FINAL

REVISED ADDENDUM FOR SWMU 27H: DOL MAINTENANCE, BUILDING 1071

FORSCOM

3d Inf Div (Mech)

TO THE

REVISED FINAL PHASE II RCRA FACILITY INVESTIGATION REPORT FOR 16 SOLID WASTE MANAGEMENT UNITS AT FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0009

March 2001

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REVISED ADDENDUM FOR SWMU 27H: DOL MAINTENANCE, BUILDING 1071 TO THE REVISED FINAL PHASE II RCRA FACILITY INVESTIGATION REPORT FOR 16 SOLID WASTE MANAGEMENT UNITS AT FORT STEWART, GEORGIA

REGULATORY AUTHORITY
Resource Conservation and Recovery Act
40 CFR 264, Title II, Subpart C, Section 3004;
42 USC 6901 et seq.

Prepared for:
U.S. Army Corps of Engineers
Savannah District
Under Contract No. DACA21-95-D-0022
DELIVERY ORDER NO. 0009

Prepared by:
Science Applications International Corporation
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37831

March 2001

The undersigned certifies that I am a qualified groundwater scientist who has received a baccalaureate or postgraduate degree in the natural sciences or engineering and have sufficient training and experience in groundwater hydrology and related fields, as demonstrated by state registration and completion of accredited university courses, to enable me to make sound professional judgments regarding groundwater monitoring and contaminant fate and transport. I further certify that this report was prepared by myself or a subordinate working under my direction.

22851
P. A. STOLL

4/23/01

Patricia Stoll, P.E.
Technical Manager
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March 26, 2001

Commander
U.S. Army Corps of Engineers
Savannah District
ATTN.: CESAS-PM-H (Ms. Ana Vegara)
100 W. Oglethorpe Avenue
Savannah, GA 31401-3640

Reference: **Contract No. DACA21-95-D-0022, Delivery Order No. 0078**

Subject: **Submittal of Revised Final Addendum for SWMU 27H: DOL Maintenance, Building 1071 to the Revised Final Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia**

Dear Ms. Vergara:

Science Applications International Corporation (SAIC) is pleased to submit two copies of the revised final addendum for Solid Waste Management Unit (SWMU) 27H, DOL Maintenance, Building 1071 to the revised final Phase II RCRA Facility Investigation Report (RFI) for 16 SWMUs at Fort Stewart, Georgia. The final document replaces the Corrective Action Plan (CAP) for SWMU 27H, Building 1071 under Delivery Order 0078. The resampling of the monitoring wells (as recommended in the final Phase II RFI Report) indicated nondetects for the constituent of concern (1,1-dichloroethene); therefore, with the concurrence of Mr. Brent Rabon of Georgia Environmental Protection Division, the Phase II RFI was revised to indicate no further action rather than development of a CAP.

Should you have any questions regarding this submittal, please do not hesitate to contact me either by telephone at (423) 481-8784 or by e-mail at Jeffery.J.Longaker@saic.com.

Sincerely,

Jeffery J. Longaker

Jeffery J. Longaker
Project Manager

Enclosures (1)

cc: Melanie Little (FSMR), Project Manager, 1 copy
Tressa Rutland (FSMR), On-site Project Manager, 3 copies
Wes Smith (USACE–Savannah District), Technical Manager (w/o attachments)
Greg Grim (SAIC), Program Manager (w/o attachments)
Bruce King (SAIC), Deputy Program Manager (w/o attachments)
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March 26, 2001

Commander
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No underline not exact title

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Subject: **Submittal of Revised Final Addendum for SWMU 27H: DOL Maintenance, Building 1071 to the Revised Final Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia**

Dear Ms. Vergara: Solid Waste Management Unit

[illegible]

Science Applications International Corporation (SAIC) is pleased to submit two copies of the revised final addendum for SWMU 27H, DOL Maintenance, Building 1071 to the revised final Phase II RCRA Facility Investigation Report (RFI) for 16 ~~Solid Waste Management Units~~ SWMUs at Fort Stewart, Georgia. The final document replaces the Corrective Action Plan (CAP) for SWMU 27H, Building 1071 under Delivery Order 0078. The resampling of the monitoring wells (as recommended in the final Phase II RFI Report) indicated nondetects for the ~~COC~~ constituent of concern (1,1-dichloroethene); therefore, with the concurrence of Mr. Brent Rabon of Georgia Environmental Protection Division, the Phase II RFI was revised to indicate no further action rather than development of a CAP.

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Central Records Facility (SAIC)

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TABLES

FIGURES

ACRONYMS

ADD	average daily dose
AT123D	Analytical Transient 1-, 2-, 3-Dimensional
AUF	area use factor
bgs	below ground surface
CAP	Corrective Action Plan
CMCOC	contaminant migration constituent of concern
CMCOPC	contaminant migration contaminant of potential concern
COC	constituent of concern
COPC	contaminant of potential concern
DO	dissolved oxygen
DOL	Directorate of Logistics
DPT	direct-push technology
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
ERA	Ecological Risk Assessment
ESV	ecological screening value
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GSSL	generic soil screening level
HHBRA	human health baseline risk assessment
HHCOC	human health constituent of concern
HHCOPC	human health contaminant of potential concern
HHPRE	human health preliminary risk evaluation
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	incremental lifetime cancer risk
IWTP	Industrial Wastewater Treatment Plant
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
NFA	no further action
NOAEL	no observed adverse effect level
NTU	nephelometric turbidity unit
ODAST	One-dimensional Solute Transport
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
QA	quality assurance
QC	quality control
QCSR	Quality Control Summary Report
RBCA	Risk-based Corrective Action
RCRA	Resource Conservation and Recovery Act
Redox	oxidation-reduction potential
RfD	reference dose
RFI	RCRA Facility Investigation
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan

