*	*	*	*
Methyl parathion	*	*	*	*	*	*	*	*
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
3-Nitrotoluene	--	*	*	--	--	--	--	--
Cyclotetramethylenetetranitramine (HMX)	--	*	*	--	--	--	--	--
PETN (Pentaerythritol tetranitrate)	--	*	*	--	--	--	2.64 U	--
RDX (Cyclonite)	4.72 C	*	*	--	--	--	--	--

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPB	A7TPB	A7TPB	A7TPC	A7TPC	A7TPC	A7TPD	A7TPD
Field Sample No.	A7TPB1	A7TPB2	A7TPB3	A7TPC1	A7TPC2	A7TPC3	A7TPD1	A7TPD2
Sample Date	09-Dec-91	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	05-Dec-91	05-Dec-91
Depth (ft.)	2	4	6	2	4	6	2	4
Metals:								
Aluminum	3700 B	*	*	4600 B	3700 B	3400 B	5800 B	3400 B
Arsenic	3.21	*	*	2.29	3.86	3.35	7	8.1
Barium	20.3	*	*	24.4	15.6	16.9	23.9	21.9
Beryllium	--	*	*	--	--	--	--	--
Cadmium	9.23 @	*	*	13.4 @	9.54 @	8.39 @	11.1 @	8.51 @
Calcium	560 B	*	*	691 B	624 B	579 B	831 B	972 B
Chromium	10.6	*	*	17.6	11.2	10.6	15	11.4
Cobalt	--	*	*	3.07	3.37	2.65	3.46	--
Copper	11.2	*	*	11.4	7.02	6.52	11.8	7.3
Iron	7500 B	*	*	11000 B	7700 B	6700 B	9600 B	7500 B
Lead	4.6	*	*	4	6.7 X	6.8 X	19	2.7
Magnesium	1410	*	*	2220	1750	1600	2320	1420
Manganese	81.7	*	*	160	190	140	120	57.9
Mercury	--	*	*	--	--	--	0.212 B	--
Nickel	4.83	*	*	9.04	7.73	5.5	8.69	4.15
Potassium	1180	*	*	1710	1060	1130	1280	1050
Silver	--	*	*	--	--	--	--	--
Sodium	--	*	*	--	--	--	--	--
Vanadium	10.2	*	*	14.2	9.84	9.87	13.3	8.69
Zinc	16.8	*	*	28.8	17.4	22.7	35.2	39.5

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPD	A7TPE	A7TPE	A7TPE	A7TPF	A7TPF	A7TPF	A7TPG
Field Sample No.	A7TPD3	A7TPE1	A7TPE2	A7TPE3	A7TPF1	A7TPF2	A7TPF3	A7TPG1
Sample Date	05-Dec-91	05-Dec-91	05-Dec-91	05-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91
Depth (ft.)	6	2	4	6	2	4	6	2
VOCs:								
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Nonane	--	--	--	--	--	--	--	--
Octane	--	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2-Methylnaphthalene	--	--	--	--	--	*	*	--
Anthracene	--	--	--	--	--	*	*	--
Bis(2-ethylhexyl) phthalate	--	--	--	0.64	0.43	*	*	--
Chrysene	--	0.79	--	--	--	*	*	--
Di-n-butyl phthalate	0.81 S	1.4 S	0.36 S	0.92 S	0.24 S	*	*	0.22 S
Palmitic acid (Hexadecanoic acid)	--	--	--	--	--	*	*	--
Phenanthrene	--	--	--	--	--	*	*	--
Stearic acid	--	--	--	--	--	*	*	--
Sulfur	--	--	--	--	--	*	*	--
PCB/Pesticides:								
Chlordane, alpha	--	--	--	--	--	*	*	--
Chlordane, gamma	--	--	--	--	--	*	*	--
Chlordane, total	--	--	--	--	--	*	*	--
Dieldrin	--	--	--	--	--	*	*	--

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPD	A7TPE	A7TPE	A7TPE	A7TPF	A7TPF	A7TPF	A7TPG
Field Sample No.	A7TPD3	A7TPE1	A7TPE2	A7TPE3	A7TPF1	A7TPF2	A7TPF3	A7TPG1
Sample Date	05-Dec-91	05-Dec-91	05-Dec-91	05-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91
Depth (ft.)	6	2	4	6	2	4	6	2
Endosulfan, alpha	--	--	--	--	--	*	*	--
Endosulfan, beta	--	--	--	--	--	*	*	--
Endosulfan, total	--	--	--	--	--	*	*	--
Endrin	--	--	--	--	--	*	*	--
Heptachlor	--	--	--	--	--	*	*	--
Heptachlor epoxide	--	--	--	--	--	*	*	--
Lindane	--	--	--	--	--	*	*	--
PCB 1242	--	--	--	--	0.171 S	*	*	--
PCB 1248	--	--	--	--	--	*	*	--
PCB 1254	--	--	--	--	0.0796 S	*	*	--
PCB 1260	--	--	--	--	--	*	*	--
PCBs, total	--	--	--	--	0.2506 S	*	*	--
ppDDD	--	--	--	--	--	*	*	--
ppDDE	--	0.0504	--	--	--	*	*	--
ppDDT	--	0.132	--	--	--	*	*	--
Organophosphorus Pesticides:								
Demeton-O	*	*	*	*	*	*	*	*
Fenthion	*	*	*	*	*	*	*	*
Methyl parathion	*	*	*	*	*	*	*	*
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
3-Nitrotoluene	--	--	--	--	--	*	*	--
Cyclotetramethylenetetranitramine (HMX)	--	--	--	--	--	*	*	--
PETN (Pentaerythritol tetranitrate)	--	--	--	--	--	*	*	--
RDX (Cyclonite)	--	--	--	--	--	*	*	--

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPD	A7TPE	A7TPE	A7TPE	A7TPF	A7TPF	A7TPF	A7TPG
Field Sample No.	A7TPD3	A7TPE1	A7TPE2	A7TPE3	A7TPF1	A7TPF2	A7TPF3	A7TPG1
Sample Date	05-Dec-91	05-Dec-91	05-Dec-91	05-Dec-91	06-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91
Depth (ft.)	6	2	4	6	2	4	6	2
Metals:								
Aluminum	2900 B	8300 B	4100 B	4500 B	3900 B	*	*	4000 B
Arsenic	8.5	27	5.19	8.8	3.56	*	*	5.26
Barium	15.5	50.3	16.9	18.5	19.1	*	*	17.6
Beryllium	--	--	--	--	--	*	*	--
Cadmium	6.62 @	12.1 @	6.33 @	9.13 @	9.33 @	*	*	9.72 @
Calcium	1050 B	2430 B	927 B	838 B	910 B	*	*	498 B
Chromium	6.51	16.9	9.3	10.1	12.4	*	*	12.2
Cobalt	--	3.78	--	--	--	*	*	2.46
Copper	5.17	94 B	5.47	6.55	5.99	*	*	13.4
Iron	5900 B	11000	5700 B	8700 B	7200 B	*	*	7600 B
Lead	3.7	53	3.76 X	4.9	2.45	*	*	21
Magnesium	1220	2110	1640	1760	1840	*	*	1760
Manganese	57.5	180	62.6	70.1	90.4	*	*	130
Mercury	0.074 B	0.148 B	0.0812 B	--	--	*	*	0.213
Nickel	3.6	9.96	4.86	4.87	5.16	*	*	6.71
Potassium	716	992	1160	1210	1390	*	*	1340
Silver	--	--	--	--	--	*	*	--
Sodium	--	--	--	--	--	*	*	--
Vanadium	6.72	16.9	8.89	10.8	11.4	*	*	10.4
Zinc	21.5	840	11.8	14.4	26.8	*	*	35

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPG	A7TPG	A7TPH	A7TPH	A7TPI	A7TPI	A7TPI	A7TPJ
Field Sample No.	A7TPG2	A7TPG3	A7TPH1	A7TPH2	A7TPI1	A7TPI2	A7TPI3	A7TPJ1
Sample Date	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91	09-Dec-91	09-Dec-91	04-Dec-91
Depth (ft.)	4	6	2	4	2	4	6	2
VOCs:								
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	0.014
Nonane	--	--	--	--	--	--	--	--
Octane	--	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2-Methylnaphthalene	*	*	--	0.23	--	*	*	--
Anthracene	*	*	--	--	--	*	*	0.24
Bis(2-ethylhexyl) phthalate	*	*	--	--	--	*	*	1.6
Chrysene	*	*	--	--	--	*	*	--
Di-n-butyl phthalate	*	*	0.39 S	0.5 S	0.19 S	*	*	0.49 S
Palmitic acid (Hexadecanoic acid)	*	*	--	--	--	*	*	--
Phenanthrene	*	*	--	--	--	*	*	--
Stearic acid	*	*	--	--	--	*	*	--
Sulfur	*	*	--	--	--	*	*	1.6 S
PCB/Pesticides:								
Chlordane, alpha	*	*	--	--	--	*	*	--
Chlordane, gamma	*	*	--	--	--	*	*	--
Chlordane, total	*	*	--	--	--	*	*	--
Dieldrin	*	*	--	--	--	*	*	--

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPG	A7TPG	A7TPH	A7TPH	A7TPI	A7TPI	A7TPI	A7TPJ
Field Sample No.	A7TPG2	A7TPG3	A7TPH1	A7TPH2	A7TPI1	A7TPI2	A7TPI3	A7TPJ1
Sample Date	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91	09-Dec-91	09-Dec-91	04-Dec-91
Depth (ft.)	4	6	2	4	2	4	6	2
Endosulfan, alpha	*	*	--	--	--	*	*	--
Endosulfan, beta	*	*	--	--	--	*	*	--
Endosulfan, total	*	*	--	--	--	*	*	--
Endrin	*	*	--	--	--	*	*	--
Heptachlor	*	*	--	--	--	*	*	--
Heptachlor epoxide	*	*	--	--	--	*	*	--
Lindane	*	*	--	--	--	*	*	--
PCB 1242	*	*	--	--	--	*	*	--
PCB 1248	*	*	--	--	--	*	*	--
PCB 1254	*	*	--	--	--	*	*	--
PCB 1260	*	*	--	--	--	*	*	--
PCBs, total	*	*	--	--	--	*	*	--
ppDDD	*	*	--	--	--	*	*	--
ppDDE	*	*	--	--	--	*	*	--
ppDDT	*	*	--	0.0173	--	*	*	--
Organophosphorus Pesticides:								
Demeton-O	*	*	*	*	*	*	*	*
Fenthion	*	*	*	*	*	*	*	*
Methyl parathion	*	*	*	*	*	*	*	*
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
3-Nitrotoluene	*	*	*	--	--	*	*	--
Cyclotetramethylenetetranitramine (HMX)	*	*	*	--	--	*	*	--
PETN (Pentaerythritol tetranitrate)	*	*	*	--	--	*	*	--
RDX (Cyclonite)	*	*	*	--	--	*	*	--

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPG	A7TPG	A7TPH	A7TPH	A7TPI	A7TPI	A7TPI	A7TPJ
Field Sample No.	A7TPG2	A7TPG3	A7TPH1	A7TPH2	A7TPI1	A7TPI2	A7TPI3	A7TPJ1
Sample Date	09-Dec-91	09-Dec-91	06-Dec-91	06-Dec-91	09-Dec-91	09-Dec-91	09-Dec-91	04-Dec-91
Depth (ft.)	4	6	2	4	2	4	6	2
Metals:								
Aluminum	*	*	4900 B	6000 B	3800 B	*	*	6200 B
Arsenic	*	*	15	9.5	4.52	*	*	5.2
Barium	*	*	16.5	37.9	12.9	*	*	32.8
Beryllium	*	*	--	--	--	*	*	--
Cadmium	*	*	11.7 @	27.5 @	10	*	*	10.6 @
Calcium	*	*	421 B	5420 B	425 B	*	*	648 B
Chromium	*	*	14.8	23.4	10.8	*	*	16
Cobalt	*	*	3.52	6.7	--	*	*	3.91
Copper	*	*	119	250	8.14	*	*	12.9
Iron	*	*	9300 B	22000 B	8400 B	*	*	9500 B
Lead	*	*	31	160 X	19	*	*	61
Magnesium	*	*	1620	2310	1550	*	*	2590
Manganese	*	*	170	240	95.5 X	*	*	130
Mercury	*	*	--	--	--	*	*	0.328 B
Nickel	*	*	9.11	18.7	6.05	*	*	10.5
Potassium	*	*	1030	1560	892	*	*	1580
Silver	*	*	--	--	--	*	*	--
Sodium	*	*	--	--	--	*	*	--
Vanadium	*	*	10	15.6	8.75	*	*	16.9
Zinc	*	*	24.7	60.5	19.7	*	*	72.8

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPJ	A7TPJ	A7TPK	A7TPL	A7TPL	A7TPL	A7TPM	A7TPM
Field Sample No.	A7TPJ2	A7TPJ3	A7TPK1	A7TPL1	A7TPL2	A7TPL3	A7TPM1	A7TPM2
Sample Date	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	12-Nov-92	12-Nov-92
Depth (ft.)	4	6	2	2	4	6	2	4
VOCs:								
1,1,2-Trichloroethane	--	--	20	--	--	--	--	--
1,2-Dichloroethane	--	--	1	--	--	--	--	--
Acetone	--	--	--	--	0.0095	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--
Chloroform	--	--	20	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	0.0099	--
Nonane	--	--	--	--	--	--	--	--
Octane	--	6 S	--	--	--	--	--	--
Tetrachloroethylene	--	--	20 X	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--
Trichloroethylene	--	--	0.1	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2-Methylnaphthalene	*	*	--	--	--	--	--	*
Anthracene	*	*	--	--	--	--	--	*
Bis(2-ethylhexyl) phthalate	*	*	--	--	0.54	--	--	*
Chrysene	*	*	--	--	--	--	--	*
Di-n-butyl phthalate	*	*	--	0.38 S	0.38 S	0.61 S	--	*
Palmitic acid (Hexadecanoic acid)	*	*	100 S	--	--	--	--	*
Phenanthrene	*	*	--	--	--	--	--	*
Stearic acid	*	*	700 S	--	--	--	--	*
Sulfur	*	*	--	--	--	--	--	*
PCB/Pesticides:								
Chlordane, alpha	*	*	0.15	--	0.00568	--	--	*
Chlordane, gamma	*	*	0.26	--	--	--	--	*
Chlordane, total	*	*	0.41	--	0.00568	--	--	*
Dieldrin	*	*	--	--	--	--	--	*

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPJ	A7TPJ	A7TPK	A7TPL	A7TPL	A7TPL	A7TPM	A7TPM
Field Sample No.	A7TPJ2	A7TPJ3	A7TPK1	A7TPL1	A7TPL2	A7TPL3	A7TPM1	A7TPM2
Sample Date	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	12-Nov-92	12-Nov-92
Depth (ft.)	4	6	2	2	4	6	2	4
Endosulfan, alpha	*	*	--	--	--	--	--	*
Endosulfan, beta	*	*	--	--	--	--	--	*
Endosulfan, total	*	*	--	--	--	--	--	*
Endrin	*	*	--	--	--	--	--	*
Heptachlor	*	*	0.064	--	--	--	--	*
Heptachlor epoxide	*	*	0.044	--	--	--	--	*
Lindane	*	*	0.52 1	--	--	--	--	*
PCB 1242	*	*	--	--	--	--	--	*
PCB 1248	*	*	--	--	--	--	--	*
PCB 1254	*	*	2 S	0.05 S	--	0.185 S	--	*
PCB 1260	*	*	--	--	--	--	--	*
PCBs, total	*	*	2 S	0.05 S	--	0.185 S	--	*
ppDDD	*	*	2.4	--	--	--	--	*
ppDDE	*	*	0.17	--	--	--	--	*
ppDDT	*	*	4.5	0.027	0.0588	0.0632	--	*
Organophosphorus Pesticides:								
Demeton-O	*	*	*	*	*	*	*	*
Fenthion	*	*	*	*	*	*	*	*
Methyl parathion	*	*	*	*	*	*	*	*
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
3-Nitrotoluene	*	*	0.953 U	--	--	--	--	*
Cyclotetramethylenetetranitramine (HMX)	*	*	1.15 U	--	--	--	--	*
PETN (Pentaerythritol tetranitrate)	*	*	--	--	--	--	--	*
RDX (Cyclonite)	*	*	--	--	--	--	--	*

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPJ	A7TPJ	A7TPK	A7TPL	A7TPL	A7TPL	A7TPM	A7TPM
Field Sample No.	A7TPJ2	A7TPJ3	A7TPK1	A7TPL1	A7TPL2	A7TPL3	A7TPM1	A7TPM2
Sample Date	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	04-Dec-91	12-Nov-92	12-Nov-92
Depth (ft.)	4	6	2	2	4	6	2	4
Metals:								
Aluminum	*	*	5000 B	5800 B	3900 B	5000 B	9800	*
Arsenic	*	*	6.17	5.06	5.3	5.3	3.8	*
Barium	*	*	27.6	20	12.3	19.8	19.8	*
Beryllium	*	*	--	--	--	--	--	*
Cadmium	*	*	24.4 @	12 @	8.51 @	9.08 @	0.956	*
Calcium	*	*	555 B	590 B	517 B	410 B	--	*
Chromium	*	*	270	13	9.15	11.4	13.8	*
Cobalt	*	*	6.01	2.9	2.98	4.64	4.28	*
Copper	*	*	27.9	11	5.96	8.64	7.69	*
Iron	*	*	20000 B	11000 B	7600 B	8500 B	11000	*
Lead	*	*	93	6.2	3.5	5.2	4.9	*
Magnesium	*	*	1820	2240	1690	2210	2090	*
Manganese	*	*	160	120	130	220	130	*
Mercury	*	*	0.384 B	--	--	--	--	*
Nickel	*	*	7.45	8.08	6.33	8.41	8.39	*
Potassium	*	*	868	1210	791	1390	1040	*
Silver	*	*	19	--	--	--	--	*
Sodium	*	*	--	--	--	--	--	*
Vanadium	*	*	12.1	12.7	8.44	12.8	17.7	*
Zinc	*	*	81.9	21.8	12.1	15.8	17.1	*

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPM	A7TPN	A7TPN	A7TPO	A7TPO	A7TPO	A7TPP	A7TPP
Field Sample No.	A7TPM3	A7TPN1	A7TPN2	A7TPO1	A7TPO2	A7TPO3	A7TPP1	DUPTP01B
Sample Date	12-Nov-92	12-Nov-92	12-Nov-92	11-Nov-92	11-Nov-92	11-Nov-92	12-Nov-92	12-Nov-92
Depth (ft.)	6	2	4	2	4	6	2	2
VOCs:								
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methylene chloride	0.0087	0.0094	0.0091	--	0.012	--	--	--
Nonane	--	--	--	--	--	--	--	--
Octane	--	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--	--
Toluene	0.0029	0.0023	--	--	--	--	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2-Methylnaphthalene	*	--	*	--	*	*	--	--
Anthracene	*	--	*	--	*	*	--	--
Bis(2-ethylhexyl) phthalate	*	--	*	--	*	*	--	--
Chrysene	*	--	*	--	*	*	--	--
Di-n-butyl phthalate	*	--	*	--	*	*	--	--
Palmitic acid (Hexadecanoic acid)	*	--	*	--	*	*	--	--
Phenanthrene	*	--	*	--	*	*	--	--
Stearic acid	*	--	*	--	*	*	--	--
Sulfur	*	--	*	--	*	*	--	--
PCB/Pesticides:								
Chlordane, alpha	*	--	*	--	*	*	--	--
Chlordane, gamma	*	--	*	--	*	*	--	--
Chlordane, total	*	--	*	--	*	*	--	--
Dieldrin	*	--	*	--	*	*	--	--

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPM	A7TPN	A7TPN	A7TPO	A7TPO	A7TPO	A7TPP	A7TPP
Field Sample No.	A7TPM3	A7TPN1	A7TPN2	A7TPO1	A7TPO2	A7TPO3	A7TPP1	DUPTP01B
Sample Date	12-Nov-92	12-Nov-92	12-Nov-92	11-Nov-92	11-Nov-92	11-Nov-92	12-Nov-92	12-Nov-92
Depth (ft.)	6	2	4	2	4	6	2	2
Endosulfan, alpha	*	--	*	0.00537 1	*	*	--	--
Endosulfan, beta	*	--	*	--	*	*	--	--
Endosulfan, total	*	--	*	0.00537 1	*	*	--	--
Endrin	*	--	*	--	*	*	--	--
Heptachlor	*	--	*	--	*	*	--	--
Heptachlor epoxide	*	--	*	--	*	*	--	--
Lindane	*	--	*	--	*	*	--	--
PCB 1242	*	--	*	--	*	*	--	--
PCB 1248	*	--	*	0.0394 1	*	*	--	--
PCB 1254	*	--	*	--	*	*	--	--
PCB 1260	*	--	*	--	*	*	--	--
PCBs, total	*	--	*	0.0394 1	*	*	--	--
ppDDD	*	--	*	0.031	*	*	--	--
ppDDE	*	--	*	0.0684	*	*	--	--
ppDDT	*	--	*	0.164	*	*	--	--
Organophosphorus Pesticides:								
Demeton-O	*	*	*	*	*	*	*	*
Fenthion	*	*	*	*	*	*	*	*
Methyl parathion	*	*	*	*	*	*	*	*
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
3-Nitrotoluene	*	--	*	--	*	*	--	--
Cyclotetramethylenetetranitramine (HMX)	*	--	*	--	*	*	--	--
PETN (Pentaerythritol tetranitrate)	*	--	*	--	*	*	--	--
RDX (Cyclonite)	*	--	*	--	*	*	--	--

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPM	A7TPN	A7TPN	A7TPO	A7TPO	A7TPO	A7TPP	A7TPP	
Field Sample No.	A7TPM3	A7TPN1	A7TPN2	A7TPO1	A7TPO2	A7TPO3	A7TPP1	DUPTP01B	
Sample Date	12-Nov-92	12-Nov-92	12-Nov-92	11-Nov-92	11-Nov-92	11-Nov-92	12-Nov-92	12-Nov-92	
Depth (ft.)	6	2	4	2	4	6	2	2	
Metals:									
Aluminum	*	12000	*	13000	*	*	8900	8300	D
Arsenic	*	2.79	*	8.9	*	*	6.2	4.18	D
Barium	*	38.8	*	32.9	*	*	21	19.5	D
Beryllium	*	0.285	*	0.272	*	*	--		
Cadmium	*	2.38	*	1.2	*	*	0.78	0.774	D
Calcium	*	--	*	847	*	*	--	--	
Chromium	*	22.8	*	15.9	*	*	13.1	10.7	D
Cobalt	*	4.63	*	3.3	*	*	3.09	--	
Copper	*	18.6	*	9.56	*	*	7.96	6.35	D
Iron	*	17000	*	13000	*	*	9600	8600	D
Lead	*	5.8	*	12	*	*	4.3	4.2	D
Magnesium	*	3610	*	2550	*	*	1950	1740	D
Manganese	*	150	*	190	*	*	84.3	78.6	D
Mercury	*	--	*	--	*	*	--	--	
Nickel	*	10.1	*	11.2	*	*	7.79	6.66	D
Potassium	*	2400	*	1160	*	*	906	810	D
Silver	*	--	*	--	*	*	--	--	
Sodium	*	--	*	--	*	*	--	--	
Vanadium	*	27.3	*	19.9	*	*	14.5	12.8	D
Zinc	*	19.6	*	35.5	*	*	15	13.2	D