SESOIL	Seasonal Soil Compartment
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TRV	toxicity reference value
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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1.0 INTRODUCTION

This addendum to the revised final Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for 16 Solid Waste Management Units (SWMUs) dated April 2000 presents the results for the Phase II RFI for SWMU 27H, Building 1071 performed in October 1999 [see Section 10.11 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)]. A Phase I RFI was performed at SWMU 27H, Building 1071 in January 1998, and the results are presented in Section 10.11 of the revised final Phase II RFI Report (SAIC 2000a). The results of the Phase I RFI indicated that additional investigation of the site was required to evaluate the nature and extent of potential soil and groundwater contamination.

This report has been prepared by Science Applications International Corporation (SAIC) for the U.S. Army Corps of Engineers (USACE)-Savannah District under Contract DACA21-95-D-0022, Delivery Order No. 0009. The RFI was conducted in accordance with USACE Guidance EM 200-1-3.

1.1 OBJECTIVES AND SCOPE OF THE INVESTIGATION

The specific objectives of this Phase II RFI for SWMU 27H, Building 1071 at Fort Stewart, Georgia, as defined in the conclusions and recommendations in Section 10.11.8 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a) and the Phase II RFI Sampling and Analysis Plan (SAP) (SAIC 1997) [approved by the Georgia Environmental Protection Division (GEPD) in October 1997] are listed below.

- Determine the horizontal and vertical extent of groundwater contamination.
- Determine whether soil and groundwater contaminants present a threat to human health or the environment.
- Determine the need for future action and/or no further action (NFA).
- Gather data necessary to support a Corrective Action Plan (CAP), if warranted.

The information provided in this addendum report is based upon data collected previously during the Phase I RFI (January 1998) and data collected as part of the Phase II RFI field sampling and analysis (October 1999). The scope of the fieldwork for the Phase II sites included the activities listed below.

- Collection of direct-push groundwater samples using a push probe.
- Collection of soil samples during monitoring well installation.
- Installation of permanent groundwater monitoring wells both upgradient and downgradient of the site.
- Groundwater sampling at newly installed monitoring wells around the SWMU.
- Collection of surface water and sediment samples.
- Surveying of the positions of all sample locations.

1.2 ADDENDUM REPORT ORGANIZATION

This report is an addendum to the revised final Phase II RFI Report for 16 SWMUs that was issued in April 2000. General procedures and/or methodology for field investigation, fate and transport analysis, human health risk assessment, and ecological risk assessment (ERA) are presented in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a) and are referenced in the appropriate addendum sections. The revised final Phase II RFI Report for 16 SWMUs consists of three volumes: 12 chapters of text in Volume I, seven appendices in Volume II, and five appendices in Volume III. The contents of each volume are described below.

Chapter 1.0 describes the purpose of this investigation, summarizes the scope of work performed, and presents the organization of the report. General information is presented in Chapters 2.0 through 8.0. Chapter 2.0 describes the Fort Stewart Military Reservation (FSMR) Installation and discusses the history of the FSMR and the FSMR's regulator history. Chapter 3.0 presents the regional setting of the FSMR, including the demographics, topography, regional geology and hydrogeology, surface drainage, soils, and ecology. Chapter 4.0 summarizes the investigation activities and methodologies used in completing the Phase II RFI fieldwork. Chapter 5.0 describes the results of the background interpretation for surface soil, subsurface soil, groundwater, surface water, and sediment and their relationship to each site. Chapter 6.0 identifies general considerations affecting contaminant fate and transport. Chapter 7.0 presents the general methodology for the human health preliminary risk evaluation (HHPRE), and Chapter 8.0 presents the general methodology for the ecological preliminary risk evaluation (EPRE).

Chapter 9.0 designates, in sequential order, the SWMUs that are recommended for NFA and for which, therefore, additional investigation and/or evaluation is not required. Chapter 10.0, in which SWMU 27H, Building 1071 is addressed (Section 10.11), designates, in sequential order, the SWMUs that are recommended for additional investigation or a CAP. Chapter 11.0 presents general conclusions and recommendations related to the SWMUs being recommended for NFA or SWMUs that indicate risk to human health or the environment and are recommended for additional investigation or a CAP. References are presented in Chapter 12.0.

Volume II of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a) contains seven appendices. Appendix A contains the direct-push technology (DPT) and boring logs. Appendix B contains monitoring well construction diagrams. Appendix C is the Quality Control Summary Report. Appendix D provides a comparison of metal data from the Phase I and Phase II RFIs. Appendix E contains the geotechnical laboratory test results. Appendix F is the background data summary. Appendix G contains the chain-of-custody forms.

Volume III of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a) contains five appendices. Appendix H provides the analytical data results. The analytical data are also provided in electronic format (i.e., on a CD). Appendix I presents the methodology for the human health baseline risk assessment (HHBRA). Appendix J contains the toxicity profiles for contaminants of potential concern (COPCs). Appendix K presents the fate and transport input data and model descriptions. Appendix L presents the revised responses to GEPD comments received on the final Phase II RFI Report for 16 SWMUs submitted in February 1999 and the meeting minutes for the comment response meeting with GEPD held on September 14, 1999.