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPP	A7TPP	A7TPQ	A7TPQ	A7TPQ	A7TPQ	A7TPR	A7TPR
Field Sample No.	A7TPP2	A7TPP3	A7TPQ1	A7TPQ2	A7TPQ3	A7TPQ4	A7TPR1	DUPTP02C
Sample Date	12-Nov-92	12-Nov-92	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	11-Nov-93	11-Nov-93
Depth (ft.)	4	6	0	2	4	5	0	0
VOCs:								
1,1,2-Trichloroethane	--	--	*	*	*	*	--	--
1,2-Dichloroethane	--	--	*	*	*	*	--	--
Acetone	--	--	*	*	*	*	--	--
Chlorobenzene	--	--	*	*	*	*	--	--
Chloroform	--	--	*	*	*	*	0.0042	--
Ethylbenzene	--	--	*	*	*	*	--	--
Methylene chloride	0.0081	--	*	*	*	*	--	0.0094 D
Nonane	--	--	*	*	*	*	--	--
Octane	--	--	*	*	*	*	--	--
Tetrachloroethylene	--	--	*	*	*	*	0.049	0.035 D
Toluene	--	--	*	*	*	*	--	--
Trichloroethylene	--	--	*	*	*	*	--	--
Xylenes, total	--	--	*	*	*	*	--	--
BNAs:								
2-Methylnaphthalene	*	*	*	*	*	*	2 1	--
Anthracene	*	*	*	*	*	*	--	--
Bis(2-ethylhexyl) phthalate	*	*	*	*	*	*	3	4 D
Chrysene	*	*	*	*	*	*	--	--
Di-n-butyl phthalate	*	*	*	*	*	*	10	--
Palmitic acid (Hexadecanoic acid)	*	*	*	*	*	*	--	--
Phenanthrene	*	*	*	*	*	*	1 1	--
Stearic acid	*	*	*	*	*	*	--	--
Sulfur	*	*	*	*	*	*	--	--
PCB/Pesticides:								
Chlordane, alpha	*	*	--	--	--	--	--	0.48 D
Chlordane, gamma	*	*	--	--	--	--	--	--
Chlordane, total	*	*	--	--	--	--	--	0.48 D
Dieldrin	*	*	--	--	--	--	0.95	4.9 D

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPP	A7TPP	A7TPQ	A7TPQ	A7TPQ	A7TPQ	A7TPR	A7TPR
Field Sample No.	A7TPP2	A7TPP3	A7TPQ1	A7TPQ2	A7TPQ3	A7TPQ4	A7TPR1	DUPTP02C
Sample Date	12-Nov-92	12-Nov-92	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	11-Nov-93	11-Nov-93
Depth (ft.)	4	6	0	2	4	5	0	0
Endosulfan, alpha	*	*	--	--	--	--	--	--
Endosulfan, beta	*	*	--	--	--	--	--	--
Endosulfan, total	*	*	--	--	--	--	--	--
Endrin	*	*	--	--	--	--	--	--
Heptachlor	*	*	--	--	--	--	--	--
Heptachlor epoxide	*	*	--	--	--	--	--	--
Lindane	*	*	--	--	--	--	--	--
PCB 1242	*	*	--	--	--	--	--	--
PCB 1248	*	*	--	--	--	--	--	--
PCB 1254	*	*	--	--	--	--	--	--
PCB 1260	*	*	--	--	--	--	--	3.1 D
PCBs, total	*	*	--	--	--	--	--	3.1 D
ppDDD	*	*	--	--	--	210	--	--
ppDDE	*	*	0.79	--	5.9	8	--	--
ppDDT	*	*	20	0.0326	350	610	--	--
Organophosphorus Pesticides:								
Demeton-O	*	*	--	--	--	--	2	0.62 D
Fenthion	*	*	--	--	--	--	--	--
Methyl parathion	*	*	--	--	--	--	0.11	--
Phosphate:								
Phosphate	*	*	*	*	*	*	450	400 D
Explosives:								
3-Nitrotoluene	*	*	*	*	*	*	--	--
Cyclotetramethylenetetranitramine (HMX)	*	*	*	*	*	*	--	--
PETN (Pentaerythritol tetranitrate)	*	*	*	*	*	*	--	--
RDX (Cyclonite)	*	*	*	*	*	*	--	--

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPP	A7TPP	A7TPQ	A7TPQ	A7TPQ	A7TPQ	A7TPR	A7TPR
Field Sample No.	A7TPP2	A7TPP3	A7TPQ1	A7TPQ2	A7TPQ3	A7TPQ4	A7TPR1	DUPTP02C
Sample Date	12-Nov-92	12-Nov-92	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	11-Nov-93	11-Nov-93
Depth (ft.)	4	6	0	2	4	5	0	0
Metals:								
Aluminum	*	*	*	*	*	*	10000	7500 D
Arsenic	*	*	*	*	*	*	4.6	3.8 D
Barium	*	*	*	*	*	*	31.1	37.6 D
Beryllium	*	*	*	*	*	*	0.406	--
Cadmium	*	*	*	*	*	*	--	--
Calcium	*	*	*	*	*	*	186	246 D
Chromium	*	*	*	*	*	*	15.3	14.5 D
Cobalt	*	*	*	*	*	*	--	--
Copper	*	*	*	*	*	*	8.78	10.6 D
Iron	*	*	*	*	*	*	12000	12000 D
Lead	*	*	*	*	*	*	11	20 D
Magnesium	*	*	*	*	*	*	1970	2460 D
Manganese	*	*	*	*	*	*	54.2	74.1 D
Mercury	*	*	*	*	*	*	--	--
Nickel	*	*	*	*	*	*	--	--
Potassium	*	*	*	*	*	*	912	1620 D
Silver	*	*	*	*	*	*	--	--
Sodium	*	*	*	*	*	*	--	--
Vanadium	*	*	*	*	*	*	19.4	19.5 D
Zinc	*	*	*	*	*	*	28.5	26.2 D

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPR	A7TPS	A7TPS	A7TPS	A7TPT	A7TPT	A7TPT
Field Sample No.	A7TPR2	A7TPS1	A7TPS2	A7TPS3	A7TPT1	A7TPT2	A7TPT3
Sample Date	11-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93
Depth (ft.)	2	0	2	4	0	2	4
VOCs:							
1,1,2-Trichloroethane	--	*	*	*	*	*	*
1,2-Dichloroethane	--	*	*	*	*	*	*
Acetone	--	*	*	*	*	*	*
Chlorobenzene	6.5 S	*	*	*	*	*	*
Chloroform	--	*	*	*	*	*	*
Ethylbenzene	0.95 S	*	*	*	*	*	*
Methylene chloride	--	*	*	*	*	*	*
Nonane	--	*	*	*	*	*	*
Octane	--	*	*	*	*	*	*
Tetrachloroethylene	2.9 S	*	*	*	*	*	*
Toluene	--	*	*	*	*	*	*
Trichloroethylene	--	*	*	*	*	*	*
Xylenes, total	4.1 S	*	*	*	*	*	*
BNAs:							
2-Methylnaphthalene	3	*	*	*	*	*	*
Anthracene	--	*	*	*	*	*	*
Bis(2-ethylhexyl) phthalate	4	*	*	*	*	*	*
Chrysene	--	*	*	*	*	*	*
Di-n-butyl phthalate	--	*	*	*	*	*	*
Palmitic acid (Hexadecanoic acid)	--	*	*	*	*	*	*
Phenanthrene	3	*	*	*	*	*	*
Stearic acid	--	*	*	*	*	*	*
Sulfur	--	*	*	*	*	*	*
PCB/Pesticides:							
Chlordane, alpha	0.4	10	1.1	0.0312	0.0704	0.038	0.0151
Chlordane, gamma	--	20	2.4	0.0597	--	0.055 1	--
Chlordane, total	0.4	30	3.5	0.0909	0.0704	0.093 1	0.0151
Dieldrin	1.5	--	--	--	--	--	--

Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPR	A7TPS	A7TPS	A7TPS	A7TPT	A7TPT	A7TPT
Field Sample No.	A7TPR2	A7TPS1	A7TPS2	A7TPS3	A7TPT1	A7TPT2	A7TPT3
Sample Date	11-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93
Depth (ft.)	2	0	2	4	0	2	4
Endosulfan, alpha	--	--	--	--	--	--	--
Endosulfan, beta	--	--	--	--	--	0.012 1	--
Endosulfan, total	--	--	--	--	--	0.012 1	--
Endrin	--	4.1	0.46	--	0.0293	--	--
Heptachlor	--	--	--	--	--	--	--
Heptachlor epoxide	--	0.29 1	0.05 1	--	0.00724	0.011	--
Lindane	0.67	--	--	--	--	--	--
PCB 1242	--	--	--	--	--	--	--
PCB 1248	--	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	--	--
PCB 1260	2.4	--	--	--	--	--	--
PCBs, total	2.4	--	--	--	--	--	--
ppDDD	--	--	--	--	--	--	--
ppDDE	--	1.1 1	0.21	0.0103 1	0.0237	0.049	0.0195 1
ppDDT	--	--	--	0.0334	0.117	0.23	0.0954
Organophosphorus Pesticides:							
Demeton-O	--	--	--	--	--	--	--
Fenthion	0.13	--	--	--	--	--	--
Methyl parathion	0.61	--	--	--	--	--	--
Phosphate:							
Phosphate	360	*	*	*	*	*	*
Explosives:							
3-Nitrotoluene	--	*	*	*	*	*	*
Cyclotetramethylenetetranitramine (HMX)	--	*	*	*	*	*	*
PETN (Pentaerythritol tetranitrate)	--	*	*	*	*	*	*
RDX (Cyclonite)	--	*	*	*	*	*	*

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Table D-11
Area A7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A7TPR	A7TPS	A7TPS	A7TPS	A7TPT	A7TPT	A7TPT
Field Sample No.	A7TPR2	A7TPS1	A7TPS2	A7TPS3	A7TPT1	A7TPT2	A7TPT3
Sample Date	11-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93
Depth (ft.)	2	0	2	4	0	2	4
Metals:							
Aluminum	8300	7000	7500	13000	*	*	*
Arsenic	4.1	4.3	3.9	5.1	*	*	*
Barium	46.7	43.6	47	67.9	*	*	*
Beryllium	--	--	0.366	0.489	*	*	*
Cadmium	--	--	--	--	*	*	*
Calcium	384	2440	1570	609	*	*	*
Chromium	33.2	17.1 B	42.8 B	24.6	*	*	*
Cobalt	--	--	--	--	*	*	*
Copper	9.1	19.8	66.1	21.2	*	*	*
Iron	11000	11000	16000	22000	*	*	*
Lead	3900	330	520	7	*	*	*
Magnesium	2880	2410	2720	4730	*	*	*
Manganese	73.2	212	320	176	*	*	*
Mercury	0.467	0.372	--	--	*	*	*
Nickel	--	14.2	13.9	10.6	*	*	*
Potassium	1980	1130	1190	4220	*	*	*
Silver	--	1.07 T	--	--	*	*	*
Sodium	--	74.5	--	83	*	*	*
Vanadium	22.3	145	33.8	40.1	*	*	*
Zinc	36.1	136	107	49.5	*	*	*

Table D-12
Area A7
Summary of Detected Compounds
TCLP Samples (ug/L)

Site ID	A7HA3	A7HA3		A7HA4	A7B17	A7B17		A7TPQ	A7TPQ	A7TPR	A7TPS
Field Sample No.	A7HA3A	DUPHA01C		A7HA4A	A7SB17B	DUPSB02C		A7TPQTC	DUPTP03C	A7TPRTC	A7TPSTC
Sample Date	28-Oct-93	28-Oct-93		28-Oct-93	12-Nov-93	12-Nov-93		12-Nov-93	12-Nov-93	11-Nov-93	12-Nov-93
Depth (ft.)	2.5	2.5		2	4	4		4	4	0	2
TCLP Pesticides:											
Lindane	*	*		--	56	23	D	--	--	*	--
TCLP Metals:											
Barium	190	1400	D	*	1700	600	D	*	*	*	330
Cadmium	--	--		*	5	5.8	D	*	*	*	5.5
Chromium	--	--		*	26	7.9	D	*	*	*	--
Lead	--	1200	D	*	1100	810	D	*	*	*	--
Mercury	6.58	6.58	D	*	--	--		*	*	*	--

Note:

No compounds were detected in the sample (A7TPRTC) collected for volatile and semivolatile organic compound TCLP exctraction and analysis.

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g)

Site ID	A7B1	A7B2	A7B3	A7B4	A7B5	A7B6	OHM-A7-7
Field Sample No.	A7SB1A	A7SB2B	A7SB3B	A7SB4B	A7SB5B	A7SB6B	A7SB7A
Sample Date	13-Mar-92	11-May-92	11-May-92	12-May-92	12-May-92	12-May-92	12-Mar-92
Depth (ft.)	4	2	2	4	4	6	2
VOCs:							
Acetone	--	0.022	0.027	--	--	--	--
Chlorobenzene	--	--	0.006	--	--	--	--
Chloroform	--	--	--	--	--	--	--
Methyl ethyl ketone	--	--	--	--	--	--	--
Methylene chloride	0.012	0.023	0.019	--	--	--	0.0086
Pinene-alpha	--	--	--	--	--	--	--
Tetrachloroethylene	--	--	--	--	--	--	--
Trichlorofluoromethane	--	--	0.11 S	--	--	--	--
Xylenes, total	--	--	--	0.1	--	--	--
BNAs:							
2-Methylnaphthalene	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	0.85	--	--	--
Benzo(b)fluoranthene	--	--	--	1.2	--	--	--
Benzo(ghi)perylene	--	--	--	0.39 S	--	--	--
Benzo[def]phenanthrene	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.65	--	--	0.47	--	--	0.72
Di-n-butyl phthalate	--	1 S	--	--	10 S	0.49 S	--
Fluoranthene	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--
Indeno[1,2,3-C,D]pyrene	--	--	--	0.54	--	--	--
Phenanthrene	--	--	--	--	--	--	--
PCB/Pesticides:							
Chlordane-alpha	--	*	*	0.125	--	--	--
Chlordane-gamma	--	*	*	0.167	--	--	--
Chlordane, total	--	*	*	0.292	--	--	--
Dieldrin	--	*	*	--	--	--	--
Heptachlor	--	*	*	0.0278	--	--	--
Heptachlor epoxide	--	*	*	0.016	--	--	--

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g)

Site ID	A7B1	A7B2	A7B3	A7B4	A7B5	A7B6	OHM-A7-7
Field Sample No.	A7SB1A	A7SB2B	A7SB3B	A7SB4B	A7SB5B	A7SB6B	A7SB7A
Sample Date	13-Mar-92	11-May-92	11-May-92	12-May-92	12-May-92	12-May-92	12-Mar-92
Depth (ft.)	4	2	2	4	4	6	2
Lindane	--	*	*	0.294	--	--	--
PCB 1254	--	*	*	0.72 T	--	--	--
PCBs, total	--	*	*	0.72 T	--	--	--
ppDDD	--	*	*	1.02	0.0282	0.0513	--
ppDDE	--	*	*	0.172	--	0.0467	--
ppDDT	--	*	*	2.15	0.0342	0.104	--
Organic Carbon:							
Total organic carbon	2320	*	*	*	*	*	*
Metals:							
Aluminum	8500	6500	6700 B	4800 B	6500 B	10000 B	9100
Arsenic	4.23	2.89	3.15	4.5	10	11	6.2
Barium	43.7	22.6	28.5	21.9	20.7	29.8	13.2
Beryllium	--	--	--	--	--	--	--
Cadmium	0.785	0.455	--	0.974	0.774	0.554	--
Calcium	--	--	494	538	604	--	--
Chromium	18	16.1	15	19.4	14.2	12	15.1
Cobalt	2.9	3.21	--	2.9 7	3.06	--	3.45
Copper	15	8.99	9.79	14.7	10.2	7.83	7.93
Iron	16000	11000 B	10000 B	11000 B	11000 B	9600 B	12000
Lead	6	3.3	5.9	1.02	5.7	28	3.58 X
Magnesium	3190	2440	2190	1840	2630	1140	2420
Manganese	120	110	110	130	140	170 B	100
Mercury	--	--	--	0.859	--	--	--
Nickel	8.08	7.79	5.59	8.04	9.29	5.82	9.7
Potassium	2910	1740	1610	1220	1340	346	869
Sodium	--	--	--	--	--	--	--
Vanadium	25.5	15.4	16.7	11	13.4	14.3	14.7
Zinc	21.7	18.2	16.7	60.2	24.8	23.9	18.3

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	OHM-A7-7	OHM-A7-7A	A7B7	A7B7	OHM-A7-8	A7B8	A7B9
Field Sample No.	A7SB7A	A7SB7AA	A7SB7B	A7SB7B	A7SB8A	A7SB8B	A7SB9B
Sample Date	12-Mar-92	14-May-92	12-May-92	12-May-92	12-Mar-92	11-May-92	12-May-92
Depth (ft.)	4	4	0	6	8	4	4
VOCs:							
Acetone	*	--	--	*	--	--	--
Chlorobenzene	*	--	--	*	0.6	--	--
Chloroform	*	--	--	*	0.3	--	--
Methyl ethyl ketone	*	--	--	*	--	--	--
Methylene chloride	*	--	--	*	--	--	--
Pinene-alpha	*	--	0.021 S	*	--	--	--
Tetrachloroethylene	*	--	--	*	0.6	--	--
Trichlorofluoromethane	*	--	--	*	--	--	--
Xylenes, total	*	--	--	*	--	--	--
BNAs:							
2-Methylnaphthalene	*	--	*	--	--	1.8	--
Benzo(a)pyrene	*	--	*	--	--	--	--
Benzo(b)fluoranthene	*	--	*	--	--	--	--
Benzo(ghi)perylene	*	--	*	--	--	--	--
Benzo[def]phenanthrene	*	--	*	--	--	--	--
Bis(2-ethylhexyl) phthalate	*	--	*	--	1.6	0.83	--
Di-n-butyl phthalate	*	0.43 S	*	--	--	0.83 S	0.39 S
Fluoranthene	*	--	*	--	--	--	--
Fluorene	*	--	*	--	--	0.91	--
Indeno[1,2,3-C,D]pyrene	*	--	*	--	--	--	--
Phenanthrene	*	--	*	--	--	1.2	--
PCB/Pesticides:							
Chlordane-alpha	*	--	*	--	--	--	--
Chlordane-gamma	*	--	*	--	--	--	--
Chlordane, total	*	--	*	--	--	--	--
Dieldrin	*	--	*	--	0.0192	--	--
Heptachlor	*	--	*	--	--	--	--
Heptachlor epoxide	*	--	*	--	--	--	--

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	OHM-A7-7	OHM-A7-7A	A7B7	A7B7	OHM-A7-8	A7B8	A7B9
Field Sample No.	A7SB7A	A7SB7AA	A7SB7B	A7SB7B	A7SB8A	A7SB8B	A7SB9B
Sample Date	12-Mar-92	14-May-92	12-May-92	12-May-92	12-Mar-92	11-May-92	12-May-92
Depth (ft.)	4	4	0	6	8	4	4
Lindane	*	--	*	--	0.51	--	--
PCB 1254	*	--	*	--	--	--	--
PCBs, total	*	--	*	--	--	--	--
ppDDD	*	--	*	--	2.6	64	--
ppDDE	*	--	*	--	0.195	1.6 1	--
ppDDT	*	--	*	--	4.5	49	--
Organic Carbon:							
Total organic carbon	1550	720	*	*	2480	*	*
Metals:							
Aluminum	*	5100 B	*	5900 B	7100	10000 B	4600 B
Arsenic	*	3.88	*	4.94	5.86	4.75	3.47
Barium	*	22.7	*	24.8	40.6	44.8	19.3
Beryllium	*	--	*	--	--	--	--
Cadmium	*	0.787	*	0.744	0.502	0.819	0.585
Calcium	*	737	*	861	572	923	657
Chromium	*	13.4	*	13	17.9	21.2	11.2
Cobalt	*	--	*	--	5.86	5.02	2.44 7
Copper	*	7.68	*	8.33	22.6	17.1	7.13
Iron	*	9500 B	*	11000 B	14000 X	18000 B	8800 B
Lead	*	3.16	*	0.564	30	6.7	1.63
Magnesium	*	2390	*	2420	2340	3500	1930
Manganese	*	90.7	*	110	160	190	86.1
Mercury	*	--	*	--	0.919	--	--
Nickel	*	7.87	*	6.85	8.6	12.4	5
Potassium	*	1760	*	1780	1560	2750	1460
Sodium	*	--	*	--	--	--	--
Vanadium	*	14	*	16.5	15.3	26.2	11.5
Zinc	*	15.9	*	17.5	46.1	30.5	13.1

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	A7B10	A7B11	A7B12	A7B13	OHM-A7-13	A7B14	A7B15
Field Sample No.	A7SB10B	A7SB11B	A7SB12B	A7SB13B	A7SB13A	A7SB14B	A7SB15B
Sample Date	11-May-92	14-May-92	14-May-92	15-Nov-93	06-Mar-92	15-Nov-93	15-Nov-93
Depth (ft.)	0	2	2	6	6	2	14
VOCs:							
Acetone	0.0096	--	--	*	--	*	*
Chlorobenzene	--	--	--	*	--	*	*
Chloroform	--	--	--	*	--	*	*
Methyl ethyl ketone	--	--	--	*	--	*	*
Methylene chloride	--	0.013	--	*	--	*	*
Pinene-alpha	--	--	--	*	--	*	*
Tetrachloroethylene	--	--	--	*	--	*	*
Trichlorofluoromethane	--	--	--	*	--	*	*
Xylenes, total	--	--	--	*	--	*	*
BNAs:							
2-Methylnaphthalene	--	--	--	*	--	*	*
Benzo(a)pyrene	--	--	--	*	--	*	*
Benzo(b)fluoranthene	--	--	--	*	--	*	*
Benzo(ghi)perylene	--	--	--	*	--	*	*
Benzo[def]phenanthrene	--	--	0.5	*	--	*	*
Bis(2-ethylhexyl) phthalate	--	--	--	*	4	*	*
Di-n-butyl phthalate	0.32 S	0.62 S	0.71 S	*	1.1 S	*	*
Fluoranthene	--	--	0.75	*	--	*	*
Fluorene	--	--	--	*	--	*	*
Indeno[1,2,3-C,D]pyrene	--	--	--	*	--	*	*
Phenanthrene	--	--	0.57	*	--	*	*
PCB/Pesticides:							
Chlordane-alpha	--	--	0.91	--	--	--	--
Chlordane-gamma	--	--	1.7	--	--	--	--
Chlordane, total	--	--	2.61	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	0.055	--	--	--	--

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	A7B10	A7B11	A7B12	A7B13	OHM-A7-13	A7B14	A7B15
Field Sample No.	A7SB10B	A7SB11B	A7SB12B	A7SB13B	A7SB13A	A7SB14B	A7SB15B
Sample Date	11-May-92	14-May-92	14-May-92	15-Nov-93	06-Mar-92	15-Nov-93	15-Nov-93
Depth (ft.)	0	2	2	6	6	2	14
Lindane	--	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	--	--
PCBs, total	--	--	--	--	--	--	--
ppDDD	--	--	--	--	--	--	--
ppDDE	--	--	0.12 1	--	--	--	--
ppDDT	--	--	0.16	--	--	--	--
Organic Carbon:							
Total organic carbon	*	*	*	*	1000	*	*
Metals:							
Aluminum	7000 B	7300 B	18000 B	*	10000	*	*
Arsenic	4.3	2.13	3.48	*	5.39	*	*
Barium	42.5	45.5	89.3	*	40.1	*	*
Beryllium	--	--	0.355	*	0.279	*	*
Cadmium	0.572	1.25	3.06	*	0.822	*	*
Calcium	437	389	771	*	--	*	*
Chromium	18.2	20.2	35.9	*	20.5	*	*
Cobalt	2.55	4.06 7	11.9	*	3.03	*	*
Copper	10.1	18.1	31.2	*	14.3	*	*
Iron	12000 B	7700 B	16000 B	*	17000	*	*
Lead	5.8	1.86	0.575	*	8.2	*	*
Magnesium	3160	3280	6670	*	3640	*	*
Manganese	120	120	480	*	150	*	*
Mercury	--	--	0.621	*	--	*	*
Nickel	6.85	10.7	16.5	*	5.77	*	*
Potassium	3070	3180	6720	*	3510	*	*
Sodium	--	--	--	*	--	*	*
Vanadium	22.5	23.2	63.4	*	30.7	*	*
Zinc	19.6	24.5	260	*	33.2	*	*

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	A7B16	A7B18	A7B19	A7B20	OHM-A7-45	OHM-A7-46	OHM-A7-51
Field Sample No.	A7SB16B	A7SB18B	A7SB19B	A7SB20B	A7SB45A	A7SB46A	A7SB51B
Sample Date	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	11-May-92	08-May-92	28-Oct-93
Depth (ft.)	10	4	4	6	6	8	8
VOCs:							
Acetone	*	*	*	*	--	0.011	--
Chlorobenzene	*	*	*	*	--	--	--
Chloroform	*	*	*	*	--	--	--
Methyl ethyl ketone	*	*	*	*	--	--	0.0043
Methylene chloride	*	*	*	*	0.026	0.023	--
Pinene-alpha	*	*	*	*	--	--	--
Tetrachloroethylene	*	*	*	*	--	--	--
Trichlorofluoromethane	*	*	*	*	--	--	--
Xylenes, total	*	*	*	*	--	--	--
BNAs:							
2-Methylnaphthalene	*	*	*	*	--	--	--
Benzo(a)pyrene	*	*	*	*	--	--	--
Benzo(b)fluoranthene	*	*	*	*	--	--	--
Benzo(ghi)perylene	*	*	*	*	--	--	--
Benzo[def]phenanthrene	*	*	*	*	--	--	--
Bis(2-ethylhexyl) phthalate	*	*	*	*	0.58	--	1.6
Di-n-butyl phthalate	*	*	*	*	0.57 S	0.41 S	--
Fluoranthene	*	*	*	*	--	--	--
Fluorene	*	*	*	*	--	--	--
Indeno[1,2,3-C,D]pyrene	*	*	*	*	--	--	--
Phenanthrene	*	*	*	*	--	--	--
PCB/Pesticides:							
Chlordane-alpha	--	--	--	--	--	--	--
Chlordane-gamma	--	--	--	--	--	--	--
Chlordane, total	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	A7B16	A7B18	A7B19	A7B20	OHM-A7-45	OHM-A7-46	OHM-A7-51
Field Sample No.	A7SB16B	A7SB18B	A7SB19B	A7SB20B	A7SB45A	A7SB46A	A7SB51B
Sample Date	12-Nov-93	12-Nov-93	12-Nov-93	12-Nov-93	11-May-92	08-May-92	28-Oct-93
Depth (ft.)	10	4	4	6	6	8	8
Lindane	0.0151 1	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	--	--
PCBs, total	--	--	--	--	--	--	--
ppDDD	0.0231	0.228	1.2	--	--	--	--
ppDDE	--	0.0639	0.0646	--	--	--	--
ppDDT	0.0327	1.4	3.8	--	--	--	--
Organic Carbon:							
Total organic carbon	*	*	*	*	915	1650	5850
Metals:							
Aluminum	*	*	*	*	4000 B	4500 B	11000
Arsenic	*	*	*	*	12	5.08	6.7
Barium	*	*	*	*	--	15.9	61.3
Beryllium	*	*	*	*	--	--	0.517
Cadmium	*	*	*	*	--	--	--
Calcium	*	*	*	*	585	530	568
Chromium	*	*	*	*	8.91	11.4	26.9
Cobalt	*	*	*	*	--	3.16	3.67
Copper	*	*	*	*	7.38	7.6	18.8
Iron	*	*	*	*	7300 B	8100 B	18000
Lead	*	*	*	*	3	4.6	7.2
Magnesium	*	*	*	*	1320	1920	3910
Manganese	*	*	*	*	62.9	180	226
Mercury	*	*	*	*	--	--	--
Nickel	*	*	*	*	7.96	7.84	12.3
Potassium	*	*	*	*	753	1070	2960
Sodium	*	*	*	*	--	--	94.7
Vanadium	*	*	*	*	7.24	10.3	29.9
Zinc	*	*	*	*	14.9	16.7	39.6

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	OHM-A7-52	A7HA1	A7HA1	A7HA2
Field Sample No.	A7SB52B	A7HA1A	DUPHA01A	A7HA2A
Sample Date	27-Oct-93	11-Aug-92	11-Aug-92	11-Aug-92
Depth (ft.)	20	1.5	1.5	1
VOCs:				
Acetone	*	--	--	--
Chlorobenzene	*	--	--	--
Chloroform	*	--	--	--
Methyl ethyl ketone	*	--	--	--
Methylene chloride	*	--	--	--
Pinene-alpha	*	--	--	--
Tetrachloroethylene	*	--	--	--
Trichlorofluoromethane	*	--	--	--
Xylenes, total	*	--	--	--
BNAs:				
2-Methylnaphthalene	*	--	--	--
Benzo(a)pyrene	*	--	--	--
Benzo(b)fluoranthene	*	--	--	--
Benzo(ghi)perylene	*	--	--	--
Benzo[def]phenanthrene	*	--	--	--
Bis(2-ethylhexyl) phthalate	*	--	--	--
Di-n-butyl phthalate	*	--	2.8 S	0.44 S
Fluoranthene	*	--	--	--
Fluorene	*	--	--	--
Indeno[1,2,3-C,D]pyrene	*	--	--	--
Phenanthrene	*	--	--	--
PCB/Pesticides:				
Chlordane-alpha	--	--	--	--
Chlordane-gamma	--	--	--	--
Chlordane, total	--	--	--	--
Dieldrin	--	--	--	--
Heptachlor	--	--	--	--
Heptachlor epoxide	--	--	--	--

Table D-13
Area A7
Summary of Detected Compounds
Boring and Hand Auger Samples (ug/g

Site ID	OHM-A7-52	A7HA1	A7HA1	A7HA2
Field Sample No.	A7SB52B	A7HA1A	DUPHA01A	A7HA2A
Sample Date	27-Oct-93	11-Aug-92	11-Aug-92	11-Aug-92
Depth (ft.)	20	1.5	1.5	1
Lindane	--	--	--	--
PCB 1254	--	--	--	--
PCBs, total	--	--	--	--
ppDDD	--	--	--	--
ppDDE	--	0.0113 1	--	--
ppDDT	--	0.0159	0.0109 D	--
Organic Carbon:				
Total organic carbon	3470	*	*	*
Metals:				
Aluminum	*	13000	10000 D	9200
Arsenic	*	6.35	4.74 D	4.4
Barium	*	58.2	30 D	37
Beryllium	*	--	0.282 D	--
Cadmium	*	3.73	3.34 D	3.13
Calcium	*	600	514 D	583
Chromium	*	27.7	20.2 D	20.1
Cobalt	*	5.29	3.9 D	4.88
Copper	*	30.9	15.4 D	19.6
Iron	*	18000	15000 D	14000
Lead	*	16	13 D	7.4 X
Magnesium	*	4400	3310 D	3600
Manganese	*	230	190 D	200
Mercury	*	--	--	--
Nickel	*	11	11 D	11.4
Potassium	*	3970	2070 D	2200
Sodium	*	--	--	--
Vanadium	*	46.4	25 D	23.3
Zinc	*	32.8	25.2 D	23.9

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-8	OHM-A7-8	OHM-A7-8	OHM-A7-8	OHM-A7-9	OHM-A7-9	OHM-A7-9
Field Sample No.	A7GW8A	A7GW8B	A7GW8C1	A7GW8C2	A7GW9A	A7GW9B	A7GW9C
Sample Date	25-Jun-92	04-Nov-92	01-Dec-93	01-Dec-93	03-Oct-91	25-Jun-92	05-Nov-92
Filtered/Unfiltered	Filtered metals	Filtered metals	Unfiltered pest	Filtered pest	Filtered metals	Filtered metals	Filtered metals
VOCs:							
1,1,1-Trichloroethane	--	--	--	*	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	*	--	--	--
1,1,2-Trichloroethane	--	--	7.2 S	*	--	--	--
Acetone	16	--	9000 S	*	14 S	16	--
Carbon tetrachloride	--	--	16 S	*	--	--	--
Chlorobenzene	--	10	--	*	--	--	--
Chloroform	24	5.4	300 S	*	--	--	--
Chloromethane	--	--	--	*	--	--	--
cis-1,2-Dichloroethene	--	--	--	*	--	--	--
Methylene chloride	--	--	--	*	7.45	--	--
Tetrachloroethylene	13	15	38 S	*	--	--	--
Toluene	--	--	--	*	--	--	--
Trichloroethylene	--	--	--	*	--	--	--
BNAs:							
Bis(2-ethylhexyl) phthalate	--	--	--	*	--	--	--
Di-n-butyl phthalate	--	6.1	--	*	--	--	5.9
Naphthalene	--	7.3	--	*	--	--	--
PCB/Pesticides:							
alpha-Hexachlorocyclohexane	--	0.029 1	0.03 1	--	--	--	--
Chlordane-alpha	0.032	0.032	--	--	--	--	--
Chlordane, total	0.032	0.032	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
Endosulfan, beta	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--
Endrin aldehyde	0.158	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--
Heptachlor epoxide	--	0.0134	--	--	--	--	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-8	OHM-A7-8	OHM-A7-8	OHM-A7-8	OHM-A7-9	OHM-A7-9	OHM-A7-9
Field Sample No.	A7GW8A	A7GW8B	A7GW8C1	A7GW8C2	A7GW9A	A7GW9B	A7GW9C
Sample Date	25-Jun-92	04-Nov-92	01-Dec-93	01-Dec-93	03-Oct-91	25-Jun-92	05-Nov-92
Filtered/Unfiltered	Filtered metals	Filtered metals	Unfiltered pest	Filtered pest	Filtered metals	Filtered metals	Filtered metals
Lindane	1.1	1.26	0.49	--	--	--	--
ppDDD	0.203	0.445	0.232	--	--	--	--
ppDDT	--	0.0761	--	--	--	--	--
Phosphate:							
Phosphate	*	*	*	*	--	*	--
::							
Explosives:							
1,3,5-Trinitrobenzene	--	--	*	*	--	--	--
Metals:							
Aluminum	--	--	*	*	121	--	--
Arsenic	--	2.98	*	*	--	--	--
Barium	--	--	*	*	6.63	--	--
Calcium	4850	9050	*	*	9900	12000	11600
Chromium	--	--	*	*	--	--	--
Copper	--	--	*	*	4.56	--	7.29
Iron	534	2540	*	*	127	--	215
Lead	--	5.96	*	*	--	--	4.35
Magnesium	--	2800	*	*	2600	2400	2740
Manganese	164	221	*	*	63.8	11.5	110
Mercury	--	--	*	*	--	--	--
Potassium	3580	3210	*	*	4000 T	3600	3600
Sodium	5760	8850	*	*	--	4560	4810
Vanadium	--	--	*	*	--	--	--
Zinc	91.9	68.8	*	*	24.6	20.1	24.7

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-10	OHM-A7-10	OHM-A7-10	OHM-A7-11	OHM-A7-11	OHM-A7-11	OHM-A7-12
Field Sample No.	A7GW10A	A7GW10B	A7GW10C	A7GW11A	A7GW11B	A7GW11C	A7GW12A
Sample Date	03-Oct-91	25-Jun-92	04-Nov-92	03-Oct-91	25-Jun-92	05-Nov-92	03-Oct-91
Filtered/Unfiltered	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals
VOCs:							
1,1,1-Trichloroethane	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--	--	--
Acetone	16 S	20	--	12 S	--	--	--
Carbon tetrachloride	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--
Chloromethane	2.91	--	--	--	--	--	3.31
cis-1,2-Dichloroethene	--	--	--	--	--	--	--
Methylene chloride	7.65	--	--	8.43	6.5	--	7.94
Tetrachloroethylene	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--
Trichloroethylene	--	--	--	--	--	--	--
BNAs:							
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	6.1	--	--	6.1	--
Naphthalene	--	--	--	--	--	--	--
PCB/Pesticides:							
alpha-Hexachlorocyclohexane	--	--	--	--	--	--	--
Chlordane-alpha	--	--	--	--	--	--	--
Chlordane, total	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
Endosulfan, beta	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--
Endrin	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--
Heptachlor	--	--	--	0.011 U	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-10	OHM-A7-10	OHM-A7-10	OHM-A7-11	OHM-A7-11	OHM-A7-11	OHM-A7-12
Field Sample No.	A7GW10A	A7GW10B	A7GW10C	A7GW11A	A7GW11B	A7GW11C	A7GW12A
Sample Date	03-Oct-91	25-Jun-92	04-Nov-92	03-Oct-91	25-Jun-92	05-Nov-92	03-Oct-91
Filtered/Unfiltered	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals
Lindane	--	--	--	--	--	--	--
ppDDD	--	--	--	--	--	--	--
ppDDT	--	--	--	--	--	--	--
Phosphate:							
Phosphate	--	*	--	36.6	*	57.9	--
::							
Explosives:							
1,3,5-Trinitrobenzene	--	--	--	--	--	--	--
Metals:							
Aluminum	640	--	--	--	--	--	--
Arsenic	--	--	--	--	--	--	--
Barium	7.77	--	--	4.63	--	--	2.62
Calcium	6600	4920	7000	19000	21200	24100	4400
Chromium	--	--	--	5.27	--	--	--
Copper	8.54	--	--	--	--	--	7.02
Iron	680	--	--	30.4	--	--	--
Lead	--	3.2	4.11	--	2.19	4.57	6.99
Magnesium	1500	--	--	4700	5080	4990	603 X
Manganese	66.2	58	47.2	59.3	114	56.7	57
Mercury	--	--	--	--	--	--	--
Potassium	2080 T	2810	--	4900 T	4880	4950	1280 T
Sodium	--	4100	4600	--	10100	10600	--
Vanadium	5.09	--	--	4.65	--	--	--
Zinc	--	10.6	20	--	9.67	17.6	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-12	OHM-A7-12	OHM-A7-13	OHM-A7-13	OHM-A7-45	OHM-A7-45	OHM-A7-45
Field Sample No.	A7GW12B	A7GW12C	A7GW13A	A7GW13B	A7GW45A	A7GW45B	A7GW45C1
Sample Date	25-Jun-92	04-Nov-92	25-Jun-92	03-Nov-92	25-Jun-92	05-Nov-92	02-Dec-93
Filtered/Unfiltered	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Unfiltered pest
VOCs:							
1,1,1-Trichloroethane	--	--	--	--	--	--	*
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	*
1,1,2-Trichloroethane	--	--	--	--	--	--	*
Acetone	--	--	12	--	--	--	*
Carbon tetrachloride	--	--	--	--	--	--	*
Chlorobenzene	--	--	--	--	--	--	*
Chloroform	--	--	--	--	--	--	*
Chloromethane	--	--	--	--	--	--	*
cis-1,2-Dichloroethene	--	--	--	--	--	--	*
Methylene chloride	--	--	5.6	--	--	--	*
Tetrachloroethylene	--	--	--	--	--	--	*
Toluene	--	2.2	--	--	--	--	*
Trichloroethylene	--	--	--	--	--	--	*
BNAs:							
Bis(2-ethylhexyl) phthalate	--	--	--	12	--	--	*
Di-n-butyl phthalate	--	5.5	--	5.6	--	--	*
Naphthalene	--	--	--	--	--	--	*
PCB/Pesticides:							
alpha-Hexachlorocyclohexane	--	--	--	--	--	--	--
Chlordane-alpha	--	--	--	--	0.0637	--	--
Chlordane, total	--	--	--	--	0.0637	--	--
Dieldrin	--	--	--	--	0.101	--	--
Endosulfan, beta	--	--	--	--	--	0.0306	--
Endosulfan, total	--	--	--	--	--	0.0306	--
Endrin	--	--	--	--	0.144	--	--
Endrin aldehyde	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	0.171	--	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-12	OHM-A7-12	OHM-A7-13	OHM-A7-13	OHM-A7-45	OHM-A7-45	OHM-A7-45
Field Sample No.	A7GW12B	A7GW12C	A7GW13A	A7GW13B	A7GW45A	A7GW45B	A7GW45C1
Sample Date	25-Jun-92	04-Nov-92	25-Jun-92	03-Nov-92	25-Jun-92	05-Nov-92	02-Dec-93
Filtered/Unfiltered	*Filtered metals*	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Filtered metals	Unfiltered pest
Lindane	--	--	--	--	--	--	--
ppDDD	--	--	--	--	--	--	--
ppDDT	--	--	--	--	0.0374	--	--
Phosphate:							
Phosphate	*	11.6	*	*	*	21.6	*
::							
Explosives:							
1,3,5-Trinitrobenzene	--	--	--	*	--	1.22 U	*
Metals:							
Aluminum	--	--	--	--	--	--	*
Arsenic	--	--	--	--	--	--	*
Barium	--	--	--	--	--	--	*
Calcium	4480	4530	3840	9510	5420	5060	*
Chromium	--	--	--	--	--	--	*
Copper	--	--	--	--	--	--	*
Iron	--	--	--	--	--	--	*
Lead	18.7	4.26	1.9	2.88	2.7	--	*
Magnesium	--	--	--	2090	--	--	*
Manganese	42	23.2	93.6	270	58	46.6	*
Mercury	--	--	0.205	--	--	--	*
Potassium	2610	--	3210	5920	3170	2120	*
Sodium	6890	7260	6490	7040	5520	6050	*
Vanadium	--	--	--	--	--	--	*
Zinc	10.6	16.7	--	35.1	15.7	18.9	*

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-45	OHM-A7-46	OHM-A7-46	OHM-A7-46	OHM-A7-46	OHM-A7-51	OHM-A7-51
Field Sample No.	A7GW45C2	A7GW46A	A7GW46B	A7GW46C1	A7GW46C2	A7GW51A1	A7GW51A2
Sample Date	02-Dec-93	25-Jun-92	05-Nov-92	01-Dec-93	01-Dec-93	01-Dec-93	01-Dec-93
Filtered/Unfiltered	Filtered pest	Filtered metals	Not applicable	Unfiltered pest	Filtered pest	Unfiltered pest	Filtered pest
VOCs:							
1,1,1-Trichloroethane	*	--	--	*	*	6.8 S	*
1,1,2,2-Tetrachloroethane	*	--	--	*	*	200 S	*
1,1,2-Trichloroethane	*	--	--	*	*	--	*
Acetone	*	20	--	*	*	--	*
Carbon tetrachloride	*	--	--	*	*	--	*
Chlorobenzene	*	--	--	*	*	13 S	*
Chloroform	*	--	--	*	*	120 S	*
Chloromethane	*	--	--	*	*	--	*
cis-1,2-Dichloroethene	*	--	--	*	*	7.6 S	*
Methylene chloride	*	--	--	*	*	--	*
Tetrachloroethylene	*	12	5.1	*	*	130 S	*
Toluene	*	--	--	*	*	--	*
Trichloroethylene	*	--	--	*	*	50 S	*
BNAs:							
Bis(2-ethylhexyl) phthalate	*	--	*	*	*	--	*
Di-n-butyl phthalate	*	--	*	*	*	--	*
Naphthalene	*	--	*	*	*	--	*
PCB/Pesticides:							
alpha-Hexachlorocyclohexane	--	0.269	*	0.143	0.149	--	--
Chlordane-alpha	--	--	*	--	--	--	--
Chlordane, total	--	--	*	--	--	--	--
Dieldrin	--	--	*	--	--	--	--
Endosulfan, beta	--	0.0444	*	--	--	--	--
Endosulfan, total	--	0.0444	*	--	--	--	--
Endrin	--	0.0627	*	--	--	--	--
Endrin aldehyde	--	--	*	--	--	--	--
Heptachlor	--	--	*	--	--	--	--
Heptachlor epoxide	--	--	*	--	--	--	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-45	OHM-A7-46	OHM-A7-46	OHM-A7-46	OHM-A7-46	OHM-A7-51	OHM-A7-51
Field Sample No.	A7GW45C2	A7GW46A	A7GW46B	A7GW46C1	A7GW46C2	A7GW51A1	A7GW51A2
Sample Date	02-Dec-93	25-Jun-92	05-Nov-92	01-Dec-93	01-Dec-93	01-Dec-93	01-Dec-93
Filtered/Unfiltered	Filtered pest	Filtered metals	Not applicable	Unfiltered pest	Filtered pest	Unfiltered pest	Filtered pest
Lindane	--	2.8 X	*	3.1 1	2.8 1	3.5 1	3.6 1
ppDDD	--	--	*	--	--	--	--
ppDDT	--	--	*	--	--	--	--
Phosphate:							
Phosphate	*	*	*	*	*	*	*
::							
Explosives:							
1,3,5-Trinitrobenzene	*	--	*	*	*	*	*
Metals:							
Aluminum	*	--	*	*	*	*	*
Arsenic	*	--	*	*	*	*	*
Barium	*	--	*	*	*	*	*
Calcium	*	6470	*	*	*	*	*
Chromium	*	--	*	*	*	*	*
Copper	*	--	*	*	*	*	*
Iron	*	--	*	*	*	*	*
Lead	*	2.68	*	*	*	*	*
Magnesium	*	--	*	*	*	*	*
Manganese	*	313	*	*	*	*	*
Mercury	*	--	*	*	*	*	*
Potassium	*	5620	*	*	*	*	*
Sodium	*	6710	*	*	*	*	*
Vanadium	*	--	*	*	*	*	*
Zinc	*	--	*	*	*	*	*