The results of the Phase I RFI for SWMU 27H, Building 1071 are presented in Section 10.11 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). This addendum follows the same organization as that of the revised final Phase II RFI Report for 16 SWMUs.

2.0 HISTORY AND DESCRIPTION OF SWMU 27H, DOL MAINTENANCE, BUILDING 1071

SWMU 27H, Building 1071 is one of two oil/water separators (OWSs) that support vehicle maintenance activities at the Directorate of Logistics (DOL) maintenance facilities and one of 32 OWSs distributed across 29 sites that support vehicle maintenance facilities within the garrison area (Figure 1). The OWS is located adjacent to an open maintenance pad identified as Building 1071 (Figure 2). Maintenance activities for military vehicles are performed at the maintenance pad. Floor drains from the maintenance pad are piped to the OWS. In addition, residual oil from collection and storage containers, filters, and such is allowed to drain onto the grating that covers the OWS. No investigations had been performed at this OWS in the DOL maintenance area prior to the Phase I RFI. The effluent from the OWS discharges to the Industrial Wastewater Treatment Plant (IWTP), and the oil is pumped out of the holding unit and burned at the Central Energy Plant.

SWMU 27H, Building 1071 is regulated under a RCRA Permit [HW-045 (S&T)] issued to Fort Stewart in August 1987 for storage and treatment of hazardous waste. Detailed regulatory history of Fort Stewart is presented in Section 2.2 of the revised final Phase II RFI Report (SAIC 2000a). A Phase I RFI was conducted at SWMU 27H, Building 1071 in January 1998, and the results are discussed in the following section.

2.1 PHASE I RCRA FACILITY INVESTIGATION

A Phase I RFI was conducted at SWMU 27H, Building 1071 in January 1998. DPT techniques were used to collect four soil and groundwater samples at the site. The locations of the soil and groundwater samples are presented in Figure 2. The four soil samples were collected based on field headspace screening for volatile organic compounds (VOCs). The soil and groundwater samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), and RCRA metals. RCRA metals were analyzed at this site because of the varied operations that are associated with DOL areas.

2.1.1 Surface Soil

No surface soil samples were collected at the site during the Phase I RFI because photoionization detector readings did not indicate elevated levels.

2.1.2 Subsurface Soil

Subsurface soil samples were collected at four locations. These samples were selected for analysis based on field headspace screening for VOCs. Analytical results are summarized in Table 1 and Figure 3.

VOCs. Acetone and toluene were detected in subsurface soil at concentrations above the analytical detection limits. Acetone and toluene were found at GP4 at concentrations of 0.0512 mg/kg and 0.0163 mg/kg, respectively. Acetone and toluene are site-related contaminants (SRCs) in subsurface soil at the site based on the Phase II RFI.

SVOCs. A wide range of SVOCs was detected in subsurface soil at sampling locations GP2, GP3, and GP4 (see Figure 3). SVOCs detected at concentrations above the analytical detection limits include the following: acenaphthylene (0.796 mg/kg at GP4 and 1.37 mg/kg at GP2), benzo(*a*)anthracene (1.86 mg/kg at GP3 to 5.24 mg/kg at GP2), benzo(*a*)pyrene (1.79 mg/kg at GP3 to 5.04 mg/kg at GP2), benzo(*b*)fluoranthene

(1.76 mg/kg at GP3 to 5.15 mg/kg at GP2), benzo(*g,h,i*)perylene (0.948 mg/kg at GP3 to 3.56 mg/kg at GP2), benzo(*k*)fluoranthene (1.42 mg/kg at GP3 to 4.72 mg/kg at GP2), chrysene (1.94 mg/kg at GP3 to 6.21 mg/kg at GP2), fluoranthene (2.18 mg/kg at GP3 to 4.93 mg/kg at GP2), indeno(*1,2,3-cd*)pyrene (0.986 mg/kg at GP3 to 3.31 mg/kg at GP2), phenanthrene (1.86 mg/kg at GP2), and pyrene (3.35 mg/kg at GP3 to 10.6 mg/kg at GP2). Based on the Phase I RFI, SRCs in subsurface soil include the following SVOCs: acenaphthylene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, fluoranthene, indeno(*1,2,3-cd*)pyrene, phenanthrene, and pyrene.

RCRA Metals. Lead and mercury were detected in subsurface soil at concentrations exceeding the site reference background levels. Lead was detected at GP4 at 47.3 mg/kg, and mercury was detected at GP3 at 0.09 mg/kg. Both lead and mercury are SRCs in subsurface soil at the site based on the Phase I RFI.

2.1.3 Groundwater

With the use of DPT techniques, groundwater samples were collected from the four Geoprobe locations at SWMU 27H, Building 1071. The results of the groundwater analyses are presented in Table 2 and Figure 3.

VOCs. Acetone was detected in groundwater at a concentration of 141 μg/L at GP2. Acetone is an SRC in groundwater at the site based on the Phase I RFI.

SVOCs. SVOCs were detected in groundwater at only sampling location GP4. SVOCs detected include: benzo(*a*)anthracene at 13.3 μg/L, benzo(*a*)pyrene at 11.5 μg/L, benzo(*b*)fluoranthene at 18.4 μg/L, benzo(*g,h,i*)perylene at 6 μg/L, chrysene at 18.6 μg/L, fluoranthene at 18.8 μg/L, indeno(*1,2,3-cd*)pyrene at 5.8 μg/L, phenanthrene at 11.7 μg/L, and pyrene at 30.4 μg/L. Based on the Phase I RFI, the SRCs in groundwater include the following SVOCs: benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, chrysene, fluoranthene, indeno(*1,2,3-cd*)pyrene, phenanthrene, and pyrene. The detected concentration of benzo(*a*)pyrene exceeded its maximum contaminant level (MCL).