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-52	OHM-A7-52
Field Sample No.	A7GW52A1	A7GW52A2
Sample Date	01-Dec-93	01-Dec-93
Filtered/Unfiltered	Unfiltered pest	Filtered pest
VOCs:		
1,1,1-Trichloroethane	*	*
1,1,2,2-Tetrachloroethane	*	*
1,1,2-Trichloroethane	*	*
Acetone	*	*
Carbon tetrachloride	*	*
Chlorobenzene	*	*
Chloroform	*	*
Chloromethane	*	*
cis-1,2-Dichloroethene	*	*
Methylene chloride	*	*
Tetrachloroethylene	*	*
Toluene	*	*
Trichloroethylene	*	*
BNAs:		
Bis(2-ethylhexyl) phthalate	*	*
Di-n-butyl phthalate	*	*
Naphthalene	*	*
PCB/Pesticides:		
alpha-Hexachlorocyclohexane	--	--
Chlordane-alpha	--	--
Chlordane, total	--	--
Dieldrin	--	--
Endosulfan, beta	--	--
Endosulfan, total	--	--
Endrin	--	--
Endrin aldehyde	--	--
Heptachlor	--	--
Heptachlor epoxide	--	--

Table D-14
Area A7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A7-52	OHM-A7-52
Field Sample No.	A7GW52A1	A7GW52A2
Sample Date	01-Dec-93	01-Dec-93
Filtered/Unfiltered	Unfiltered pest	Filtered pest
Lindane	0.0669	0.0793
ppDDD	--	--
ppDDT	--	--
Phosphate:		
Phosphate	*	*
::		
Explosives:		
1,3,5-Trinitrobenzene	*	*
Metals:		
Aluminum	*	*
Arsenic	*	*
Barium	*	*
Calcium	*	*
Chromium	*	*
Copper	*	*
Iron	*	*
Lead	*	*
Magnesium	*	*
Manganese	*	*
Mercury	*	*
Potassium	*	*
Sodium	*	*
Vanadium	*	*
Zinc	*	*

Table D-15
Area A7
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	A7SW1	A7SW2	A7SW3	A7SW3
Field Sample No.	A7SW1A	A7SW2A	A7SW3B	DUPSW01C
Sample Date	04-May-92	04-May-92	02-Nov-93	02-Nov-93
Depth (ft.)	0	0	0	0
Phosphate:				
Phosphate	*	*	31.3	33.2 D
Metals:				
Aluminum	--	650	140	152 D
Arsenic	--	9.44	--	--
Calcium	6070	6210	13100	12200 D
Iron	464	2830	952	879 D
Lead	2.58	5.31	--	--
Magnesium	--	--	1880	1910 D
Manganese	94	261	194	208 D
Potassium	--	--	2260	2260 D
Sodium	5000	4840	5710	5730 D
Zinc	15.8 B	18.1 B	600 B	497 B

Table D-16
Area P9
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	P9SW1	P9SW2	P9SW3	P9SW4
Field Sample No.	P9SW1A	P9SW2A	P9SW3A	P9SW4A
Sample Date	29-Apr-92	29-Apr-92	30-Apr-92	29-Apr-92
Depth (ft.)	0	0	0	0
Phosphate:				
Phosphate	151	--	--	--
Metals:				
Calcium	5570	5410	5750	5370
Iron	740	841	791	671
Lead	2.03	--	--	--
Manganese	22	22	24.4	19.8
Sodium	5020	4940	5060	4960 B
Zinc	11.7 B	--	--	11.1

Table D-17
Area A7
Summary of Detected Compounds - Surface Water (ug/L)
Dames & Moore and Ecology & Environment Sample Locations

Site ID		E3-BCK-D03	
Field Sample No.	SED8	DXBCK031	
Sample Date	10-Oct-84	17-Sept-93	
Depth (ft.)	0.49	0	
VOCs:			
Acetone	6	--	
Dimethoxydimethylsilane	10	--	
Hexamethylcyclotrisiloxane	30	--	
Methylene chloride	40	--	
BNAs:			
Bis(2-ethylhexyl) phthtalate	20	--	
Dioctyl adipate	200	--	
PCB/Pesticides:			
ppDDE	*	0.038	C
ppDDT	*	0.003	C
Explosives:			
1.3-Dinitrobenzene	*	< 1	
Phosphate:			
Total phosphorus	--	25	J
Metals:			
Aluminum	*	71.3	J
Arsenic	--	1.52	J
Barium	--	5.56	J
Calcium	*	8760	
Iron	300	760	
Lead	--	1.04	J
Magnesium	*	1950	
Manganese	--	154	
Potassium	*	4460	
Sodium	*	6600	
Zinc	--	17.3	J

Notes:

-- = Analyte was not detected
* = Not analyzed
J = Estimated value

Table D-18
Area A7
Summary of Detected Compounds
Sediment (ug/g)

Site ID	A7SD1		A7SD2		A7SD3	A7SD3	
Field Sample No.	A7SD1A		A7SD2A		A7SD3B	DUPSD01C	
Sample Date	04-May-92		04-May-92		02-Nov-93	02-Nov-93	
Depth (ft.)	0.25		2		0.5	0.5	
VOCs:							
Acetone	--		0.024		0.3	0.23	D
Methyl ethyl ketone	--		--		0.05	0.04	D
Methylene chloride	0.021		0.023		--	--	
BNAs:							
Bis(2-ethylhexyl) phthalate	--		0.55		--	--	
Di-n-butyl phthalate	2.6	S	1.6	S	--	--	
N,N-Bis(2-hydroxyethyl)dodecanamide	1.4	S	--		--	--	
N-Nitrosodi-n-propylamine	--		1.7		--	--	
Phosphate:							
Phosphate	*		*		570	600	D
Organic Carbon:							
Total organic carbon	6190		5490		1660000	923000	D
Metals:							
Aluminum	4200	B	15000	B	9020	9370	D
Arsenic	14		12		28	35	D
Barium	21.2		27.2		66.4	68.4	D
Beryllium	--		0.379		--	--	
Calcium	663		--		5690	5370	D
Chromium	8.21		17.2		14.2	15.2	D
Cobalt	5.27		11.6		--	--	
Copper	3.5		17		--	--	
Iron	11000	B	16000	B	14000	17000	D
Lead	12		6.1		12	16	D
Magnesium	1530		2230		1660	1920	D
Manganese	1900		99.4		460	529	D
Nickel	7.75		25.7		--	--	
Potassium	548		599		--	--	
Selenium	--		--		2.4	2.2	D
Vanadium	8.67		17.9		17.3	20.2	D
Zinc	23.6		29.9		44	50.8	D

Table D-19
Area P9
Summary of Detected Compounds
Sediment (ug/g)

Site ID	P9SD1	P9SD2	P9SD3	P9SD4
Field Sample No.	P9SD1A	P9SD2A	P9SD3A	P9SD4A
Sample Date	29-Apr-92	29-Apr-92	30-Apr-92	29-Apr-92
Depth (ft.)	0.5	0.5	0.5	0.5
VOCs:				
Methylene chloride	--	0.0089	0.0095	0.013
BNAs:				
Di-n-butyl phthalate	0.48 S	--	2 S	2 S
Sulfur	1.2 S	--	--	--
PCB/Pesticides:				
Chlordane, alpha	--	0.108	0.0337	--
Chlordane, gamma	--	0.179 1	0.0513	--
Chlordane, total	--	0.287 1	0.085	--
ppDDD	--	0.0182	0.0152 1	--
ppDDE	--	--	0.0156 1	--
ppDDT	--	0.0143	0.0155	--
Organic Carbon:				
Total organic carbon	9720	5510	8540	3980
Metals:				
Aluminum	5400 B	4000 B	5700 B	8300 B
Arsenic	11	10	2.66	3.94
Barium	34.1	17.7	29.1	34.3
Calcium	702	895	1190	484
Chromium	11.3	9.63	16.1	18.8
Cobalt	--	--	--	3.46
Copper	4.15	7.7	9.39	10.2
Iron	11000 B	11000 B	11000 B	13000 B
Lead	5.9	11	13	8.9
Magnesium	1950	2090	2840	3230
Manganese	170	130	110	140
Nickel	6.14	7.6	10.1	9.61
Potassium	1900	982	1800	2360
Vanadium	17.4	11.5	17.5	20.5
Zinc	27.3	21.4	25.4	22.9

Table D-20
Area A7
Summary of Detected Compounds - Sediment (ug/g)
Dames & Moore and Ecology & Environment Sample Locations

Site ID		E3-BCK-D03	
Field Sample No.	SED8	DXBCK031	
Sample Date	10-Oct-84	17-Sept-93	
Depth (ft.)	0.49	0	
BNAs:			
3-(t-butyl) phenol	7	--	
Acenaphthylene	0.3	--	
Alcohols	5	--	
Benzo(a)pyrene	0.2	--	
Benzo(ghi)perylene	0.2	--	
Benzo(k)fluoranthene	0.3	--	
Diethyl phthalate	0.2	--	
Di-n-butyl phthalate	0.1	--	
Hexadecanoic acid	0.9	--	
Hydrocarbons	10	--	
Indeno[1,2,3-C,D]pyrene	0.1	--	
Isophorone	0.1	--	
Naphthalene	0.2	--	
Phenanthrene	0.2	--	
Phenol	1	--	
Tetradecanoic acid	0.6	--	
PCB/Pesticides:			
ppDDE	*	0.038	C
ppDDT	*	0.003	C
TPH:			
Total petroleum hydrocarbons	*	16.7	J
Organic Carbon:			
Total organic carbon	44100	16600	
Metals:			
Aluminum	*	3880	
Arsenic	30	2.95	
Barium	*	17.9	
Beryllium	*	0.159	J
Calcium	*	558	J
Chromium	--	8.51	
Cobalt	*	4.81	
Copper	--	13.1	L
Iron	*	9030	
Lead	15.5	18	J
Magnesium	*	1570	
Manganese	*	108	
Nickel	*	7.8	
Potassium	*	742	
Thallium	*	0.088	J
Sodium	*	--	
Vanadium	*	11.5	
Zinc	32.4	28.3	J

Notes:

-- = Analyte was not detected
* = Not analyzed
C = Confirmed on second column
J = Estimated Value
L = Result bias low

Table D-21
Assabet River
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	FWISW14		FWISW15		FWISW16		FWISW16	
Field Sample No.	FWISW14A		FWISW15A		FWISW16A		DUPSW05A	
Sample Date	13-May-92		13-May-92		13-May-92		13-May-92	
Depth (ft.)	0		0		0		0	
BNAs:								
Bis(2-ethylhexyl) phthalate	200		28		--		6.9	1
Herbicides:								
Dacthal	0.828		--		0.529		0.656	D
Phosphate:								
Phosphate	198		--		66.2		68.9	D
Metals:								
Calcium	13600		7180		12800		13200	D
Iron	531		515		594		575	D
Lead	2.92	B	3.68	B	2.47	B	2.77	B
Magnesium	2210		--		2120		2180	D
Manganese	123		84.9		128		125	D
Potassium	3130		--		2710		2870	D
Sodium	27100		5510		24800		25500	D
Zinc	9.86		--		9.75		--	

Table D-22
Assabet River
Summary of Detected Compounds
Sediment (ug/g)

Site ID	FWISD14	FWISD14	FWISD14	FWISD15	FWISD15	FWISD15	FWISD16	FWISD16
Field Sample No.	FWSD14A1	FWSD14A2	FWSD14A3	FWSD15A1	FWSD15A2	FWSD15A3	FWSD16A1	DUPSD05A
Sample Date	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92
Depth (ft.)	0	1	3	0	1	3	0	0
VOCs:								
Acetone	--	--	--	0.9	0.4 1	0.4 1	0.2	0.05 D
Carbon disulfide	--	--	--	0.02	--	--	--	--
Methyl ethyl ketone	--	--	--	0.024	0.1	0.2	0.081	0.044 D
Methylene chloride	--	0.0098	0.018	0.06	0.13	0.061	--	--
Tetrachloroethylene	--	--	--	0.016	--	--	--	--
Toluene	--	--	--	0.019	--	--	--	--
BNAs:								
Benzo(a)pyrene	1.4	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.91	1.3	0.89	--	--	--	--	--
Di-n-butyl phthalate	0.46 S	0.7 S	0.64 S	--	--	--	--	--
PCB/Pesticides:								
Chlordane, alpha	--	--	--	0.0497	0.126	--	--	--
Chlordane, gamma	--	--	--	--	0.23	--	--	--
Chlordane, total	--	--	--	0.0497	0.356	--	--	--
PCB 1254	--	--	--	--	--	0.49 T	--	--
PCBs, total	--	--	--	--	--	0.49 T	--	--
ppDDD	--	--	--	--	0.254	0.0885	--	--
ppDDE	--	--	--	--	0.112	--	--	--
ppDDT	--	--	--	--	0.0763	--	--	--
Phosphate:								
Phosphate	--	1.32	1.48	--	8.03	--	--	--
Organic Carbon:								
Total organic carbon	7300	4400	2570	370000	367000	304000	98000	65000 D

Table D-22
Assabet River
Summary of Detected Compounds
Sediment (ug/g)

Site ID	FWISD14	FWISD14	FWISD14	FWISD15	FWISD15	FWISD15	FWISD16	FWISD16
Field Sample No.	FWSD14A1	FWSD14A2	FWSD14A3	FWSD15A1	FWSD15A2	FWSD15A3	FWSD16A1	DUPSD05A
Sample Date	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92	13-May-92
Depth (ft.)	0	1	3	0	1	3	0	0
Metals:								
Aluminum	6800 B	8100 B	5500 B	13000 B	11000 B	12000 B	13000 B	17000 B
Arsenic	18	88	34	140	120	140	20	19 D
Barium	26.7	175	28.8	107	88.2	97.1	28.5	31.4 D
Cadmium	0.664	1.61	0.92	4.46	2.47	3.48	--	1.13 D
Calcium	781	669	--	7690	6900	6630	1000	1310 D
Chromium	17.5	16.7	13	--	24.6	24.1	20.2	29.1 D
Cobalt	4.13 7	320 B	33.9 7	--	15.5 7	20.5 7	--	7.33 7
Copper	--	21.4	11.2	28.1	26.5	29.2	9.5	14.7 D
Iron	7800 B	9700 B	14000 B	42000 B	35000 B	36000 B	16000 B	15000 B
Lead	2.06	0.905	0.828	8.2	5.42	3.37	3.24	1.8 D
Magnesium	2500	2520	2060	1650	1460	1580	2010	2410 D
Manganese	160	3500	700	1100	990	800	157	208 D
Mercury	--	--	--	0.414	0.372	0.438	--	0.23 D
Nickel	16.4	101	22.2	26.3	31.5	31.1	11.2	16.9 D
Potassium	416	1530	1180	--	--	--	587	529 D
Vanadium	14	14.6	12.3	22.8	20.8	24.9	21.4	25.5 D
Zinc	23.2	56.8	27	248	183	237	34.8	85.3 D

Table D-22
Assabet River
Summary of Detected Compounds
Sediment (ug/g)

Site ID	FWISD16	FWISD16
Field Sample No.	FWSD16A2	FWSD16A3
Sample Date	13-May-92	13-May-92
Depth (ft.)	1	3
VOCs:		
Acetone	0.2	0.027
Carbon disulfide	--	--
Methyl ethyl ketone	0.066	--
Methylene chloride	0.025	--
Tetrachloroethylene	--	--
Toluene	--	--
BNAs:		
Benzo(a)pyrene	--	--
Bis(2-ethylhexyl) phthalate	--	--
Di-n-butyl phthalate	--	--
PCB/Pesticides:		
Chlordane, alpha	--	--
Chlordane, gamma	--	--
Chlordane, total	--	--
PCB 1254	--	--
PCBs, total	--	--
ppDDD	--	--
ppDDE	--	--
ppDDT	--	--
Phosphate:		
Phosphate	7.85	--
Organic Carbon:		
Total organic carbon	89100	25500

Table D-22
Assabet River
Summary of Detected Compounds
Sediment (ug/g)

Site ID	FWISD16		FWISD16	
Field Sample No.	FWSD16A2		FWSD16A3	
Sample Date	13-May-92		13-May-92	
Depth (ft.)	1		3	
Metals:				
Aluminum	84.2		15000	B
Arsenic	25		12	
Barium	49		36.4	
Cadmium	1.3		--	
Calcium	2020		770	
Chromium	41.1		25.9	
Cobalt	11.8	7	7.18	7
Copper	23.3		9.91	
Iron	21000	B	11000	B
Lead	2.47		0.986	
Magnesium	3430		3000	
Manganese	288		138	
Mercury	0.246		0.111	
Nickel	22.7		25.1	
Potassium	866		575	
Vanadium	34.9		20.3	
Zinc	118		82.1	

Table D-23
Area A9
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A9CD1	A9SO1	A9SO2	A9SO3	A9SO4	A9SO5	A9SO6
Field Sample No.	A9CD1A	A9SO1A	A9SO2A	A9SO3A	A9SO4A	A9SO5A	A9SO6A
Sample Date	18-May-92	15-Apr-92	15-Apr-92	15-Apr-92	15-Apr-92	15-Apr-92	15-Apr-92
Depth (ft.)	0	0	0	0	0	0	0
VOCs:							
Acetone	0.012	--	--	--	--	--	--
Methylene chloride	--	0.012	0.011	--	--	0.011	0.01
Pinene-alpha	0.32 S	--	--	0.25 S	--	0.011 S	--
BNAs:							
Bis(2-ethylhexyl) phthalate	0.58	--	--	--	--	--	--
Di-n-butyl phthalate	2 S	--	1 S	4 S	0.8 S	1 S	--
PCB/Pesticides:							
ppDDE	0.0254	--	--	--	--	--	--
ppDDT	0.0585	0.0141	--	--	--	--	--
Metals:							
Aluminum	9800 B	9500	10000	8800	8900	5700	8500
Arsenic	8.1	46	5.7	18	5.95	5.68	8
Barium	22.8	22.5	50.6	22.3	28.4	21.9	23.8
Beryllium	--	--	--	--	--	--	--
Cadmium	1.44	--	0.671	--	--	--	0.452
Calcium	--	--	647	--	--	566	--
Chromium	22.7	14.7	24.5	13.3	15.6	10.6	15.1
Cobalt	2.95	2.84	6.1	2.7	3.46	2.45	3.44
Copper	10.7	9.33	10.9	8.86	11.2	7.5	9.09
Iron	13000 B	10000	15000 X	9500	12000	7600	11000
Lead	450	37	14	26	12	8.7	22
Magnesium	2120	2260	4070	1960	2660	1930	2600
Manganese	120	110	190	83.1	110	81.5	110
Nickel	8.55	7.8	13.9	6.91	8.27	6.7	8.3
Potassium	987	1080	2870	1050	1660	1210	1540
Selenium	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--
Vanadium	23.4	18.6	26.7	19.2	20.8	12.4	22.6
Zinc	22.5	109	95.5	35.1	21.8	16.8	20.6

Table D-23
Area A9
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A9SO7	A9SO8	A9SO9	A9SO10
Field Sample No.	A9SO7B	A9SO8B	A9SO9B	A9SO10B
Sample Date	15-Nov-93	15-Nov-93	15-Nov-93	15-Nov-93
Depth (ft.)	0	0	0	0
VOCs:				
Acetone	*	*	*	*
Methylene chloride	*	*	*	*
Pinene-alpha	*	*	*	*
BNAs:				
Bis(2-ethylhexyl) phthalate	*	*	*	*
Di-n-butyl phthalate	*	*	*	*
PCB/Pesticides:				
ppDDE	*	*	*	*
ppDDT	*	*	*	*
Metals:				
Aluminum	14000	11000	7100	11000
Arsenic	20	4.1	6.9	9.3
Barium	32.8	75.8	38.5	31.5
Beryllium	0.547	--	--	0.547
Cadmium	--	--	--	--
Calcium	474	2010	926	460
Chromium	16.2	53.9	13.7	15.4
Cobalt	3.76	3.96	--	3.76
Copper	7.14	11.7	6.92	5.63
Iron	12000	16000	9900	9900
Lead	26	31	35	270
Magnesium	2020	5720	2260	1830
Manganese	158	186	250	128
Nickel	--	12	--	--
Potassium	766	2990	1020	608
Selenium	0.45	0.33	0.35	0.51
Sodium	61.7	280	66.6	--
Thallium	304	--	--	--
Vanadium	22.9	48.7	20.3	20.8
Zinc	28	42.3	28.6	28.2

Table D-24
Area A9
Summary of Detected Compounds
Hand Auger Samples (ug/g)