RCRA Metals. RCRA metals were not detected above reference background criteria in any of the four groundwater samples.

2.1.4 Surface Water

No surface water samples were collected because no definitive surface water pathway had been identified prior to the Phase I RFI.

2.1.5 Sediment

No sediment samples were collected because no definitive sediment pathway had been identified prior to the Phase I RFI.

2.2 CONCLUSIONS AND RECOMMENDATIONS OF THE PHASE I RFI

Acetone, toluene, 11 SVOCs, lead, and mercury were identified as SRCs in subsurface soil. Of these, benzo(a)anthracene and benzo(b)fluoranthene were identified as contaminant migration contaminants of potential concern (CMCOPCs) and benzo(a)pyrene was identified as a human health contaminant of potential concern (HHCOPC). Acetone and nine SVOCs were identified as SRCs in groundwater. Benzo(a)pyrene was detected above its MCL. All of the SRCs in groundwater except two were identified as HHCOPCs in groundwater. The nine SVOCs detected in groundwater were identified as ecological contaminants of potential concern (ECOPCs) based on the potential hazards to aquatic biota if groundwater discharges to a nearby surface water body. Therefore, the Phase I RFI [see Section 10.11.8.2, page 10.11-7 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)] concluded that the vertical and horizontal extent of potential soil and groundwater contamination had not been determined and recommended that additional groundwater screening and shallow and potentially deep groundwater monitoring wells be installed (upgradient and downgradient). In addition, the surface water and sediment in the adjacent drainage ditch was to be sampled.

3.0 SUMMARY OF PHASE II RCRA FACILITY INVESTIGATION

The extent of potential soil and groundwater contamination was not determined by the Phase I RFI. DPT techniques were used to collect seven groundwater screening samples to determine the horizontal and vertical extent of groundwater contamination. The DPT groundwater screening samples were analyzed for VOCs. One vertical-profile boring (VP1) was installed at the groundwater screening location that indicated the highest level of contamination to investigate the vertical extent of contamination. The vertical-profile samples were analyzed for VOCs. The results of the groundwater screening were used to locate eight monitoring wells (four shallow and four deep) at the site. One shallow and one deep monitoring well (MW1 and MW2, respectively) were installed upgradient of the site (i.e., site background wells). The Phase II RFI sampling locations are shown in Figure 4. Boring logs and monitoring well diagrams are presented in Appendices A (page A.21-1) and B (page B.10-1) of the revised final Phase II RFI Report (SAIC 2000a), respectively. Monitoring well construction details are presented in Table 3. Two soil samples were collected at each well following the procedures outlined in the revised final SAP for Phase II RFIs of 16 SWMUs (SAIC 1997). The soil samples were analyzed for VOCs, SVOCs, and RCRA metals.

Geotechnical samples were collected from the monitoring wells, and the results are presented in Table 4. Only three of the nine wells were developed until the turbidity was less than or equal to 10 nephelometric turbidity units (NTUs). Monitoring well development data are presented in Table 5. All wells were sampled using low-flow techniques. The high turbidities were associated with the deep well installations. These deep well installations were extended into the Hawthorn confining (clay) layer, and sandy/clay was being encountered at the time of the high readings. The turbidities remained elevated and constant during well development (Table 5). Groundwater samples collected from the monitoring wells were analyzed for VOCs, SVOCs, and RCRA metals.

Three surface water and sediment samples were collected in the drainage ditch located approximately 50 feet southwest of the OWS. One surface water/sediment sample and two surface water/sediment samples were collected upstream and downstream, respectively, of the OWS. The surface water and sediment samples were analyzed for VOCs, SVOCs, and RCRA metals.

Conductivity, temperature, dissolved oxygen (DO), oxidation-reduction potential (Redox), and turbidity were measured in the field during groundwater and surface water sampling, and the results are presented in Table 6. The sampling locations are presented in Figure 4.

4.0 PHYSICAL CHARACTERISTICS OF THE SITE

4.1 TOPOGRAPHY

The topography of the OWS site is essentially level. The OWS area is concrete, and all the surrounding sides are concrete vehicle parking areas. The surface elevation is approximately 83 feet above mean sea level.

4.2 SURFACE DRAINAGE

There is a man-made drainage ditch, which is separated from the site by a boundary fence, approximately 50 feet southwest of the OWS. The drainage ditch receives runoff from the vehicle parking area and outside storage area surrounding the OWS, from the adjacent asphalt road that borders the western side of the drainage ditch, and from other upstream industrial sources. The water in the drainage ditch is usually stagnant, except during rainfall events. The surface water in the drainage ditch ultimately discharges into Mill Creek approximately 2,600 feet to the west. The OWS discharges directly to the IWTP; however, the adjacent drainage ditch is rather deep and may potentially intercept the relatively shallow groundwater. The deeper surficial groundwater may potentially migrate below the drainage ditch and to a tributary of Mill Creek located approximately 1,500 feet to the south.

4.3 SOILS

The soils across the site consist of alternating layers of sand and silty to clayey sands, as indicated in cross sections A-A' and B-B' (Figures 5 and 6, respectively).