Site ID	A9HA1	A9HA2	A9HA3	A9HA4	A9HA5	A9HA6	A9HA7	A9HA8
Field Sample No.	A9HA1A	A9HA2A	A9HA3A	A9HA4A	A9HA5B	A9HA6B	A9HA7B	A9HA8B
Sample Date	15-Oct-92	15-Oct-92	15-Oct-92	15-Oct-92	15-Nov-93	15-Nov-93	15-Nov-93	15-Nov-93
Depth (ft.)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
VOCs:								
Pinene-alpha	--	--	--	0.035 S	*	*	*	*
BNAs:								
Benzo(a)pyrene	0.29	--	--	--	*	*	*	*
Chrysene	0.31	--	--	--	*	*	*	*
Di-n-butyl phthalate	--	--	0.41 S	0.47 S	*	*	*	*
Fluoranthene	0.42	0.33	0.2	--	*	*	*	*
Indeno[1,2,3-C,D]pyrene	0.23	--	--	--	*	*	*	*
Phenanthrene	0.23	0.21	--	--	*	*	*	*
PCB/Pesticides:								
ppDDT	0.038	0.0441	0.0355	--	*	*	*	*
Metals:								
Aluminum	11000 B	9900 B	11000 B	12000 B	15000	17000	5200	7300
Arsenic	56	59	70	65	140	14	6.4	7.6
Barium	19.6	18.7	19.1	21.3	42.7	31.5	18.1	20.6
Beryllium	--	--	0.305	0.336	0.676	0.692	--	--
Cadmium	1.64	1.39	1.63	1.13	0.774	--	--	--
Calcium	--	--	--	--	369	241	601	373
Chromium	16.5	15.4	14.7	15	16.8	19.3	12	14.7
Cobalt	2.62	--	2.99	--	4.86	4.85	--	--
Copper	10.1	8.47	8.62	8.22	5.69	4.43	5.63	7.04
Iron	12000 B	11000 B	11000 B	11000 B	13000	15000	8100	11000
Lead	20	21	14	9.2	17	8.1	3.3	9.1
Magnesium	2370	2170	2180	1990	2030	2170	2150	2730
Manganese	150	110	130	130	174	101	83.3	98.9
Nickel	8.12	8	7.42	8.45	9.45	10.3	9.04	10.6
Potassium	939	938	962	708	547	411	1110	1250
Selenium	--	--	--	--	0.54	0.49	0.27	0.23
Vanadium	21.9	22.1	20.4	17.2	21.2	23.3	10.9	14.1
Zinc	44.5	26.6	25.2	25.8	34.3	30	21.1	25.3

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B1	A9B1	A9B1	A9B2	A9B2	A9B2	A9B3	A9B3
Field Sample No.	A9SB1A	A9SB1B	A9SB1C	A9SB2A	A9SB2B	A9SB2C	A9SB3A	A9SB3B
Sample Date	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	28-Feb-92	28-Feb-92
Depth (ft.)	4	14	20	8	16	18	10	16
VOCs:								
1,1,1-Trichloroethane	--	--	--	0.022	0.012	0.2	--	--
1,1,3-Trimethylcyclohexane	--	--	--	--	--	--	--	--
1,3-Dimethylbenzene	--	--	--	--	--	--	--	--
1,3-Dimethylcyclohexane	--	--	--	--	--	--	--	--
1,4-Dimethylcyclohexane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methyl ethyl ketone	--	--	--	--	--	--	--	--
Methylene chloride	0.0086	--	0.016	0.01	0.013	--	0.0099	--
Toluene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	0.5	--	--
BNAs:								
2,6-Dinitrotoluene	--	--	--	--	--	1.1	--	--
2-Methylnaphthalene	--	--	--	--	--	10	--	--
Benzo[def]phenanthrene	--	--	--	--	--	0.39	--	--
Bis(2-ethylhexyl) phthalate	0.49	0.44	1.2	2.3 X	2	5	0.89	0.64
Di-n-butyl phthalate	--	0.57 S	1.7 S	0.34 S	--	0.67 S	--	0.91 S
Di-n-octyl phthalate	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	1.4	--	--
Fluoranthene	--	--	--	--	--	1.4	--	--
Fluorene	--	--	--	--	--	2.4	--	--
Naphthalene	--	--	--	--	--	2.3	--	--
Phenanthrene	--	--	--	--	--	10	--	--
PCB/Pesticides:								
Endosulfan, beta	--	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	0.0156	--	--
ppDDD	--	--	--	--	--	--	--	--
ppDDE	--	--	--	--	--	--	--	--
Organic Carbon:								

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B1	A9B1	A9B1	A9B2	A9B2	A9B2	A9B3	A9B3
Field Sample No.	A9SB1A	A9SB1B	A9SB1C	A9SB2A	A9SB2B	A9SB2C	A9SB3A	A9SB3B
Sample Date	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	27-Feb-92	28-Feb-92	28-Feb-92
Depth (ft.)	4	14	20	8	16	18	10	16
Total organic carbon	*	*	*	*	*	*	*	*
Metals:								
Aluminum	9000	4400	6400	8900	6600	4700	4700	3800
Arsenic	17	5.14	5.97	5.16	5.8	4.98	6.23 X	4.7
Barium	23.7	12.2	29.8	29.3	19.4	15.3	12.4	10.9
Cadmium	--	--	0.546	0.526	--	0.398	--	--
Calcium	449	556	1450	450	531	743	957	458
Chromium	14.2	9.72	14.1	16.1	12.7	9.83	8.2	7.9
Cobalt	2.94	--	--	2.98	--	2.98	--	--
Copper	8.36	6.2	6.45	9.89	7.9	7.86	5.89	4.54
Iron	11000	7900	10000	12000	9700	7600	7300	6900
Lead	5.2	3.15	2.63	5.9	5.2	2.54	2.79	2.45
Magnesium	2110	1870	2510	2520	1900	1770	1340	1460
Manganese	130	93.8	130	130	98	100	73.8	73.4
Mercury	--	--	--	--	--	--	--	--
Nickel	7.62	7.01	7.55	7.31	6.3	6.41	4.58	4.84
Potassium	1040	1020	1920	1580	1160	1080	719	812
Selenium	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	14.8	8.97	14.8	18.8	13	9.71	7.7	7.5
Zinc	16.1	16.1	21.8	19.2	16.1	15.1	11.2	11.8

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B3	A9B4	A9B4	A9B4	A9B5	A9B5	A9B5	A9B6
Field Sample No.	A9SB3C	A9SB4A	A9SB4B	A9SB4C	A9SB5A	A9SB5B	A9SB5C	A9SB6A
Sample Date	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	19-May-92
Depth (ft.)	18	4	12	18	8	14	20	8
VOCs:								
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--
1,1,3-Trimethylcyclohexane	--	--	--	--	--	--	--	--
1,3-Dimethylbenzene	--	--	--	--	--	--	--	--
1,3-Dimethylcyclohexane	--	--	--	--	--	--	--	--
1,4-Dimethylcyclohexane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Methyl ethyl ketone	--	--	--	--	--	--	--	--
Methylene chloride	0.011	--	--	0.0087	--	--	0.0099	--
Toluene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
2,6-Dinitrotoluene	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--
Benzo[def]phenanthrene	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.64	0.53	0.74	2.1 X	1.7	1	0.68	--
Di-n-butyl phthalate	0.83 S	--	1 S	1.7 S	2.1 S	0.63 S	--	0.45 S
Di-n-octyl phthalate	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--
PCB/Pesticides:								
Endosulfan, beta	--	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--
ppDDD	--	--	--	--	--	--	--	--
ppDDE	--	--	--	--	--	--	--	--
Organic Carbon:								

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B3	A9B4	A9B4	A9B4	A9B5	A9B5	A9B5	A9B6
Field Sample No.	A9SB3C	A9SB4A	A9SB4B	A9SB4C	A9SB5A	A9SB5B	A9SB5C	A9SB6A
Sample Date	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	28-Feb-92	19-May-92
Depth (ft.)	18	4	12	18	8	14	20	8
Total organic carbon	*	*	*	*	*	*	*	510
Metals:								
Aluminum	6200	5500	5300	8300	5300	4600	7600	3500 B
Arsenic	7.21 X	3.88	7.9	5.34	5.99	9.5	8.7	6.8
Barium	25	22	23.5	32.5	18.9	17.7	25.8	13.2
Cadmium	--	--	--	--	--	--	--	0.503
Calcium	1360	532	1160	1310	848	1280	1190	960
Chromium	12.6	12.6	11.6	16.4	9.37	9.36	14.2	6.61
Cobalt	2.96	2.47	--	2.96	--	--	3.32	--
Copper	7.86	7.18	6.09	10.7	6.2	5.7	9.34	4.68
Iron	10000	9200	9000	12000	7900	8000	11000	6200 B
Lead	3.27	3.4	2.9	4.3	3.4	2.62	4.3	2.42
Magnesium	2210	2280	1990	2810	1570	1680	2470	1180
Manganese	150	95	140	150	78.4	95	140	60.3
Mercury	--	--	--	--	--	--	--	--
Nickel	8.14	5.93	6.96	11.1	5.2	6.55	12.3	4.17
Potassium	1550	1790	1270	1640	1070	1070	1490	774
Selenium	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	12.8	15	11.1	15.2	10	8.98	13.8	6.77
Zinc	19.2	13.4	16.8	25	12.3	16	22.8	16.7

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B6	A9B7	A9B7	A9B8	A9B8	A9B9	A9B9	A9B10
Field Sample No.	A9SB6B	A9SB7A	A9SB7B	A9SB8A	A9SB8B	A9SB9A	A9SB9B	A9SB10B
Sample Date	19-May-92	19-May-92	19-May-92	19-May-92	19-May-92	18-May-92	18-May-92	15-Nov-93
Depth (ft.)	12	2	14	2	8	10	18	4
VOCs:								
1,1,1-Trichloroethane	--	--	--	--	*	--	--	*
1,1,3-Trimethylcyclohexane	--	--	--	0.025 S	*	--	--	*
1,3-Dimethylbenzene	--	0.025 S	--	--	*	--	--	*
1,3-Dimethylcyclohexane	--	0.037 S	--	--	*	--	--	*
1,4-Dimethylcyclohexane	--	--	0.011 S	--	*	--	--	*
Acetone	--	0.032	0.021	0.023	*	--	--	*
Ethylbenzene	--	0.011	--	0.0099	*	--	--	*
Methyl ethyl ketone	--	0.0083	--	--	*	--	--	*
Methylene chloride	--	--	0.008	--	*	--	--	*
Toluene	--	--	--	--	*	--	--	*
Xylenes, total	--	0.022	0.0076	0.0066	*	--	--	*
BNAs:								
2,6-Dinitrotoluene	--	--	--	--	--	--	--	*
2-Methylnaphthalene	--	--	--	--	--	--	--	*
Benzo[def]phenanthrene	--	--	--	--	--	--	--	*
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	--	*
Di-n-butyl phthalate	0.94 S	1.7 S	--	1.6 S	0.94 S	1 S	0.79 S	*
Di-n-octyl phthalate	--	--	--	--	--	--	--	*
Dibenzofuran	--	--	--	--	--	--	--	*
Fluoranthene	--	--	--	--	--	--	--	*
Fluorene	--	--	--	--	--	--	--	*
Naphthalene	--	--	--	--	--	--	--	*
Phenanthrene	--	--	--	--	--	--	--	*
PCB/Pesticides:								
Endosulfan, beta	--	--	--	--	--	--	*	*
Endosulfan, total	--	--	--	--	--	--	*	*
Heptachlor epoxide	--	--	--	--	--	--	*	*
ppDDD	--	--	--	0.0891	--	--	*	*
ppDDE	--	--	--	0.0325	--	--	*	*
Organic Carbon:								

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B6	A9B7	A9B7	A9B8	A9B8	A9B9	A9B9	A9B10
Field Sample No.	A9SB6B	A9SB7A	A9SB7B	A9SB8A	A9SB8B	A9SB9A	A9SB9B	A9SB10B
Sample Date	19-May-92	19-May-92	19-May-92	19-May-92	19-May-92	18-May-92	18-May-92	15-Nov-93
Depth (ft.)	12	2	14	2	8	10	18	4
Total organic carbon	590	16000	1800	20000	890	310	260	*
Metals:								
Aluminum	5200 B	12000 B	6000 B	11000 B	5500 B	3400 B	2300 B	4440
Arsenic	8.3	6.2	7.1	5.72	8.8	8	8.3	3.7
Barium	19.2	30.5	20.3	35.6	14.6	13.7	10.3	19.1
Cadmium	0.902	0.586	--	0.827	0.942	0.468	--	--
Calcium	1040	557	799	684	643	1190	1380	510
Chromium	10.6	13.7	12.7	12.8	9.42	6.55	5.14	9.65
Cobalt	--	--	--	--	2.87	--	--	--
Copper	7.07	6.27	7.68	8.5	6.46	4.82	3.87	4.53
Iron	8900 B	17000 B	8200 B	10000 B	9200 B	6300 B	5100 B	7000
Lead	3.8	16 B	7.3 B	17	5.1	2.6	2.29	3
Magnesium	1860	1520	1690	1500	1430	1270	1010	1820
Manganese	94	120	100	106	410	78.3	52	64.6
Mercury	--	--	--	0.112	--	--	--	--
Nickel	6.93	5.88	5.48	6.21	5.25	4.72	3.92	--
Potassium	1120	578	1410	498	1030	814	696	1100
Selenium	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	10.1	17.2	10.6	16.6	14.5	7.11	5.57	10
Zinc	19.6	19.6	13.9	31.2	14.4	12	9.63	20

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B11	OHM-A9-16	OHM-A9-17	OHM-A9-18	OHM-A9-18	OHM-A9-47	OHM-A9-48	OHM-A9-49
Field Sample No.	A9SB11B	A9SB16A	A9SB17A	A9SB18A	A9SB18A	A9SB47A	A9SB48A	A9SB49A
Sample Date	15-Nov-93	11-Feb-92	25-Feb-92	19-Feb-92	19-Feb-92	15-May-92	15-May-92	14-May-92
Depth (ft.)	4	14	28	20	22	10	12	8
VOCs:								
1,1,1-Trichloroethane	*	--	--	--	*	--	--	--
1,1,3-Trimethylcyclohexane	*	--	--	--	*	--	--	--
1,3-Dimethylbenzene	*	--	--	--	*	--	--	--
1,3-Dimethylcyclohexane	*	--	--	--	*	--	--	--
1,4-Dimethylcyclohexane	*	--	--	--	*	--	--	--
Acetone	*	--	--	--	*	--	--	--
Ethylbenzene	*	--	--	--	*	--	--	--
Methyl ethyl ketone	*	--	--	--	*	--	--	--
Methylene chloride	*	--	0.02	--	*	--	--	--
Toluene	*	--	--	--	*	--	--	--
Xylenes, total	*	--	--	--	*	--	--	--
BNAs:								
2,6-Dinitrotoluene	*	--	--	--	*	--	--	--
2-Methylnaphthalene	*	--	--	--	*	--	--	--
Benzo[def]phenanthrene	*	--	--	--	*	--	--	--
Bis(2-ethylhexyl) phthalate	*	--	0.58	1.7	*	--	--	--
Di-n-butyl phthalate	*	0.55 S	0.8 S	0.25 S	*	0.41 S	0.52 S	1.1 S
Di-n-octyl phthalate	*	--	--	0.5 S	*	--	--	--
Dibenzofuran	*	--	--	--	*	--	--	--
Fluoranthene	*	--	--	--	*	--	--	--
Fluorene	*	--	--	--	*	--	--	--
Naphthalene	*	--	--	--	*	--	--	--
Phenanthrene	*	--	--	--	*	--	--	--
PCB/Pesticides:								
Endosulfan, beta	*	--	--	--	*	--	--	--
Endosulfan, total	*	--	--	--	*	--	--	--
Heptachlor epoxide	*	--	--	--	*	--	--	--
ppDDD	*	--	--	--	*	--	--	--
ppDDE	*	--	--	--	*	--	--	--
Organic Carbon:								

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	A9B11	OHM-A9-16	OHM-A9-17	OHM-A9-18	OHM-A9-18	OHM-A9-47	OHM-A9-48	OHM-A9-49
Field Sample No.	A9SB11B	A9SB16A	A9SB17A	A9SB18A	A9SB18A	A9SB47A	A9SB48A	A9SB49A
Sample Date	15-Nov-93	11-Feb-92	25-Feb-92	19-Feb-92	19-Feb-92	15-May-92	15-May-92	14-May-92
Depth (ft.)	4	14	28	20	22	10	12	8
Total organic carbon	*	306	582	*	405	360	380	550
Metals:								
Aluminum	4960	4200	7300	3600	*	5100 B	3800 B	7000 B
Arsenic	4.1	6.1 X	8.3	13	*	4.54	7.5	3.63
Barium	22.7	14.6	27.6	12.8	*	17.2	17.9	30.1
Cadmium	--	--	0.493	0.399	*	0.784	0.787	0.791
Calcium	865	912	1130	844	*	712	1550	1040
Chromium	10.8	7.92	15.6	8.14	*	9.48	9.19	14.5
Cobalt	--	--	3.02	--	*	--	--	2.85 7
Copper	5.62	4.93	8.55	5.79	*	7.06	6.12	8.43
Iron	8300	7700	12000	9500	*	8100 B	8300 B	10000 B
Lead	3.1	2.12	4.4	2.65	*	2.85	2.74	3.07
Magnesium	1810	1470	2390	1380	*	1790	1720	2740
Manganese	67.6	89.4	160	82.1	*	79.5	92.4	120
Mercury	--	--	--	--	*	--	--	--
Nickel	--	5.27	9.27	4.52	*	6.39	6.71	7.87
Potassium	1020	939	1390	867	*	1120	1180	2020
Selenium	--	--	--	--	*	--	--	--
Sodium	--	--	--	--	*	--	--	--
Vanadium	10.8	8.09	12.7	8.24	*	10.1	9.74	17.5
Zinc	18.5	12.8	21.5	12.7	*	13.4	16.3	20.8

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	OHM-A9-53	OHM-A9-53	OHM-A9-54	OHM-A9-55	OHM-A9-56	OHM-A9-57	OHM-A9-58	OHM-BW-5
Field Sample No.	A9SB53B	DUPSB01C	A9SB54B	A9SB55B	A9SB56B	A9SB57B	A9SB58B	FWSB5B
Sample Date	09-Nov-93	09-Nov-93	01-Nov-93	02-Nov-93	03-Nov-93	04-Nov-93	08-Nov-93	11-Nov-93
Depth (ft.)	32	32	24	18	24	24	30	30
VOCs:								
1,1,1-Trichloroethane	--	--	--	0.0063	--	--	--	--
1,1,3-Trimethylcyclohexane	--	--	--	--	--	--	--	--
1,3-Dimethylbenzene	--	--	--	--	--	--	--	--
1,3-Dimethylcyclohexane	--	--	--	--	--	--	--	--
1,4-Dimethylcyclohexane	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Ethylbenzene	0.0059	--	0.018	--	--	--	--	--
Methyl ethyl ketone	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Toluene	--	--	0.019	--	--	--	--	0.0036
Xylenes, total	0.044	0.043 D	0.1	0.048	--	--	--	--
BNAs:								
2,6-Dinitrotoluene	--	*	--	--	--	--	--	--
2-Methylnaphthalene	--	*	--	2.2	--	--	--	--
Benzo[def]phenanthrene	--	*	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.69	*	0.79	5.7	0.73	0.62	0.44	0.54
Di-n-butyl phthalate	--	*	--	--	--	--	--	--
Di-n-octyl phthalate	--	*	--	--	--	--	--	--
Dibenzofuran	--	*	--	0.27	--	--	--	--
Fluoranthene	--	*	--	0.51	--	--	--	--
Fluorene	--	*	--	--	--	--	--	--
Naphthalene	--	*	--	0.44	--	--	--	--
Phenanthrene	--	*	--	2.5	--	--	--	--
PCB/Pesticides:								
Endosulfan, beta	--	*	--	0.0102 1	--	--	--	--
Endosulfan, total	--	*	--	0.0102 1	--	--	--	--
Heptachlor epoxide	--	*	--	--	--	--	--	--
ppDDD	--	*	--	--	--	--	--	--
ppDDE	--	*	--	--	--	--	--	--
Organic Carbon:								

Table D-25
Area A9
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	OHM-A9-53	OHM-A9-53	OHM-A9-54	OHM-A9-55	OHM-A9-56	OHM-A9-57	OHM-A9-58	OHM-BW-5
Field Sample No.	A9SB53B	DUPSB01C	A9SB54B	A9SB55B	A9SB56B	A9SB57B	A9SB58B	FWSB5B
Sample Date	09-Nov-93	09-Nov-93	01-Nov-93	02-Nov-93	03-Nov-93	04-Nov-93	08-Nov-93	11-Nov-93
Depth (ft.)	32	32	24	18	24	24	30	30
Total organic carbon	4110	2550 D	2820	5940	1520	3760	4350	4180
Metals:								
Aluminum	3910	3440 D	3790	4970	4550	5400	4610	5450
Arsenic	6	5.8 D	5.7	4.6	5.1	5.9	4.3	10
Barium	15	11.8 D	27.1	22.9	18.9	22.1	16.2	36.5
Cadmium	--	--	--	--	--	--	--	--
Calcium	707	828 D	1140	1100	1060	1190	1100	1690
Chromium	10.6 B	7.21 B	8.01	99.1	8.61	11.3	11.9	12.7
Cobalt	--	--	--	3.54	--	--	--	--
Copper	4.47	--	--	4.69	--	4.74	6.23	6.31
Iron	7000	6100 D	6400	7400	7300	8400	8800	9800
Lead	2.2	2.3 D	2.5	2.4	2.3	2.9	2.6	3.3
Magnesium	1460	1330 D	1550	1790	1620	1930	1950	2350
Manganese	64.4	55.5 D	62.8	78.9	94	98	144	115
Mercury	--	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--	--
Potassium	898	727 D	1040	1260	1050	1240	851	1750
Selenium	--	--	--	2.8	--	--	--	--
Sodium	--	--	--	--	58.6	--	--	--
Vanadium	7.93	7.39 D	9.51	11.5	10.1	11.3	10.7	14.2
Zinc	16.8	14.9 D	18.3	18.7	16.9	20.8	20.4	25

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	DM8	DM8	DM8	DM9A	DM9A	DM9A	DM10	DM10
Field Sample No.	DMGW8A	DMGW8B	DMGW8C	DMGW9AA	DMGW9AB	DMGW9AC	DMGW10A	DMGW10B
Sample Date	29-Jun-92	03-Nov-92	07-Dec-93	30-Jun-92	05-Nov-92	07-Dec-93	30-Jun-92	04-Nov-92
Filtered/Unfiltered Metals	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered
VOCs:								
1,1,1-Trichloroethane	23	16	28 S	--	--	--	--	--
1,1-Dichloroethene	--	--	--	--	--	--	--	--
1,3-Dimethylbenzene	--	--	--	260 S	--	--	--	--
Acetone	--	--	--	13	--	15 S	--	--
Ethylbenzene	--	--	--	25	--	170 S	--	--
Ethylmethyl benzene	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--
Toluene	--	--	--	17	--	21 S	--	--
Trichloroethylene	--	--	--	--	--	--	--	--
Xylenes, total	--	--	--	200	200	460 S	--	--
BNAs:								
1,2,3,4-Tetramethylbenzene	--	--	--	21 S	--	--	--	--
1,2,3-Trimethylbenzene	--	--	--	120 S	--	--	--	--
1-Ethyl-2-methylbenzene	--	--	--	150 S	--	--	--	--
1-Methylnaphthalene	--	--	--	14 S	--	--	--	--
2-Methylnaphthalene	--	--	--	27	10	22 S	--	--
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	40	--
Di-n-butyl phthalate	--	--	--	--	6	--	--	6.2
Naphthalene	--	--	--	57	39	83 S	--	--
N,N-Diethyl-3-methylbenzamide	13 S	--	--	--	--	--	13 S	--
PCB/Pesticides:								
Chlordane-alpha	--	--	--	--	--	--	--	--
Chlordane, total	--	--	--	--	--	--	--	--
Endosulfan, beta	--	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--	--
Endrin aldehyde	0.176	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	--	--	--
PCBs, total	--	--	--	--	--	--	--	--