4.4 HYDROGEOLOGY

Groundwater was encountered at approximately 8 feet to 10 feet below ground surface (bgs) in the monitoring wells during the Phase II RFI. The shallow surficial groundwater flow direction across the site is to the west (Figure 7). The deep surficial groundwater flow direction is to the southwest–south (Figure 8). The hydraulic gradient of the shallow and deep surficial groundwater is 0.007 foot/foot and 0.017 foot/foot, respectively. The shallow surficial groundwater flow may intercept the man-made drainage ditch located approximately 50 feet to the southwest of the OWS. The deeper surficial groundwater may potentially migrate to a tributary of Mill Creek located approximately 1,500 feet to the south.

4.5 ECOLOGY

As stated in Section 8.2 of the revised final Phase II RFI Report (SAIC 2000a), SWMU 27H, Building 1071 is classified as an "industrialized area." The site is comprised of approximately 0.11 acre, with concrete surfaces and man-made structures existing throughout. No natural habitat is present within or adjacent to the SWMU's boundaries.

5.0 NATURE AND EXTENT OF CONTAMINATION

5.1 SURFACE SOIL

The SWMU 27H, Building 1071 site is covered with concrete; therefore, the surface soil samples were collected from the uppermost 1 foot to 2 feet below the concrete. A total of eight surface soil samples were collected at the monitoring well boring locations. The surface soil was analyzed for VOCs, SVOCs, and RCRA metals. Analytical results for the Phase II RFI are summarized in Table 7 and Figure 9. Chain-of-custody forms and complete analytical results are presented in Appendix G (page G-175) and Appendix H (page H.22-1), respectively, of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

VOCs. Six VOCs were detected in surface soil from the monitoring wells. 2-Butanone, acetone, and styrene were detected at MW5 at concentrations of 0.0097 mg/kg, 0.0361 mg/kg, and 0.0036 mg/kg, respectively. Carbon disulfide was detected in seven out of eight subsurface soil samples at concentrations ranging from 0.003 mg/kg at MW3 and MW6 to 0.0141 mg/kg at MW5. Ethylbenzene was detected at concentrations of 0.338 mg/kg and 0.0333 mg/kg at MW4 and MW5, respectively. Total xylenes were detected at concentrations of 3.97 mg/kg and 0.318 mg/kg at MW4 and MW5, respectively. All the VOCs and the maximum concentrations (except for that of total xylenes) were detected at MW5. 2-Butanone, acetone, carbon disulfide, ethylbenzene, styrene, and total xylenes are considered to be SRCs in surface soil based on the Phase II RFI.

SVOCs. Seventeen SVOCs were detected in the surface soil at SWMU 27H, Building 1071 during the Phase II RFI. The most elevated concentrations of SVOCs were detected at MW4 and MW5, which are locations that are next to one another (shallow/deep well pair). Another shallow/deep well pair (MW6 and MW7) and MW1 (site-specific background location) had 10 to 12 SVOCs detected. The relatively widespread surface soil contamination may be the result of practices at the DOL maintenance area and not specifically from the OWS. 2-Methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, dibenzo(*a,h*)anthracene, fluoranthene, fluorene, indeno(*1,2,3-cd*)pyrene, naphthalene, phenanthrene, and pyrene are considered to be SRCs in surface soil based on the Phase II RFI.

RCRA Metals. Arsenic, barium, cadmium, chromium, lead, mercury, and silver were detected in the surface soil; however, only barium, cadmium, chromium, and lead were detected above reference background criteria. Barium was detected at a concentration of 29.2 mg/kg at MW3. Cadmium was detected at concentrations of 0.76 mg/kg at MW4 and 0.22 mg/kg at MW5. Lead was detected at a concentration of 7.4 mg/kg at MW5. Mercury was detected in five out of eight samples (including from site background locations) at concentrations ranging from 15.6 mg/kg at MW8 to 32.2 mg/kg at MW5. Barium, cadmium, chromium, and lead are SRCs in surface soil based on the Phase II RFI.

5.2 SUBSURFACE SOIL

A total of eight subsurface soil samples were collected during the Phase II RFI (Figure 10). These samples were selected for analysis based on field headspace screening for VOCs. Analytical results for the Phase II RFI are summarized in Table 8 and Figure 10. Chain-of-custody forms and complete analytical results are presented in Appendix G (page G-175) and Appendix H (page H.22-1), respectively, of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

VOCs. 2-Butanone, acetone, ethylbenzene, and total xylenes were detected at MW5 at concentrations of 0.008 mg/kg, 0.038 mg/kg, 0.0094 mg/kg, and 0.107 m/kg, respectively. 2-Butanone was also detected at concentrations of 0.0033 mg/kg at MW6 and 0.0022 mg/kg at MW1 (site-specific background location). 2-Butanone, acetone, ethylbenzene, and total xylenes are SRCs in subsurface soil.

SVOCs. Eleven SVOCs were detected in subsurface soil, primarily at one location, MW7. 2-Methylnaphthalene and naphthalene were detected at MW5 at concentrations of 0.102 mg/kg and 0.0627 mg/kg, respectively. Bis(2-ethylhexyl)phthalate was detected at a concentration of 15.4 mg/kg at MW8. The remaining SVOCs were detected at only MW7. These included acenaphthylene (0.529 mg/kg), benzo(*a*)anthracene (2.31 mg/kg), benzo(*a*)pyrene (3.06 mg/kg), benzo(*b*)fluoranthene (2.91 mg/kg), benzo(*k*)fluoranthene (2.79 mg/kg), chrysene (3.12 mg/kg), fluoranthene (1.93 mg/kg), and pyrene (3.9 mg/kg). 2-Methylnaphthalene, acenaphthylene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, naphthalene, and pyrene are considered to be SRCs in subsurface soil based on the Phase II RFI.