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	DM8	DM8	DM8	DM9A	DM9A	DM9A	DM10	DM10
Field Sample No.	DMGW8A	DMGW8B	DMGW8C	DMGW9AA	DMGW9AB	DMGW9AC	DMGW10A	DMGW10B
Sample Date	29-Jun-92	03-Nov-92	07-Dec-93	30-Jun-92	05-Nov-92	07-Dec-93	30-Jun-92	04-Nov-92
Filtered/Unfiltered Metals	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered
Phosphate:								
Phosphate	*	11.1	*	*	--	*	*'	*
Explosives:								
1,3,5-Trinitrobenzene	--	--	*	--	20.8 C	*	0.665 U	--
2,4,6-Trinitrotoluene	--	--	*	--	15.4 C	*	--	--
3-Nitrotoluene	--	--	*	1.34 C	--	*	--	--
4-Nitrotoluene	--	--	*	--	4.03 U	*	--	--
Nitroglycerine	--	--	*	--	42.4 U	*	--	--
PETN (Pentaerythritol tetranitrate)	--	--	*	11.6 U	--	*	--	--
Metals:								
Aluminum	--	--	371	--	--	880	--	--
Arsenic	--	--	--	--	--	--	--	--
Barium	--	--	--	--	--	--	--	--
Calcium	6030	5980	11000 G	5850	5810	14600 G	7060	6310
Chromium	--	--	--	--	--	--	--	--
Copper	--	--	--	--	7.29	--	7.19	--
Iron	--	--	496	111	257	904	--	--
Lead	4.3	--	--	2.52	--	--	2.05	3.35
Magnesium	--	--	1050	--	--	899	--	--
Manganese	8.03	7.31	49.2	533	485	478	--	--
Potassium	2510	--	1760	2270	--	--	2450	--
Sodium	3860	4530	5320	2800	--	2250	3230	5490
Zinc	9.67	--	575 BG	12.5	20.2	969 BG	14.4	12.7

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-16	OHM-A9-16	OHM-A9-17	OHM-A9-17	OHM-A9-47	OHM-A9-47	OHM-A9-47	OHM-A9-48
Field Sample No.	A9GW16A	A9GW16B	A9GW17A	A9GW17B	A9GW47A	A9GW47B	A9GW47C	A9GW48A
Sample Date	29-Jun-92	04-Nov-92	30-Jun-92	04-Nov-92	30-Jun-92	04-Nov-92	06-Dec-93	30-Jun-92
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Unfiltered	Filtered
VOCs:								
1,1,1-Trichloroethane	--	--	--	--	400	14	500 S	--
1,1-Dichloroethene	--	--	--	--	5.1	--	17 S	--
1,3-Dimethylbenzene	--	--	--	--	--	--	--	--
Acetone	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--
Ethylmethyl benzene	--	--	--	--	190 S	--	--	--
Methylene chloride	7.7	--	--	--	100	--	--	9.5
Toluene	--	--	--	--	--	2.1	--	--
Trichloroethylene	--	--	--	--	4.6	--	7.4 S	--
Xylenes, total	--	--	--	--	--	--	--	--
BNAs:								
1,2,3,4-Tetramethylbenzene	--	--	--	--	--	--	--	--
1,2,3-Trimethylbenzene	--	--	--	--	--	--	--	--
1-Ethyl-2-methylbenzene	--	--	--	--	--	--	--	--
1-Methylnaphthalene	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	5.6	--	5.9	--	6.4	--	--
Naphthalene	--	--	--	--	--	--	--	--
N,N-Diethyl-3-methylbenzamide	15 S	--	--	--	--	--	--	--
PCB/Pesticides:								
Chlordane-alpha	--	--	--	--	--	--	--	--
Chlordane, total	--	--	--	--	--	--	--	--
Endosulfan, beta	--	--	--	--	--	--	--	--
Endosulfan, total	--	--	--	--	--	--	--	--
Endrin aldehyde	--	--	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--		--	--
PCB 1254	--	--	--	--	--	0.104 T	--	--
PCBs, total	--	--	--	--	--	0.104 T	--	--

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-16	OHM-A9-16	OHM-A9-17	OHM-A9-17	OHM-A9-47	OHM-A9-47	OHM-A9-47	OHM-A9-48
Field Sample No.	A9GW16A	A9GW16B	A9GW17A	A9GW17B	A9GW47A	A9GW47B	A9GW47C	A9GW48A
Sample Date	29-Jun-92	04-Nov-92	30-Jun-92	04-Nov-92	30-Jun-92	04-Nov-92	06-Dec-93	30-Jun-92
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Unfiltered	Filtered
Phosphate:								
Phosphate	*	*	*	--	*	*	*	*
Explosives:								
1,3,5-Trinitrobenzene	--	--	--	--	--	0.675 U	*	--
2,4,6-Trinitrotoluene	--	--	--	--	--	--	*	--
3-Nitrotoluene	--	--	--	--	--	--	*	--
4-Nitrotoluene	--	--	--	--	--	--	*	--
Nitroglycerine	--	--	--	--	--	--	*	--
PETN (Pentaerythritol tetranitrate)	--	--	--	--	--	--	*	--
Metals:								
Aluminum	--	--	--	--	--	--	2220	--
Arsenic	--	--	--	4.11	--	--	--	--
Barium	--	--	--	--	--	--	27.2	--
Calcium	5930	5320	9080	8200	8410	7520	16700	7930
Chromium	14.4 7	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--
Iron	--	--	2440	3250	--	--	2260	--
Lead	4.78	3.53	3.55	9.54	2.07	1.54	--	1.91
Magnesium	--	--	2690	2310	--	--	1750	--
Manganese	10.5	--	328	274	232	542	701	71.9
Potassium	2940	--	3570	2890	2630	2450	3150	2800
Sodium	5290	4710	6970	6730	6010	6430	6140	6230
Zinc	64.1	25.2	--	12.5	11.8	13	863 B	11.5

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-48	OHM-A9-49	OHM-A9-53	OHM-A9-54	OHM-A9-55	OHM-A9-56	OHM-A9-56	OHM-A9-57
Field Sample No.	A9GW48B	A9GW49A	A9GW53A	A9GW54A	A9GW55A	A9GW56A	A9GW56B	A9GW57A
Sample Date	04-Nov-92	29-Jun-92	03-Dec-93	06-Dec-93	06-Dec-93	02-Dec-93	09-Dec-93	02-Dec-93
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Not Applicable	Filtered
VOCs:								
1,1,1-Trichloroethane	--	--	--	--	900 S	2000 S	*	18 S
1,1-Dichloroethene	--	--	--	--	20 S	70 S	*	--
1,3-Dimethylbenzene	--	--	--	--	--	--	*	--
Acetone	--	--	--	400 S	--	--	*	--
Ethylbenzene	--	--	1000 S	2000 S	--	--	*	--
Ethylmethyl benzene	--	--	--	--	--	--	*	--
Methylene chloride	--	--	--	--	--	--	*	--
Toluene	--	--	400 S	2000 S	--	--	*	--
Trichloroethylene	--	--	--	--	--	--	*	--
Xylenes, total	--	--	4000 S	8000 S	100 S	--	*	--
BNAs:								
1,2,3,4-Tetramethylbenzene	--	--	--	--	--	--	*	--
1,2,3-Trimethylbenzene	--	--	--	--	--	--	*	--
1-Ethyl-2-methylbenzene	--	--	--	--	--	--	*	--
1-Methylnaphthalene	--	--	--	--	--	--	*	--
2-Methylnaphthalene	--	--	33 S	81 S	81 S	--	*	--
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	*	--
Di-n-butyl phthalate	5.4	--	--	--	--	--	*	--
Naphthalene	--	--	150 S	90 S	400 S	--	*	--
N,N-Diethyl-3-methylbenzamide	--	16 S	--	--	--	--	*	--
PCB/Pesticides:								
Chlordane-alpha	--	0.0287	--	*	*	*	--	*
Chlordane, total	--	0.0287	--	*	*	*	--	*
Endosulfan, beta	--	0.0206	--	*	*	*	--	*
Endosulfan, total	--	0.0206	--	*	*	*	--	*
Endrin aldehyde	--	--	--	*	*	*	--	*
Heptachlor epoxide	--	0.0463	--	*	*	*	--	*
PCB 1254	--	--	--	*	*	*	--	*
PCBs, total	--	--	--	*	*	*	--	*

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-48	OHM-A9-49	OHM-A9-53	OHM-A9-54	OHM-A9-55	OHM-A9-56	OHM-A9-56	OHM-A9-57
Field Sample No.	A9GW48B	A9GW49A	A9GW53A	A9GW54A	A9GW55A	A9GW56A	A9GW56B	A9GW57A
Sample Date	04-Nov-92	29-Jun-92	03-Dec-93	06-Dec-93	06-Dec-93	02-Dec-93	09-Dec-93	02-Dec-93
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Not Applicable	Filtered
Phosphate:								
Phosphate	*	*	*	*	*	*	*	*
Explosives:								
1,3,5-Trinitrobenzene	--	--	*	*	*	*	*	*
2,4,6-Trinitrotoluene	--	--	*	*	*	*	*	*
3-Nitrotoluene	--	--	*	*	*	*	*	*
4-Nitrotoluene	--	--	*	*	*	*	*	*
Nitroglycerine	--	--	*	*	*	*	*	*
PETN (Pentaerythritol tetranitrate)	--	--	*	*	*	*	*	*
Metals:								
Aluminum	--	--	173	113	--	--	*	--
Arsenic	--	--	20	--	--	--	*	--
Barium	--	--	--	--	--	--	*	--
Calcium	7530	9080	18400	11200	11100	10300	*	11800
Chromium	--	--	--	--	--	--	*	--
Copper	--	--	--	--	--	--	*	--
Iron	--	--	7010	--	--.	163	*	--
Lead	1.67	4.22	--	41	--	--	*	--
Magnesium	--	--	1190	639	718	968	*	783
Manganese	17.7	32.9	1660	709	222	1280	*	26.1
Potassium	--	2680	2080	1650	1970	2800	*	2830
Sodium	6870	26400	2180	1470	10800	6500	*	2600
Zinc	--	15.5	1070 B	629 B	549 B	373	*	564

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-57	OHM-A9-57	OHM-A9-58	OHM-BW-5
Field Sample No.	A9GW57B	DUPGW01C	A9GW58A	FWGW5A
Sample Date	09-Dec-93	02-Dec-93	03-Dec-93	03-Dec-93
Filtered/Unfiltered Metals	Not Applicable	Filtered	Filtered	Filtered
VOCs:				
1,1,1-Trichloroethane	*	17 S	46 S	--
1,1-Dichloroethene	*	--	--	--
1,3-Dimethylbenzene	*	--	--	--
Acetone	*	--	--	--
Ethylbenzene	*	--	--	--
Ethylmethyl benzene	*	--	--	--
Methylene chloride	*	--	--	--
Toluene	*	--	--	--
Trichloroethylene	*	--	--	--
Xylenes, total	*	--	--	--
BNAs:				
1,2,3,4-Tetramethylbenzene	*	--	--	--
1,2,3-Trimethylbenzene	*	--	--	--
1-Ethyl-2-methylbenzene	*	--	--	--
1-Methylnaphthalene	*	--	--	--
2-Methylnaphthalene	*	--	--	--
Bis(2-ethylhexyl) phthalate	*	--	--	--
Di-n-butyl phthalate	*	--	--	--
Naphthalene	*	--	--	--
N,N-Diethyl-3-methylbenzamide	*	--	--	--
PCB/Pesticides:				
Chlordane-alpha	--	--	--	--
Chlordane, total	--	--	--	--
Endosulfan, beta	--	--	--	--
Endosulfan, total	--	--	--	--
Endrin aldehyde	--	--	--	--
Heptachlor epoxide	--	--	--	--
PCB 1254	--	--	--	--
PCBs, total	--	--	--	--

Table D-26
Area A9
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-A9-57	OHM-A9-57	OHM-A9-58	OHM-BW-5
Field Sample No.	A9GW57B	DUPGW01C	A9GW58A	FWGW5A
Sample Date	09-Dec-93	02-Dec-93	03-Dec-93	03-Dec-93
Filtered/Unfiltered Metals	Not Applicable	Filtered	Filtered	Filtered
Phosphate:				
Phosphate	*	*	*	*
Explosives:				
1,3,5-Trinitrobenzene	*	*	*	*
2,4,6-Trinitrotoluene	*	*	*	*
3-Nitrotoluene	*	*	*	*
4-Nitrotoluene	*	*	*	*
Nitroglycerine	*	*	*	*
PETN (Pentaerythritol tetranitrate)	*	*	*	*
Metals:				
Aluminum	*	--	147	--
Arsenic	*	--	--	--
Barium	*	--	--	--
Calcium	*	11700 D	13700	6900
Chromium	*	--	--	--
Copper	*	--	--	--
Iron	*	--	201	287
Lead	*	--	--	--
Magnesium	*	789 D	779	520
Manganese	*	25.1 D	44.2	117
Potassium	*	3150 D	1970	--
Sodium	*	2420 D	2650	3190
Zinc	*	541 B	837 B	436 B

Table D-27
Area A3/P5
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	A3CD1	A3CD2	A3CD3	A3CD4	P5CD1	P5CD2	P5CD3	A3SO1
Field Sample No.	A3CD1A	A3CD2A	A3CD3A	A3CD4A	P5CD1A	P5CD2A	P5CD3A	A3SO1A
Sample Date	29-May-92	29-May-92	29-May-92	29-May-92	28-May-92	28-May-92	28-May-92	21-Apr-92
Depth (ft.)	0	0	0	0	0	0	0	0
VOCs:								
Acetone	--	0.011	--	--	--	--	--	--
Methylene chloride	--	--	0.0096	--	0.0083	--	--	0.013
BNAs:								
Di-n-butyl phthalate	--	--	--	0.36 S	0.58 S	0.38 S	0.36 S	3 S
PCB/Pesticides:								
ppDDD	--	--	--	--	0.159	0.055	0.0413	--
ppDDE	0.0635	0.0589	--	--	0.117	0.0224	0.0878	--
ppDDT	0.0892	0.167	0.0128	0.0162	0.15	0.13	0.0688	--
Metals:								
Aluminum	8300 B	11000 B	5900 B	6700 B	12000 B	9600 B	11000 B	11000 B
Arsenic	3.66	3.28	2.96	4.05	7.7	11	10	2.37
Barium	27	41.9	27	--	22.1	13.7	17.3	28.7
Beryllium	--	--	--	--	0.325	--	--	0.443
Cadmium	--	0.392	0.531	--	0.43	--	0.506	--
Calcium	--	612	840	396	486	--	--	--
Chromium	14.4	18.5	7.3	9.63	18.8	13.4	68.3 X	10.4
Cobalt	6.24	3.14	--	--	3.84	--	2.55	--
Copper	12.9	10.3	10.8	7.78	8.47	4.77	13.2	5.03
Iron	13000 X	13000 B	9400 B	7600 B	12000 B	11000 B	20000 B	10000 B
Lead	4.9 B	21 B	78 B	8.3 B	35 X	40 B	220 B	5.9 B
Magnesium	2840	2960	1220	1530	2570	2120	1700	741
Manganese	160	130	100	85.3	130	88.7	130	69.2
Mercury	--	--	--	--	0.0859	--	--	--
Nickel	9.74	10.4	4.5	6.41	9.9	5.03	9.32	4.59
Potassium	2140	1740	1060	720	1080	597	676	243
Selenium	--	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	--	--
Vanadium	20.3	23.6	9.63	10.4	24.4	18.7	24.3	13
Zinc	25.1	36.9	32.4	57.5	27.2	20.9	29.2	11.2

Table D-27
Area A3/P5
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P5SO1	P5SO2	P5SO3	P5SO4
Field Sample No.	P5SO1B	P5SO2B	P5SO3B	P5SO4B
Sample Date	25-Oct-93	25-Oct-93	25-Oct-93	25-Oct-93
Depth (ft.)	0	0	0	0
VOCs:				
Acetone	*	*	*	*
Methylene chloride	*	*	*	*
BNAs:				
Di-n-butyl phthalate	*	*	*	*
PCB/Pesticides:				
ppDDD	*	*	*	*
ppDDE	*	*	*	*
ppDDT	*	*	*	*
Metals:				
Aluminum	10000	8200	8900	8700
Arsenic	9.4	8.4	12	18
Barium	21.9	18.7	23.6	32.5
Beryllium	0.406	0.415	0.426	0.547
Cadmium	--	--	--	--
Calcium	272	499	696	1040
Chromium	19.5	13.1	12.3	12.1
Cobalt	3.58	--	--	3.24 1
Copper	5.57	4.56	4.8	4.88
Iron	12000	9400	10000	10000
Lead	85	33	41	60
Magnesium	2030	1710	1570	1510
Manganese	83.3	61.5	119	146
Mercury	--	--	--	--
Nickel	--	--	--	--
Potassium	774	624	584	536
Selenium	0.32	0.33	0.35	0.31
Sodium	78.1	--	--	--
Vanadium	26	24.4	23.9	21
Zinc	31.8	23.9	27.4	30

Table D-28
Area A3/P5
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A3TPA	A3TPA	A3TPA	A3TPB	A3TPC	A3TPC	A3TPC
Field Sample No.	A3TPA1	A3TPA2	A3TPA3	A3TPB1	A3TPC1	A3TPC2	A3TPC3
Sample Date	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93
Depth (ft.)	0	2	4	0	0	2	4
BNAs:							
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	0.25	--
Fluoranthene	--	--	--	--	--	0.27	0.25
Phenanthrene	--	--	--	--	--	--	--
PCB/Pesticides:							
Chlordane, alpha	--	--	--	0.0069	--	--	--
Chlordane, total	--	--	--	0.0069	--	--	--
Heptachlor epoxide	--	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	2.3 Z	--
PCBs, total	--	--	--	--	--	2.3 Z	--
ppDDD	--	--	--	0.0368	--	0.0335	--
ppDDE	--	--	--	0.0329	--	0.0791	--
ppDDT	0.0127	--	--	0.0483	--	0.236	--
Metals:							
Aluminum	8400	5300	6100	6400	13000	9800	12000
Arsenic	4.2	3.5	2.5	3.5	8	6.8	3.8
Barium	35.6	26.7	38.3	31.1	30	37.7	57.5
Beryllium	--	--	0.376	0.379	0.561	0.522	0.506
Calcium	872	411	620	438	368	357	233
Chromium	16.2	12.6	8.5	9.74	17.3	11.8	14.6
Cobalt	--	4.65	--	--	--	--	--
Copper	10.5	6.02	5.62	6.82	7.95	7.65	10.8
Iron	12000	8700	7500	8600	12000	11000	12000
Lead	9.3	4.8	3.5	4.7	14	10	19
Magnesium	3130	2350	1820	1820	2350	1900	2470
Manganese	96	109	93.5	66.9	85.6	77.4	89.7
Potassium	2000	1540	1510	1320	1010	1430	1940
Selenium	--	--	--	--	0.33	0.44	--
Sodium	--	--	--	62.5	--	--	--
Vanadium	20.3	14.6	13	12.5	22.7	16.9	19.4
Zinc	32	23.6	17.2	19.3	38.6	23.6	32.3

Table D-28
Area A3/P5
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	A3TPD	A3TPD	A3TPD	A3TPE	A3TPE	A3TPE
Field Sample No.	A3TPD1	A3TPD2	A3TPD3	A3TPE1	A3TPE2	A3TPE3
Sample Date	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93	10-Nov-93
Depth (ft.)	0	2	4	0	2	4
BNAs:						
Bis(2-ethylhexyl) phthalate	--	--	--	--	--	--
Fluoranthene	--	--	0.6	0.31	--	--
Phenanthrene	--	0.24	0.28	0.15 1	--	--
PCB/Pesticides:						
Chlordane, alpha	--	--	--	--	--	--
Chlordane, total	--	--	--	--	--	--
Heptachlor epoxide	--	--	--	--	--	0.00735
PCB 1254	--	--	--	--	--	--
PCBs, total	--	--	--	--	--	--
ppDDD	0.0538	0.0153 1	0.0495	0.0367	--	--
ppDDE	0.0356	0.0148 1	0.0332	0.0685	--	--
ppDDT	0.0346	0.0127 1	0.0316	0.0778	--	--
Metals:						
Aluminum	10000	9600	11000	13000	9600	9800
Arsenic	5.8	5.4	5	9.9	3	4.4
Barium	31.4	37.6	44.3	37.6	60.2	41.3
Beryllium	0.541	0.41	0.535	0.568	0.5	0.511
Calcium	320	439	435	606	251	399
Chromium	13.3	13.9	22	15.2	12.3	12
Cobalt	--	--	--	--	--	--
Copper	7.67	14.9	8.19	7.4	9.37	9.58
Iron	11000	13000	13000	13000	10000	11000
Lead	17	15	15	26	4.6	9.4
Magnesium	1720	2080	3030	1700	2220	2030
Manganese	95.9	111	121	162	88.4	96.1
Potassium	985	1390	1600	471	1930	1550
Selenium	--	--	--	0.28	--	--
Sodium	--	--	--	--	--	--
Vanadium	18.3	18.8	21.8	20.5	19	16.7
Zinc	29.2	53	36.7	43.7	21.8	27.6

Table D-29
Area A3/P5
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	OHM-A3-1	OHM-A3-2	OHM-A3-2A	OHM-A3-3
Field Sample No.	A3SB1A	A3SB2A	A3SB2AA	A3SB3A
Sample Date	03-Feb-92	30-Jan-92	23-Mar-92	31-Jan-92
Depth (ft.)	2	6	4	4
VOCs:				
Acetone	--	0.016	0.035	--
BNAs:				
Bis(2-ethylhexyl) phthalate	1.7	--	0.78	--
Di-n-butyl phthalate	--	8.4 S	0.97 S	3 S
Sulfur	--	--	2.2 S	--
PCB/Pesticides:				
ppDDT	0.0096 1	--	--	--
Organic Carbon:				
Total organic carbon	1440	*	*	788
Metals:				
Aluminum	14000	13000	10000	7200
Arsenic	9.5	2.64	3.77	4.6
Barium	19.6	54.2	41.5	26.9
Beryllium	0.474	0.354	0.274	--
Cadmium	0.481	0.653	--	0.5
Calcium	897	--	630	--
Chromium	15.6	16.9	12.8	16.8
Cobalt	--	3.62	3.3	2.69
Copper	6.24	10.7	11.6	9.12
Iron	12000	16000 X	11000	14000
Lead	14	3.8	5.2	3.7
Magnesium	1590	2800	2220	2730
Manganese	80	120	94.8	110
Nickel	7.48	7.69	7.75	7.49
Potassium	433	2300	1800	2180
Vanadium	19	21.7	18.3	20.3
Zinc	17	23.1	20.6	17

Table D-30
Area A3/P5
Summary of Detcted Compounds
Ground Water (ug/L)

Site ID	EHA6	EHA6	OHM-A3-1	OHM-A3-1		OHM-A3-1	OHM-A3-3	OHM-A3-3
Field Sample No.	EHAGW6A	EHAGW6B	A3GW1A	DUPGW02A		A3GW1B	A3GW3A	A3GW3B
Sample Date	22-Jun-92	29-Oct-92	22-Jun-92	22-Jun-92		30-Oct-92	22-Jun-92	30-Oct-92
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	Filtered		Filtered	Filtered	Filtered
VOCs:								
Methylene chloride	7.1	--	--	--		--	--	--
PCB/Pesticides:								
Endosulfan, beta	--	*	0.0902	--		--	--	--
Endosulfan, total	--	*	0.0902	--		--	--	--
Heptachlor epoxide	--	*	--	0.00897	D	--	--	--
Metals:								
Calcium	17600	*	4120	4130	D	3710	5800	5340
Iron	207	*	--	--		--	--	--
Lead	2.6	*	3.72	1.71	D	--	8.64	3.33
Magnesium	2970	*	--	--		--	--	--
Manganese	29.2	*	84.7	78.6	D	78	132	29
Potassium	3250	*	2490	2530	D	--	2460	--
Sodium	5820	*	3990	4230	D	3390	3920	2980
Zinc	51.5	*	35.9	18.2	D	15.7	20.7	12.3

Table D-31
Area P4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P4CD1	P4CD2	P4SO1	P4SO1	P4SO2	P4SO2	P4SO3	P4SO3	P4SO4
Field Sample No.	P4CD1A	P4CD2A	P4SO1B	P4SO1C	P4SO2B	P4SO2C	P4SO3B	P4SO3C	P4SO4B
Sample Date	19-May-92	19-May-92	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93	26-Oct-93
Depth (ft.)	0	0	0	0	0	0	0	0	0
VOCs:									
Methylene chloride	--	0.012	*	*	*	*	*	*	*
BNAs:									
Acenaphthylene	--	--	*	--	*	--	*	--	*
Anthracene	--	--	*	--	*	--	*	--	*
Benzo(a)anthracene	--	--	*	--	*	--	*	--	*
Benzo(a)pyrene	--	--	*	--	*	--	*	--	*
Benzo(b)fluoranthene	--	--	*	--	*	--	*	--	*
Benzo(ghi)perylene	--	--	*	--	*	--	*	--	*
Benzo(k)fluoranthene	--	--	*	--	*	--	*	--	*
Benzo[def]phenanthrene	--	--	*	--	*	--	*	--	*
Chrysene	--	--	*	--	*	--	*	--	*
Di-n-butyl phthalate	--	0.59 S	*	--	*	--	*	--	*
Dibenz(ah)anthracene	--	--	*	--	*	--	*	--	*
Fluoranthene	4	--	*	--	*	--	*	--	*
Indeno[1,2,3-C,D]pyrene	--	--	*	--	*	--	*	--	*
Mesityl oxide	--	4.6 S	*	--	*	--	*	--	*
Phenanthrene	--	--	*	--	*	--	*	--	*
PCB/Pesticides:									
Dieldrin	--	--	*	--	*	--	*	0.0177	*
Endosulfan, beta	0.0364	--	*	--	*	--	*	--	*
Endosulfan, total	0.0364	--	*	--	*	--	*	--	*
Endrin	--	--	*	--	*	--	*	--	*
ppDDD	0.104	0.0173	*	--	*	--	*	--	*
ppDDE	0.191	0.0366	*	0.0606	*	0.0182	*	0.411 X	*
ppDDT	0.47	0.0848	*	0.0244	*	0.025	*	0.232	*

Table D-31
Area P4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P4CD1	P4CD2	P4SO1	P4SO1	P4SO2	P4SO2	P4SO3	P4SO3	P4SO4
Field Sample No.	P4CD1A	P4CD2A	P4SO1B	P4SO1C	P4SO2B	P4SO2C	P4SO3B	P4SO3C	P4SO4B
Sample Date	19-May-92	19-May-92	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93	26-Oct-93
Depth (ft.)	0	0	0	0	0	0	0	0	0
Metals:									
Aluminum	6800 B	4900 B	5590	*	4250	*	5910	*	6100
Antimony	2.89	--	--	*	--	*	--	*	--
Arsenic	200	16	7.1	*	7.2	*	130	*	210
Barium	23.2	--	23	*	13.9	*	33.8	*	24.2
Cadmium	1.66	0.952	--	*	--	*	--	*	--
Calcium	547	--	270	*	361	*	625	*	376
Chromium	16.8	10.4	14.5	*	9.56	*	16.1	*	13
Cobalt	2.97	3.6	--	*	--	*	--	*	--
Copper	14.3	10.7	8.54	*	5.31	*	18.1	*	12.5
Iron	15000 B	8100 B	9200	*	7000	*	16000	*	10000
Lead	48	20	44	*	10	*	31	*	17
Magnesium	2240	1390	1990	*	1590	*	1620	*	2000
Manganese	130	170	56.5	*	101	*	70.1	*	85.2
Nickel	9.28	9.58	--	*	--	*	--	*	--
Potassium	1180	511	1370	*	626	*	722	*	1300
Selenium	--	--	0.43	*	0.28	*	1.7	*	0.27
Vanadium	18.8	11.7	33.3	*	11.4	*	25.4	*	16.4
Zinc	28.2	20.7	24.8	*	17.8	*	24.5	*	19.2

Table D-31
Area P4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P4SO4	
Field Sample No.	P4SO4C	
Sample Date	15-Nov-93	
Depth (ft.)	0	
VOCs:		
Methylene chloride	*	
BNAs:		
Acenaphthylene	0.76	
Anthracene	0.61	
Benzo(a)anthracene	1.4	
Benzo(a)pyrene	1.6	
Benzo(b)fluoranthene	2.2	
Benzo(ghi)perylene	1.5	
Benzo(k)fluoranthene	2.4	
Benzo[def]phenanthrene	4	
Chrysene	2.8	
Di-n-butyl phthalate	--	
Dibenz(ah)anthracene	0.46	
Fluoranthene	3.5	
Indeno[1,2,3-C,D]pyrene	1.6	
Mesityl oxide	--	
Phenanthrene	1.3	
PCB/Pesticides:		
Dieldrin	--	
Endosulfan, beta	--	
Endosulfan, total	--	
Endrin	0.0392	JI
ppDDD	--	
ppDDE	0.0484	
ppDDT	0.145	

Table D-31
Area P4
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P4SO4
Field Sample No.	P4SO4C
Sample Date	15-Nov-93
Depth (ft.)	0
Metals:	
Aluminum	*
Antimony	*
Arsenic	*
Barium	*
Cadmium	*
Calcium	*
Chromium	*
Cobalt	*
Copper	*
Iron	*
Lead	*
Magnesium	*
Manganese	*
Nickel	*
Potassium	*
Selenium	*
Vanadium	*
Zinc	*

Table D-32
Area P4
Summary of Detected Compounds
Surface Water (ug/L)

Site ID	P4SW1
Field Sample No.	P4SW1A
Sample Date	23-Apr-92
Depth (ft.)	0.25
VOCs:	
Acetone	--
BNAs:	
Di-n-butyl phthalate	--
Sulfur	--
Organic Carbon:	
Total organic carbon	*
Metals:	
Aluminum	293
Arsenic	13.2
Barium	--
Cadmium	--
Calcium	2700
Chromium	--
Cobalt	--
Copper	--
Iron	1900
Lead	2
Magnesium	--
Manganese	97.9
Nickel	--
Potassium	--
Vanadium	--
Zinc	--

Table D-33
Area P4
Summary of Detected Compounds
Sediment (ug/g)

Site ID	P4SD1	
Field Sample No.	P4SD1A	
Sample Date	23-Apr-92	
Depth (ft.)	1	
VOCs:		
Acetone	0.03	
BNAs:		
Di-n-butyl phthalate	1	S
Sulfur	10	S
Organic Carbon:		
Total organic carbon	8350	
Metals:		
Aluminum	6600	B
Arsenic	9.4	
Barium	12.4	
Cadmium	0.641	
Calcium	700	B
Chromium	13.1	
Cobalt	3.61	
Copper	8.46	
Iron	14000	B
Lead	4.6	B
Magnesium	2030	
Manganese	180	
Nickel	10.8	
Potassium	769	
Vanadium	12	
Zinc	21.6	

Table D-34
Area P7
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	P7TPA		P7TPA	P7TPA	P7TPB		P7TPB	P7TPB
Field Sample No.	P7TPA1		P7TPA2	P7TPA3	P7TPB1		P7TPB2	P7TPB3
Sample Date	10-Dec-91		10-Dec-91	10-Dec-91	10-Dec-91		10-Dec-91	10-Dec-91
Depth (ft.)	2		4	6	2		4	6
BNAs:								
Di-n-butyl phthalate	0.42	S	*	*	0.36	S	*	*
Metals:								
Aluminum	3300	B	*	*	3000	B	*	*
Arsenic	6.29	X	*	*	3.77		*	*
Cadmium	7.62	@	*	*	5.79	@	*	*
Calcium	406	B	*	*	--		*	*
Chromium	7.45		*	*	6.1		*	*
Copper	5.63		*	*	6.57		*	*
Iron	6200	B	*	*	4800	B	*	*
Lead	2.68		*	*	2.51		*	*
Magnesium	1210		*	*	902		*	*
Manganese	120		*	*	93.1		*	*
Nickel	6.69		*	*	6.04		*	*
Potassium	593		*	*	478		*	*
Vanadium	6.49		*	*	5.04		*	*
Zinc	12.9		*	*	12.3		*	*

Note:

Samples P7TPA2, P7TPA3, P7TPB2, and P7TPB3 have been listed in this table for completeness. These four samples were submitted for VOC analysis only and there were no positive detections to report.

Table D-35
Area P7
Summary of Detected Compounds
Boring Samples (ug/g)

Site ID	OHM-P7-28		OHM-P7-30		OHM-P7-30		OHM-P7-31	
Field Sample No.	P7SB28A		P7SB30A		DUPSB02A		P7SB31A	
Sample Date	23-Mar-92		20-Mar-92		20-Mar-92		20-Mar-92	
Depth (ft.)	4		4		4		4	
VOCs:								
Acetone	--		0.023		0.023	D	--	
BNAs:								
Di-n-butyl phthalate	0.47	S	0.69	S	0.59	S	0.32	S
Organic Carbon:								
Total organic carbon	343		369		369	D	373	
Metals:								
Aluminum	3700		3600		4900	D	4300	
Arsenic	6.1		7.9		6.2	D	11	
Barium	--		--		12.6	D	--	
Cadmium	--		--		--		--	
Calcium	--		--		--		441	
Chromium	6.27		6.16		12	D	7.73	
Cobalt	--		--		3.73	D	3.89	
Copper	4.95		4.99		6.92	D	6.2	
Iron	5500		6000		8600	D	7100	
Lead	3		3.21		5.3	D	4.2	
Magnesium	1240		1250		2090	D	1700	
Manganese	94		180		260	D	190	
Nickel	6.74		7.24		10.5	D	8.24	
Potassium	522		538		894	D	736	
Vanadium	5.39		5.4		9.27	D	6.84	
Zinc	12		13.4		18.4	D	15	

Table D-36
Area P7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-P7-28	OHM-P7-28	OHM-P7-28	OHM-P7-30	OHM-P7-30	OHM-P7-30	OHM-P7-31
Field Sample No.	P7GW28A	P7GW28B	P7GW28C	P7GW30A	P7GW30B	P7GW30C	P7GW31A
Sample Date	18-Jun-92	26-Oct-92	02-Dec-93	18-Jun-92	26-Oct-92	07-Dec-93	18-Jun-92
Filtered/Unfiltered Metals	Filtered	Filtered	Not Applicable	Filtered	Filtered	Not Applicable	Filtered
VOCs:							
Toluene	--	--	--	--	--	--	--
PCB/Pesticides:							
ppDDT	0.0547	--	*	--	--	*	--
Metals:							
Aluminum	286	340	*	383	460	*	390
Lead	3.04	1.56	*	--	1.56	*	--
Manganese	103	205	*	98	103	*	78
Potassium	2120	--	*	--	--	*	--
Sodium	6900	5030	*	4020	6910	*	4580
Zinc	41.5	16.8	*	20.8	14.3	*	13.3

Table D-36
Area P7
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-P7-31	OHM-P7-31
Field Sample No.	P7GW31B	P7GW31C
Sample Date	26-Oct-92	09-Dec-93
Filtered/Unfiltered Metals	Filtered	Not Applicable
VOCs:		
Toluene	2.6	--
PCB/Pesticides:		
ppDDT	--	*
Metals:		
Aluminum	321	*
Lead	2.75	*
Manganese	70.5	*
Potassium	--	*
Sodium	3900	*
Zinc	22.3	*

Table D-37
Area P17
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P17CD1	P17CD1	P17SO1	P17SO1	P17SO2	P17SO2	P17SO3	P17SO3
Field Sample No.	P17CD1A	DUPCD01A	P17SO1B	P17SO1C	P17SO2B	P17SO2C	P17SO3B	P17SO3C
Sample Date	27-May-92	27-May-92	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93	26-Oct-93	15-Nov-93
Depth (ft.)	0	0	0	0	0	0	0	0
VOCs:								
Methylene chloride	0.0086	--	*	*	*	*	*	*
PCB/Pesticides:								
Benzenehexachloride, beta	--	0.01 D	*	--	*	--	*	--
ppDDD	0.107	0.071 D	*	0.09	*	0.13	*	0.21 JI
ppDDE	0.315	0.274 X	*	0.55	*	0.57	*	1.1 1
ppDDT	0.368	0.338 D	*	0.33 2	*	0.32 2	*	0.21 JI2
Metals:								
Aluminum	6100 B	6500 B	8400	*	8500	*	7900	*
Arsenic	220	210 D	260	*	260	*	250	*
Barium	27.9	28.6 D	27.3	*	29.4	*	21.7	*
Beryllium	--	--	0.582	*	0.448	*	0.436	*
Cadmium	--	--	0.694	*	0.712	*	0.694	*
Calcium	--	--	512	*	1160	*	320	*
Chromium	6.85	7.53 D	9.6	*	9.71	*	9.06	*
Cobalt	--	--	--	*	3.53 1	*	--	*
Copper	10.5	11 D	7.19	*	7.24	*	6.12	*
Iron	7300 B	7400 B	11000	*	10000	*	9900	*
Lead	56 B	57 B	33	*	38	*	37	*
Magnesium	805	902 D	1190	*	1260	*	1070	*
Manganese	87.9	78.9 D	121	*	143	*	79.9	*
Nickel	2.95	3.6 D	--	*	--	*	--	*
Potassium	289	331 D	423	*	467	*	348	*
Selenium	--	--	0.44	*	0.37	*	0.41	*
Vanadium	12.1	13.3 D	17.7	*	19	*	18.1	*
Zinc	19.3	20.9 D	30.4	*	37	*	27	*

Table D-37
Area P17
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P17SO4	P17SO4	
Field Sample No.	P17SO4B	P17SO4C	
Sample Date	26-Oct-93	15-Nov-93	
Depth (ft.)	0	0	
VOCs:			
Methylene chloride	*	*	
PCB/Pesticides:			
Benzenehexachloride, beta	*	--	
ppDDD	*	0.055	
ppDDE	*	0.36	
ppDDT	*	0.239	2
Metals:			
Aluminum	7600	*	
Arsenic	240	*	
Barium	21.5	*	
Beryllium	0.507	*	
Cadmium	0.605	*	
Calcium	327	*	
Chromium	8.49	*	
Cobalt	--	*	
Copper	5.57	*	
Iron	9000	*	
Lead	24	*	
Magnesium	987	*	
Manganese	72.3	*	
Nickel	--	*	
Potassium	319	*	
Selenium	0.29	*	
Vanadium	14.7	*	
Zinc	23.7	*	

Table D-38
Area P17
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	P17TPA	P17TPA	P17TPA	P17TPB	P17TPB	P17TPB	P17TPC	P17TPC
Field Sample No.	P17TPA1	P17TPA2	P17TPA3	P17TPB1	P17TPB2	P17TPB3	P17TPC1	P17TPC2
Sample Date	28-Jan-92	28-Jan-92	28-Jan-92	27-Jan-92	27-Jan-92	27-Jan-92	27-Jan-92	27-Jan-92
Depth (ft.)	2	4	6	2	4	6	2	4
VOCs:								
Methylene chloride	--	--	0.008	--	--	0.0088	--	--
BNAs:								
Di-n-butyl phthalate	4.5 S	*	*	1.2 S	*	*	2 S	*
Toluene	--	*	*	--	*	*	--	*
PCB/Pesticides:								
Heptachlor epoxide	--	*	*	--	*	*	--	*
ppDDE	--	*	*	--	*	*	--	*
ppDDT	--	*	*	--	*	*	0.0208	*
Phosphate:								
Phosphate	--	*	*	--	*	*	1.64	*
Metals:								
Aluminum	7000	*	*	6000	*	*	5300	*
Arsenic	4.84	*	*	4.81	*	*	11	*
Barium	--	*	*	--	*	*	--	*
Cadmium	--	*	*	--	*	*	0.438	*
Calcium	433	*	*	405	*	*	695	*
Chromium	9.3	*	*	8.16	*	*	9.07	*
Cobalt	--	*	*	--	*	*	--	*
Copper	5.79	*	*	7.1	*	*	6.36	*
Iron	8100	*	*	8400	*	*	8400	*
Lead	6.6	*	*	3.6	*	*	21	*
Magnesium	1470	*	*	1890	*	*	1710	*
Manganese	96	*	*	120	*	*	110	*
Nickel	7.03	*	*	8.28	*	*	7.36	*
Potassium	517	*	*	522	*	*	725	*
Vanadium	9.65	*	*	8.74	*	*	8.56	*
Zinc	16.4	*	*	15.5	*	*	31.2	*

Table D-38
Area P17
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	P17TPC	P17TPD	P17TPD	P17TPD	P17TPE	P17TPE	P17TPE
Field Sample No.	P17TPC3	P17TPD1	P17TPD2	P17TPD3	P17TPE1	P17TPE2	P17TPE3
Sample Date	27-Jan-92	28-Jan-92	28-Jan-92	28-Jan-92	24-Jan-92	24-Jan-92	24-Jan-92
Depth (ft.)	6	2	4	6	2	4	6
VOCs:							
Methylene chloride	--	0.01	0.0095	0.0091	0.014	--	--
BNAs:							
Di-n-butyl phthalate	*	0.87 S	*	*	2.3 S	*	*
Toluene	*	--	*	*	--	*	*
PCB/Pesticides:							
Heptachlor epoxide	*	0.0122	*	*	--	*	*
ppDDE	*	--	*	*	--	*	*
ppDDT	*	--	*	*	--	*	*
Phosphate:							
Phosphate	*	--	*	*	--	*	*
Metals:							
Aluminum	*	6100	*	*	7300	*	*
Arsenic	*	6.34	*	*	9.8	*	*
Barium	*	11.6	*	*	13.8	*	*
Cadmium	*	--	*	*	0.87	*	*
Calcium	*	672	*	*	602	*	*
Chromium	*	9.64	*	*	11.7	*	*
Cobalt	*	--	*	*	2.66	*	*
Copper	*	6.63	*	*	8.05	*	*
Iron	*	8000	*	*	10000	*	*
Lead	*	4.4	*	*	4.4	*	*
Magnesium	*	1680	*	*	1910	*	*
Manganese	*	84.1	*	*	120	*	*
Nickel	*	7.2	*	*	8.13	*	*
Potassium	*	796	*	*	900	*	*
Vanadium	*	9.13	*	*	10.7	*	*
Zinc	*	15.3	*	*	36.7	*	*

Table D-38
Area P17
Summary of Detected Compounds
Test Pits (ug/g)

Site ID	P17TPF	P17TPF	P17TPF	P17TPG	P17TPG	P17TPG	P17TPH	P17TPH
Field Sample No.	P17TPF1	P17TPF2	P17TPF3	P17TPG1	P17TPG2	P17TPG3	P17TPH1	P17TPH2
Sample Date	28-Jan-92	28-Jan-92	28-Jan-92	28-Jan-92	28-Jan-92	28-Jan-92	24-Jan-92	24-Jan-92
Depth (ft.)	2	4	6	2	4	6	2	4
VOCs:								
Methylene chloride	--	--	--	0.0098	0.0085	0.009	--	--
BNAs:								
Di-n-butyl phthalate	3.4 S	*	*	5.6 S	*	*	4 S	1.7
Toluene	--	*	*	--	*	*	--	--
PCB/Pesticides:								
Heptachlor epoxide	--	*	*	0.011	*	*	--	--
ppDDE	--	*	*	--	*	*	0.0733	0.0143
ppDDT	--	*	*	--	*	*	0.103	0.0767
Phosphate:								
Phosphate	--	*	*	--	*	*	--	--
Metals:								
Aluminum	5700	*	*	6100	*	*	11000	10000
Arsenic	8.7	*	*	9.2	*	*	22	13
Barium	--	*	*	14.3	*	*	15.5	16.8
Cadmium	--	*	*	--	*	*	--	0.518
Calcium	492	*	*	946	*	*	--	445
Chromium	8.21	*	*	10.6	*	*	12.2	13.8
Cobalt	--	*	*	2.72	*	*	--	3.52
Copper	5.11	*	*	7.76	*	*	6.23	8.62
Iron	7500	*	*	8600	*	*	11000	12000
Lead	3.3	*	*	3.2	*	*	21	20
Magnesium	1390	*	*	1960	*	*	1520	2080
Manganese	100	*	*	160	*	*	190	190
Nickel	6.21	*	*	8.42	*	*	6.44	11.9
Potassium	658	*	*	967	*	*	408	655
Vanadium	8.23	*	*	9.84	*	*	13.4	15
Zinc	13.1	*	*	16	*	*	18	39.4

Table D-38
Area P17
Summary of Detected Compounds
Test Pits (ug/g)