RCRA Metals. All eight RCRA metals were detected in subsurface soil; however, only cadmium, lead, and mercury were detected above reference background criteria. Cadmium and lead were detected at MW7 at concentrations of 0.35 mg/kg and 18.4 mg/kg, respectively. Mercury was detected at concentrations of 0.12 mg/kg at MW2 (site-specific background), 0.18 mg/kg at MW3, and 0.08 mg/kg at MW4. Cadmium, lead, and mercury are considered to be SRCs in subsurface soil based on the Phase II RFI.

5.3 GROUNDWATER

With the use of DPT techniques, groundwater screening samples were collected from seven locations, including one vertical-profile sample. Groundwater screening samples were analyzed for only VOCs. The results of the groundwater screening were used to locate eight monitoring wells (four shallow and four deep). Groundwater samples from monitoring wells were analyzed for VOCs, SVOCs, and RCRA metals. The results of the groundwater analyses are presented in Tables 9 and 10 and Figure 11. Chain-of-custody forms and complete analytical results are presented in Appendix G (page G-175) and Appendix H (page H.22-1), respectively, of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

5.3.1 Shallow Surficial Groundwater

The shallow surficial groundwater was evaluated using the results of the groundwater screening samples (GP5 through GP11), shallow vertical-profile sample [VP1 (12 feet to 16 feet bgs)], and shallow monitoring wells (MW1, MW3, MW4, and MW6).

VOCs. Four VOCs (1,1-dichloroethane; 1,1-dichloroethene; ethylbenzene; and total xylenes) were detected in the shallow surficial groundwater. Ethylbenzene was detected at four out of 12 groundwater samples at concentrations ranging from 2.1 µg/L at GP9 to 5.8 µg/L at GP8. Total xylenes were detected at five out of 12 shallow surficial groundwater samples at concentrations ranging from 7 µg/L at GP10 to 56.9 µg/L at GP8. 1,1-Dichloroethane and 1,1-dichloroethene were detected at MW3 at concentrations of 9.6 µg/L and 8.6 µg/L, respectively. 1,1-Dichloroethane; 1,1-dichloroethene; ethylbenzene; and total xylenes are considered to be SRCs in shallow surficial groundwater based on the Phase II RFI.

SVOCs. Benzoic acid and naphthalene were detected at MW4 at concentrations of 15 µg/L and 3.4 µg/L, respectively. Benzoic acid and naphthalene are SRCs in shallow surficial groundwater based on the Phase II RFI.

RCRA Metals. Chromium was detected above the reference background criterion at MW4 at a concentration of 6.2 µg/L. Filtered metals were also collected on groundwater from MW4, the only shallow surficial groundwater sample with a metal (chromium) indicated above the reference background criterion. The filtered concentration of chromium was nondetect, indicating that the elevated concentration was probably the result of particulates or colloids in the water. The turbidity of the groundwater at MW4 at the time of sampling was slightly elevated [59.3 NTUs (see Table 6)], indicating the presence of particulates or colloids in the water. Chromium is an SRC in shallow surficial groundwater based on the Phase II RFI.

5.3.2 Deep Surficial Groundwater

The deep surficial groundwater was evaluated using the results of the deep monitoring wells (MW2, MW5, MW7, and MW9).

VOCs. Two VOCs were detected in the deep surficial groundwater. 1,1-Dichloroethane and 1,1-dichloroethene were detected in MW8 at concentrations of 3.4 μg/L and 2.7 μg/L, respectively. No VOCs were detected in the deep surficial groundwater upgradient (MW2) or within the area of soil contamination (MW5 and MW7). MW8 is located on the western side of the drainage ditch. The presence of VOCs in MW8 and no detections upgradient indicate a possible source other than the contamination around the OWS. 1,1-Dichloroethane and 1,1-dichloroethene are considered to be SRCs in the deep surficial groundwater.

SVOCs. No SVOCs were detected in the deep surficial groundwater.

RCRA Metals. Three RCRA metals—barium, chromium, and lead—were detected above reference background criteria in the downgradient deep surficial groundwater. Barium was detected at a concentration of 155 μg/L in MW8. Chromium and lead were detected in MW5 at concentrations of 31 μg/L and 9.6 μg/L, respectively. Arsenic, barium, chromium, lead, and selenium were detected in the deep site-specific background location (MW2) at concentrations of 15.8 μg/L, 170 μg/L, 48.1 μg/L, 27.7 μg/L, and 5.7 μg/L, respectively. All of the locations that indicated elevated metals constituents also had elevated turbidities (see Table 6) at the time of sampling. MW2, MW5, and MW8 had turbidities of 830 NTUs, 257 NTUs, and 95.7 NTUs, respectively. The high turbidities are indicative of particulates or colloids in the groundwater that probably are the source of the elevated metal concentrations. Dissolved metals analyses were also preformed on groundwater from MW2, MW5, and MW8, and the results are presented in Table 10. Except for those of barium, all the filtered metals concentrations at these locations were either nondetect or below the reference background criteria. The filtered concentration of barium was slightly below the total barium concentration; however, barium was still detected in filtered samples above the reference background criterion. Barium, chromium, and lead are considered to be SRCs in the deep surficial groundwater based on the Phase II RFI.