Site ID		P17TPH		P17TPI		P17TPI	P17TPI	P17TPJ	P17TPJ	P17TPJ
Field Sample No.		P17TPH3		P17TPI1		P17TPI2	P17TPI3	P17TPJ1	P17TPJ2	P17TPJ3
Sample Date		24-Jan-92		24-Jan-92		24-Jan-92	24-Jan-92	27-Jan-92	27-Jan-92	27-Jan-92
Depth (ft.)		6		2		4	6	2	4	6
VOCs:										
Methylene chloride		--		0.011		--	--	--	--	0.0092
BNAs:										
Di-n-butyl phthalate	S	1.9	S	1.9	S	*	*	5.5	S *	*
Toluene		3.5	S	--		*	*	--	*	*
PCB/Pesticides:										
Heptachlor epoxide		--		--		*	*	--	*	*
ppDDE	1	--		--		*	*	--	*	*
ppDDT		--		--		*	*	--	*	*
Phosphate:										
Phosphate		--		--		*	*	--	*	*
Metals:										
Aluminum		5600		7000		*	*	6300	*	*
Arsenic		6.34		9.2		*	*	5.47	*	*
Barium		--		--		*	*	--	*	*
Cadmium		--		--		*	*	--	*	*
Calcium		917		552		*	*	479	*	*
Chromium		9.1		11.2		*	*	9.89	*	*
Cobalt		--		2.68		*	*	4.56	*	*
Copper		5.94		5.74		*	*	8.56	*	*
Iron		8200		9100		*	*	9100	*	*
Lead		3.3		4.7		*	*	3.8	*	*
Magnesium		1680		1730		*	*	1900	*	*
Manganese		98.9		130		*	*	130	*	*
Nickel		7.61		8.29		*	*	8.55	*	*
Potassium		767		612		*	*	804	*	*
Vanadium		8.73		10.1		*	*	9.45	*	*
Zinc		16.5		15.3		*	*	16.6	*	*

Table D-39
Area P17
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	OHM-BW-3	OHM-BW-3	OHM-BW-3
Field Sample No.	BKGGW03A	BKGGW3B	BKGGW3C
Sample Date	02-Oct-91	18-Jun-92	26-Oct-92
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered
VOCs:			
Chloromethane	14.2	--	--
Methylene chloride	11.8	--	--
BNAs:			
N,N-Diethyl-3-methylbenzamide (DEET)	--	12 S	--
PCB/Pesticides:			
Heptachlor	0.01 U	--	--
Phosphate:			
Phosphate	--	10.4	13.7
Metals:			
Barium	4.3	--	--
Calcium	5400	6710	7100
Copper	5.73	--	--
Iron	69.8	--	--
Lead	--	1.48	--
Magnesium	870	--	--
Manganese	25.3	10.7	8.23
Potassium	848 T	2210	--
Zinc	--	26.3	12

Table P-40
Area P19
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P19CD1
Field Sample No.	P19CD1B
Sample Date	27-Oct-93
Depth (ft.)	0.0
PCB/Pesticides:	
ppDDE	0.0751
ppDDT	0.0341
Metals:	
Aluminum	11000
Arsenic	10
Barium	34.8
Beryllium	0.479
Calcium	223
Chromium	12.9
Cobalt	4.38
Copper	7.45
Iron	11000
Lead	80
Magnesium	1470
Manganese	238
Potassium	480
Selenium	0.64
Vanadium	20.7
Zinc	38.7

Table D-41
Area P20
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P20CD1		P20SO1		P20SO2	P20SO3	P20SO4	P20SO5
Field Sample No.	P20CD1A		P20SO1A		P20SO2B	P20SO3B	P20SO4B	P20SO5B
Sample Date	18-May-92		20-Apr-92		27-Oct-93	27-Oct-93	27-Oct-93	27-Oct-93
Depth (ft.)	0		0		0	0	0	0
VOCs:								
Acetone	0.021		0.059	X	*	*	*	*
Pinene-alpha	0.12	S	--		*	*	*	*
BNAs:								
Di-n-butyl phthalate	0.88	S	3	S	*	*	*	*
PCB/Pesticides:								
ppDDE	--		0.0241		*	*	*	*
ppDDT	0.0222		0.0374		*	*	*	*
Metals:								
Aluminum	7600	B	11000		4770	7400	6500	5800
Arsenic	7.5		7.94		6.6	7.2	4.6	7
Barium	12.9		--		15.7	20.4	14.4	15.3
Beryllium	--		--		--	0.568	--	--
Cadmium	0.885		--		--	--	--	--
Calcium	--		--		414	532	267	319
Chromium	12.4		16		11.3	14.4	11.5	10.5
Cobalt	3.92		--		3.13	5.24	3.85	3.68
Copper	6.09		39.8		6.5	100	9.36	5.96
Iron	10000	B	13000		8700	9900	8100	9000
Lead	35		780		26	3000	110	14
Magnesium	2050		2490		1920	2530	1750	1800
Manganese	180		160		181	214	87.9	163
Nickel	9.67		11.2		--	12.3	--	--
Potassium	705		758		887	791	474	769
Selenium	--		--		--	--	0.25	--
Vanadium	13.7		21.2		12.7	17.2	15.6	13.1
Zinc	17.9		33.5		23.2	39.7	26.6	20.9

Table D-42
Area P25
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P25CA1	P25CA2	P25SO1	P25SO2	P25SO3	P25SO4	P25SO5
Field Sample No.	P25CA1A	P25CA2A	P25SO1A	P25SO2B	P25SO3B	P25SO4B	P25SO5B
Sample Date	15-Oct-92	15-Oct-92	20-Apr-92	28-Oct-93	28-Oct-93	28-Oct-93	28-Oct-93
Depth (ft.)	0	0	0	0	0	0	0
VOCs:							
Methylene chloride	*	*	0.01	*	*	*	*
BNAs:							
Di-n-butyl phthalate	*	*	0.9 S	*	*	*	*
PCB/Pesticides:							
Chlordane, alpha	*	*	--	0.0074	--	--	--
Chlordane, total	*	*	--	0.0074	--	--	--
Endrin aldehyde	*	*	--	0.0508	--	--	0.0606
ppDDD	*	*	0.0415	0.21	--	--	--
ppDDE	*	*	0.0546	0.178	--	0.5	--
ppDDT	*	*	0.241	0.36	--	0.0852	0.0901
TPH:							
Total petroleum hydrocarbons	180	--	*	*	*	*	*
Metals:							
Aluminum	*	*	6900 B	4250	8200	7000	5070
Arsenic	*	*	4.9	6.3	8.4	3.9	4.6
Barium	*	*	37.2	28.9	45.7	38.1	38.5
Beryllium	*	*	--	--	0.401	--	--
Cadmium	*	*	1.24	1.32	--	--	0.653
Calcium	*	*	940 B	2220	710	1450	2460
Chromium	*	*	24.1	26.9	16.5	15.4	12.1
Cobalt	*	*	3.82	--	--	--	--
Copper	*	*	55.4	56.5	13.8	14.7	10.5
Iron	*	*	11000 B	15000	12000	11000	8200
Lead	*	*	29 B	36	10	21	23
Magnesium	*	*	2480	1640	2840	2390	1930
Manganese	*	*	180	270	158	203	280
Nickel	*	*	9.9	18.4	25	--	--
Potassium	*	*	2000	890	2000	1310	1000
Silver	*	*	52.3	1.45 T	--	8.25 T	3.21 T
Sodium	*	*	--	70.3	--	--	61.5
Vanadium	*	*	15.6	16.9	21.8	19.3	12.8
Zinc	*	*	65.4	300	31.9	46.6	43.2

Table D-43
Area P35
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P35SO1	P35SO1	P35SO2	P35SO3	P35SO4	P35SO5
Field Sample No.	P35SO1A	DUPSO03A	P35SO2B	P35SO3B	P35SO4B	P35SO5B
Sample Date	20-Apr-92	20-Apr-92	28-Oct-93	28-Oct-93	28-Oct-93	28-Oct-93
Depth (ft.)	0	0	0	0	0	0
VOCs:						
Methylene chloride	0.0085	--	*	*	*	*
BNAs:						
2-Methylnaphthalene	2 1	2 1	*	*	*	*
PCB/Pesticides:						
Chlordane, alpha	0.0834	0.109 D	2.8	0.00813	0.0265	0.23
Chlordane, gamma	0.11	0.16 D	4.1	--	--	0.34 X
Chlordane, total	0.1934	0.269 D	6.9	0.00813	0.0265	0.57 X
Endrin	0.0471	0.0436 D	--	--	--	--
Endrin aldehyde	--	--	--	0.0548	0.0748	0.129
Heptachlor epoxide	0.0133	0.0377 D	--	--	--	0.0174
ppDDD	0.85	0.88 D	2.6	0.0917	1.2	0.43
ppDDE	0.46	0.49 D	1.5 1	0.44	2.4	0.188
ppDDT	3	3.4 D	--	0.26	1.3	0.48
Metals:						
Aluminum	8600	6400 B	9100	6500	7600	7200
Arsenic	7.3	5.43 D	7.8	32	5	4.6
Barium	30.5	20.6 D	163	31.5	34.4	35.5
Beryllium	--	--	0.448	--	--	--
Cadmium	0.901	0.832 D	1.99	--	--	1.62
Calcium	1480	1010 B	1460	1230	990	1430
Chromium	16.7	12.4 D	19.1	13.5	25.6	18.6
Cobalt	--	--	4.24	--	--	--
Copper	13.8	11.9 D	22.3	10.4	14.7	74
Iron	9800	8300 B	11000	8500	10000	11000
Lead	130	120 B	360	110	100	170
Magnesium	1700	1230 D	2080	1580	2240	2210
Manganese	120	100 D	142	131	158	129
Mercury	0.353	0.415 D	0.36	--	--	--
Nickel	7.96	7.03 D	11.5	--	--	14.3
Potassium	694	484 D	720	615	591	597
Selenium	--	--	0.34	0.37	--	--
Vanadium	16	12 D	20	13.9	16.1	15.5
Zinc	93.2	76.8 D	453	71.6	81.1	378

Table D-44
Area P35
Summary of Detected Compounds
Ground Water (ug/L)

Site ID	GDHS	GDHS	GDHS	
Field Sample No.	FWGW1A	FWGW1B	DUPGW02B	
Sample Date	18-Jun-92	26-Oct-92	26-Oct-92	
Filtered/Unfiltered Metals	Filtered	Filtered	Filtered	
Metals:				
Calcium	10200	12400	12100	D
Lead	--	1.79	3.24	D
Manganese	30.2	17.4	20.1	D
Potassium	--	1990	--	
Sodium	9900	12000	11500	D
Zinc	16.4	--	12.7	D

Table D-45
Area P35
Summary of Detected Compounds
Transformer Samples (ug/g)

Site ID	P35TF1	P35TF2	P35TF3	P35TF4	P35TF5	P35TF7	P35TF8
Field Sample No.	P35TF1A	P35TF2A	P35TF3A	P35TF4A	P35TF5A	P35TF7A	P35TF8A
Sample Date	09-Jul-92	09-Jul-92	09-Jul-92	09-Jul-92	09-Jul-92	09-Jul-92	09-Jul-92
PCBs:							
PCB 1016	--	--	--	--	--	--	--
PCB 1221	--	--	--	--	--	--	--
PCB 1232	--	--	--	--	--	--	--
PCB 1242	--	--	--	--	--	--	--
PCB 1248	--	--	--	--	--	--	--
PCB 1254	--	--	--	--	--	--	--
PCB 1260	6.1	--	--	--	--	--	--
PCBs, total	6.1	--	--	--	--	--	--

Table D-46
Area P49
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P49CD1	P49SO1	P49SO1	P49SO2	P49SO2	P49SO3	P49SO3	P49SO4	P49SO4
Field Sample No.	P49CD1A	P49SO1B	P49SO1C	P49SO2B	P49SO2C	P49SO3B	P49SO3C	P49SO4B	P49SO4C
Sample Date	19-May-92	28-Oct-93	15-Nov-93	28-Oct-93	15-Nov-93	28-Oct-93	15-Nov-93	28-Oct-93	15-Nov-93
Depth (ft.)	0	0	0	0	0	0	0	0	0
VOCs:									
Tetrachloroethylene	0.0031	*	--	*	--	*	--	*	--
BNAs:									
Di-n-butyl phthalate	0.98 S	*	*	*	*	*	*	*	*
PCB/Pesticides:									
Dieldrin	0.0124	--	*	--	*	--	*	--	*
Heptachlor epoxide	--	--	*	--	*	0.00497 1	*	--	*
ppDDD	0.0711	0.0319	*	0.0256	*	0.0157 1	*	--	*
ppDDE	0.124	0.128	*	0.0546	*	0.0801	*	0.0152 1	*
ppDDT	0.23	0.193	*	0.142	*	0.171	*	0.03	*
Metals:									
Aluminum	7600 B	*	*	*	*	*	*	*	*
Arsenic	6.4	*	*	*	*	*	*	*	*
Chromium	8.31	*	*	*	*	*	*	*	*
Copper	3.22	*	*	*	*	*	*	*	*
Iron	8000 B	*	*	*	*	*	*	*	*
Lead	16 B	*	*	*	*	*	*	*	*
Magnesium	1070	*	*	*	*	*	*	*	*
Manganese	61.7	*	*	*	*	*	*	*	*
Nickel	4.15	*	*	*	*	*	*	*	*
Potassium	393	*	*	*	*	*	*	*	*
Vanadium	10.7	*	*	*	*	*	*	*	*
Zinc	13.8	*	*	*	*	*	*	*	*

Table D-47
Area P51
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	P51CD1	P51SO1	P51SO2	P51SO3	P51SO4
Field Sample No.	P51CD1A	P51SO1B	P51SO2B	P51SO3B	P51SO4B
Sample Date	19-May-92	01-Nov-93	01-Nov-93	01-Nov-93	01-Nov-93
Depth (ft.)	0	0	0	0	0
PCB/Pesticides:					
Chlordane, alpha	--	0.0443	--	0.00648 1	--
Chlordane, total	--	0.0443	--	0.00648 1	--
Dieldrin	0.117	--	--	--	--
ppDDD	0.18	0.11	0.039	0.152	0.0474
ppDDE	0.512	0.244	0.139	0.314	0.355
ppDDT	0.283	0.418	0.107	0.365	0.238
Metals:					
Aluminum	5900 B	5280	7440	6320	13000
Arsenic	4.68	3.6	3.4	3.7	12
Barium	--	16.7	17.8	14.6	21
Beryllium	--	--	--	--	0.734
Calcium	--	258	252	--	372
Chromium	--	12	14.5	13.9	13.2
Copper	14.4	9.25	11.8	12.4	26
Iron	7500 B	8800	5900	3200	15000
Lead	77	58	56	70	45
Magnesium	--	920	971	--	1290
Manganese	24.2	36.3	31.5	14.3	53.4
Mercury	0.367	--	--	--	--
Potassium	751	337	348	--	--
Selenium	--	0.49	0.58	1.1	0.99
Vanadium	14.2	14.7	12.3	12.6	22.1
Zinc	--	22.2	22.2	15.1	25.3

Table D-48
Area P59
Summary of Detected Compounds
Sediment (ug/g)

Site ID	FWISD21	FWISD22	FWISD23	FWISD24	FWISD25
Field Sample No.	FWISD21B	FWISD22B	FWISD23B	FWISD24B	FWISD25B
Sample Date	16-Nov-93	16-Nov-93	16-Nov-93	16-Nov-93	16-Nov-93
Depth (ft.)	0	0.5	0	0	0.5
BNAs:					
Benzo(a)anthracene	--	--	0.58	--	--
Benzo(a)pyrene	0.48	--	0.78	--	--
Benzo(ghi)perylene	--	--	0.78	--	--
Benzo[def]phenanthrene	--	--	1.4 1	--	--
Bis(2-ethylhexyl) phthalate	--	--	--	1.4	1.2
Chrysene	0.3	--	1	--	--
Fluoranthene	0.3	--	0.49	--	--
Indeno[1,2,3-C,D]pyrene	--	--	0.47	--	--
Phenanthrene	--	--	0.4	--	--
PCB/Pesticides:					
Lindane	--	--	--	--	0.108
ppDDD	0.335	0.418	4.7	0.92	0.255
ppDDE	0.279	0.374	0.372	0.114	0.124
ppDDT	0.129 2	0.0744 2	5.4 2	0.424 2	--
Metals:					
Aluminum	3330	4230	2080	10800	10100
Arsenic	22	27	36	15	--
Barium	14.9	--	12.2	26.2	25.7
Beryllium	--	--	--	--	1.53
Calcium	462	898	461	711	1760
Chromium	14.7	24.4	13.1	18.1	6.77
Copper	48.6	155	152	187	28.7
Iron	110000	150000	130000	110000	7200
Lead	120	110	110	86	19
Manganese	262	279	264	250	20.4
Nickel	--	--	45.2	37.7	--
Selenium	1.2	1.4	0.68	1.9	1.4
Sodium	--	--	115	--	--
Vanadium	13.9	18.8	16.1	15.8	--
Zinc	49.1	75.4	50.3	58.8	27.1

Table D-49
Area P60
Summary of Detected Compounds
Surface Soil (ug/g)

Site ID	FWICD1	FWICD2
Field Sample No.	FWICD1B	FWICD2B
Sample Date	16-Nov-93	16-Nov-93
Depth (ft.)	0	0
BNAs:		
Bis(2-ethylhexyl) phthalate	0.69	--
PCB/Pesticides:		
ppDDD	0.0329	0.0702
ppDDE	0.0916	0.199
ppDDT	0.14 2	0.231 2
Metals:		
Aluminum	12000	14000
Arsenic	260	460
Barium	12.2	19.8
Beryllium	--	0.41
Cadmium	1.27	2.74
Calcium	150	211
Chromium	12.8	13.9
Copper	4.89	--
Iron	11000	12000
Lead	41	24
Magnesium	1360	1540
Manganese	61.8	70.8
Potassium	326	502
Selenium	0.55	0.5
Vanadium	17.6	20.3
Zinc	30.6	38.6

TABLE D-50
SUMMARY OF DETECTED UNKNOWN COMPOUNDS

Area	File Type	Site Type	Method	Types of Unknowns Detected	Number of Detections	Minimum Detection	Maximum Detection	Unit
A3/P5	CGW	WELL	BNA	1	4	14	17	UGL
			VOC	2	4	3	11	UGL
	CSO	BORE	BNA	13	16	1.093	66.667	UGG
			VOC	4	4	0.011	0.11	UGG
	CSO	EXCV	BNA	58	197	0.07	1	UGG
	CSO	SURF	BNA	18	50	1.02	22.851	UGG
			VOC	7	10	0.010	0.026	UGG
A4	CGW	WELL	BNA	9	12	2	14	UGL
			VOC	2	5	3	6	UGL
	CSE	DTCH	BNA	6	6	1.316	21.053	UGG
		MT	BNA	113	520	0.09	66.667	UGG
			VOC	2	3	0.013	0.133	UGG
		STRM	BNA	1	2	15.625	36.364	UGG
			VOC	1	1	1.255	1.255	UGG
	CSO	BORE	BNA	30	50	0.09	24.823	UGG
			VOC	5	8	0.035	0.696	UGG
		EXCV	BNA	34	79	0.08	9	UGG
			VOC	1	1	0.04	0.04	UGG
		SURF	BNA	34	36	0.1	53.262	UGG
			VOC	5	6	0.010	0.069	UGG
	CSW	MT	BNA	58	78	5	60	UGL
			VOC	1	1	11	11	UGL
		STRM	VOC	1	1	23	23	UGL
		TANK	BNA	1	1	6	6	UGL
A7	CGW	WELL	BNA	29	37	2	14	UGL
			VOC	5	8	3	40	UGL
	CSE	STRM	BNA	79	156	0.3	17.15	UGG
			VOC	3	4	0.092	0.856	UGG
	CSO	BORE	BNA	58	110	0.08	40.948	UGG
			VOC	10	17	0.001	0.346	UGG
		EXCV	BNA	84	214	0.8	100	UGG
			VOC	39	62	0.01	7	UGG
		SURF	BNA	21	36	1	200	UGG
			VOC	11	14	0.011	0.122	UGG
	CSW	STRM	BNA	25	33	4	400	UGL
			VOC	1	1	11	11	UGL
A9	CGW	WELL	BNA	59	139	2	800	UGL
			VOC	84	155	3	4000	UGL
	CSO	BORE	BNA	90	200	0.08	200	UGG
			VOC	79	131	0.006	1.341	UGG
		DTCH	BNA	12	28	1	20	UGG
			VOC	2	2	0.01	0.01	UGG
		SURF	BNA	4	4	6	104.651	UGG
			VOC	7	10	0.011	0.099	UGG

TABLE D-50
SUMMARY OF DETECTED UNKNOWN COMPOUNDS

Area	File Type	Site Type	Method	Types of Unknowns Detected	Number of Detections	Minimum Detection	Maximum Detection	Unit
AR	CSE	RVER	BNA	8	14	1	299.401	UGG
			VOC	1	8	0.034	0.667	UGG
	CSW	RVER	BNA	2	2	4	11	UGL
			VOC	2	3	14	19	UGL
P4	CSE	DTCH	VOC	1	1	0.076	0.076	UGG
	CSO	SURF	BNA	76	147	0.07	100	UGG
			VOC	1	2	0.012	0.012	UGG
	CSW	DTCH	BNA	1	1	15	15	UGL
P7	CGW	WELL	BNA	1	3	12	13	UGL
			VOC	3	3	3	11	UGL
	CSO	BORE	BNA	8	15	1	7	UGG
			VOC	2	5	0.01	0.04	UGG
	CSO	EXCV	BNA	2	2	1.116	1.853	UGG
P9	CSE	STRM	BNA	9	14	1.19	31.707	UGG
			VOC	1	1	0.699	0.699	UGG
	CSW	STRM	VOC	2	2	25	1600	UGL
P17	CGW	WELL	BNA	2	2	15	20	UGL
	CSO	EXCV	BNA	9	30	1.087	46.099	UGG
			VOC	4	10	0.005	0.011	UGG
	CSO	SURF	BNA	4	5	2.347	23.781	UGG
			VOC	1	1	0.012	0.012	UGG
P19	CSO	SURF	BNA	64	64	0.1	20	UGG
			VOC	1	1	0.007	0.007	UGG
P20	CSO	SURF	BNA	4	4	2	20	UGG
			VOC	6	6	0.011	0.055	UGG
P25	CSO	SURF	BNA	1	1	22.198	22.198	UGG
			VOC	2	2	0.011	0.055	UGG
P35	CGW	WELL	BNA	1	1	14	14	UGL
			VOC	1	1	3	3	UGL
	CSO	SURF	VOC	2	2	0.012	0.118	UGG
P49	CSO	SURF	BNA	1	1	2	2	UGG
			VOC	3	5	0.008	0.1	UGG
P51	CSO	SURF	VOC	1	1	0.074	0.074	UGG
P59	CSE	SWAP	BNA	95	329	0.07	10	UGG
P60	CSO	SURF	BNA	48	82	0.02	2	UGG