5.4 SURFACE WATER

Three surface water samples (one upstream and two downstream of the OWS) were collected within the man-made ditch located approximately 50 feet southwest of the OWS. SWS1 was located upstream of the OWS and Building 1071. SWS2 and SWS3 were located adjacent to and downstream of the OWS, respectively. Because the surface water in the drainage ditch receives significant contributions from other sources and was stagnant, SWS1 was not considered to be a quality background location; therefore, the site reference background criteria for surface water (SWS1) were taken from the results of the Phase II RFI for the 724th Tanker Purging Station (SWMU 26) (SAIC 1998). Although the background surface water sample (SWS1) from SWMU 26 is upgradient of the garrison area in Mill Creek, it is an appropriate background sample for the surface water in the drainage ditch for the following reasons: (1) the regional proximity of Mill Creek to the drainage ditch and (2) the fact that the drainage ditch and creeks in this area (i.e., Mill, Taylors, and Horse) are chemically similar due to climate, vegetation, underlying geology, etc. The surface water samples were analyzed for VOCs, SVOCs, and RCRA Metals. The results of the surface water analyses are presented in

Table 11 and Figure 12. Chain-of-custody forms and complete analytical results are presented in Appendix G (page G-175) and Appendix H (page H.22-1), respectively, of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

VOCs. 1,1-Dichloroethane was detected at concentrations of 2.1 µg/L at SWS1 (site-specific background location) and 2.3 µg/L in SWS3. 1,1-Dichloroethane is an SRC in surface water based on the Phase II RFI.

SVOCs. Pyrene was detected at a concentration of 2.1 µg/L at SWS2. Pyrene is an SRC in surface water based on the Phase II RFI.

RCRA Metals. Arsenic, barium, cadmium, chromium, and lead were detected above reference background criteria (taken from SWS1 at SWMU 26) in the surface water. Of these, barium, cadmium, chromium, and lead were also detected in the site-specific background location, indicating a potential source of RCRA metals other than the OWS. Arsenic and barium were detected in SWS2 at concentrations of 4.5 µg/L and 49.2 µg/L, respectively. Cadmium was detected at concentrations of 0.91 µg/L, 3.8 µg/L, and 1.1 µg/L in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Chromium was detected at concentrations of 2.8 µg/L, 6 µg/L, and 1.9 µg/L in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Lead was detected at concentrations of 9.3 µg/L, 27.5 µg/L, and 6.6 µg/L in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Arsenic, barium, cadmium, chromium, and lead are considered to be SRCs in surface water.

5.5 SEDIMENT

Three sediment samples (one upstream and two downstream of the OWS) were collected within the man-made ditch located approximately 50 feet southwest of the OWS. Because the surface water in the drainage ditch received significant contributions from other sources and was stagnant, SWS1 was not considered to be a quality background location; therefore, the site reference background criteria for sediment (SWS1) were taken from the Phase II RFI results for the 724th Tanker Purging Station (SWMU 26) (SAIC 1998). Although the background sediment sample (SWS1) from SWMU 26 was collected upgradient of the garrison area in Mill Creek, it is an appropriate background sample for the sediment in the drainage ditch for the following reasons: (1) the regional proximity of Mill Creek to the drainage ditch and (2) the fact that the drainage ditch and creeks in this area (i.e., Mill, Taylors, and Horse) are chemically similar due to climate, vegetation, underlying geology, etc. The sediment samples were analyzed for VOCs, SVOCs, and RCRA Metals. The results of the sediment analyses are presented in Table 12 and Figure 12. Chain-of-custody forms and complete analytical results are presented in Appendix G (page G-175) and Appendix H (page H.22-1), respectively, of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

VOCs. 2-Butanone and acetone were detected at concentrations of 0.0209 mg/kg and 0.307 mg/kg, respectively, at SWS3. 2-Butanone and acetone are SRCs in sediment based on the Phase II RFI.

SVOCs. Fluoranthene was detected at concentrations of 0.0544 mg/kg, 0.0422 mg/kg, and 0.265 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Phenanthrene was detected at a concentration of 0.109 mg/kg at SWS3. Pyrene was detected at concentrations of 0.0878 mg/kg, 0.0762 mg/kg, and 0.408 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Fluoranthene, phenanthrene, and pyrene are SRCs in sediment based on the Phase II RFI.

RCRA Metals. Barium, cadmium, chromium, lead, mercury, silver, and selenium were detected above reference background criteria (taken from SWS1 at SWMU 26) in sediment. Of these only barium was not detected in the site-specific background location, indicating a potential source of RCRA metal constituents to the sediment other than the OWS. Barium was detected in SWS2 and SWS3 at concentrations of 8 mg/kg and 3.6 mg/kg, respectively. Cadmium was detected at concentrations of 0.14 mg/kg, 1 mg/kg, and 0.26 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Chromium was detected at concentrations of 11 mg/kg, 7.1 mg/kg, and 3.6 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Lead was detected at concentrations of 8.3 mg/kg, 14.9 mg/kg, and 14 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Mercury and selenium were detected in SWS1 at concentrations of 0.15 mg/kg and 0.46 mg/kg, respectively. Silver was detected at concentrations of 0.3 mg/kg, 0.34 mg/kg, and 0.3 mg/kg in SWS1 (site-specific background location), SWS2, and SWS3, respectively. Barium, cadmium, chromium, lead, mercury, silver, and selenium are considered to be SRCs in sediment based on the Phase II RFI.

5.6 SITE-RELATED CONTAMINANT SUMMARY

Soil samples collected during the Phase I and Phase II RFIs were used to determine the SRCs in surface and subsurface soil. SRCs for groundwater were determined using only the most current groundwater characterization data (collected from DPT and monitoring well locations during the Phase II RFI). The results for the shallow and deep surficial groundwater were combined to determine SRCs. The SRCs by medium and the corresponding maximum concentrations are presented in Table 13.

6.0 FATE AND TRANSPORT CONSIDERATIONS

The potential for soil contaminants to migrate (i.e., their leachability) to groundwater was evaluated by comparing the maximum concentrations of soil and sediment SRCs to their respective generic soil screening levels (GSSLs).

Of the organic SRCs identified in surface and subsurface soil, benzo(*a*)anthracene, benzo(*b*)fluoranthene, and dibenzo(*a,h*)anthracene exceeded their respective GSSLs (Table 14) and are considered to be CMCOPCs in soil at SWMU 27H, Building 1071.

Of the metal SRCs identified in surface and subsurface soil, cadmium, chromium, and mercury exceeded their respective GSSLs (Table 14) and are considered to be CMCOPCs in soil at SWMU 27H, Building 1071.

Of the SRCs identified in sediment, none of the analytes exceeded their respective GSSLs (Table 15); therefore, there are no CMCOPCs in sediment at SWMU 27H, Building 1071.

None of the organic CMCOPCs in soil were detected in groundwater. Cadmium and mercury were not detected in the groundwater. Chromium was detected above the reference background criterion; however, chromium was not detected above its MCL.

7.0 HUMAN HEALTH PRELIMINARY RISK EVALUATION, SWMU 27H, BUILDING 1071

SRCs were identified for surface soil, subsurface soil, groundwater, surface water, and sediment. Evaluation of the potential risks resulting from exposure to these constituents and the identification of HHCOPCs are addressed in this section.

7.1 EXPOSURE EVALUATION

The exposure evaluation addresses what human receptor populations, both on-site and off-site, might be exposed to contaminants present at the site. The exposure evaluation also addresses how contaminants might migrate and the potential exposure pathways for the various receptors. This is a preliminary evaluation that is used to evaluate and select the appropriate screening values used in the HHPRE.

7.2 RECEPTOR ASSESSMENT

This is an active, secured site within the garrison area. On-site soil contamination at this site is present in both surface soil and subsurface soil. The site is covered by concrete; therefore, current receptors are not likely to be exposed to COPCs in surface soil. SRCs in subsurface soil are effectively isolated from most on-site receptors; therefore, only a construction worker or other individuals working within an excavation are likely to be exposed to subsurface soil contaminants. Groundwater at the site is not currently used for any purpose; however, it may discharge to a nearby ditch, and, therefore, a juvenile trespasser may come in contact with groundwater contaminants present in the surface water within the ditch. The ditch drains to Mill Creek, which is used for recreational purposes. A sportsman fishing in Mill Creek may be exposed to SRCs that have migrated from the drainage ditch.

Land use at this site is not likely to change; therefore, future receptor populations are likely to be the same as the current ones.

7.3 MIGRATION AND EXPOSURE PATHWAY ANALYSIS

The site is relatively flat and is comprised entirely of concrete surfaces and man-made structures. No natural habitat is present within or adjacent to the SWMU's boundaries. The potential migration pathway for soil is leaching into groundwater. Surface soil and subsurface soil at the site are currently covered with concrete, effectively eliminating migration via wind erosion or surface water runoff.

There is a deep drainage ditch located approximately 50 feet southwest of the OWS. The shallow surficial groundwater, which is located approximately 8 feet bgs, may intercept this drainage ditch. The lower portion of the aquifer (i.e., deep surficial groundwater at greater than 33 feet bgs) may migrate to a tributary to Mill Creek approximately 1,500 feet to the south; therefore, migration via discharge of groundwater to surface water is a viable migration pathway.

The on-site resident scenario is not considered to be a viable scenario for this site; however, in accordance with Risk-based Corrective Action (RBCA) guidance, it is used to derive screening values. The exposure pathways associated with this scenario are presented to show what pathways would be associated with an on-site resident exposure scenario.

7.4 RISK EVALUATION

The results of the human health risk screening are given below.

The SRCs for surface soil included six volatile organics (2-butanone, acetone, carbon disulfide, ethylbenzene, styrene, and total xylenes), 17 SVOCs, and four RCRA metals (barium, cadmium, chromium, and lead). Benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3*-

cd)pyrene exceeded their respective screening values and are considered to be HHCOPCs in surface soil (Table 16).

The maximum concentrations of all of the constituents were within an order of magnitude of their respective residential screening values [benzo(*a*)anthracene (2.87 mg/kg vs. 0.875 mg/kg), benzo(*a*)pyrene (4.06 mg/kg vs. 0.0875 mg/kg), benzo(*b*)fluoranthene (3.64 mg/kg vs. 0.875 mg/kg), dibenzo(*a,h*)anthracene (2.77 mg/kg vs. 0.0875 mg/kg), and indeno(*1,2,3-cd*)pyrene (2.46 mg/kg vs. 0.875 mg/kg)].

The SRCs for subsurface soil included four volatile organics (2-butanone, acetone, ethylbenzene, and total xylenes), 14 SVOCs, and three RCRA metals (cadmium, lead, and mercury). Only benzo(*a*)pyrene exceeded its screening value and is considered to be an HHCOPC in subsurface soil (Table 16). The maximum concentration of benzo(*a*)pyrene (5.04 mg/kg) was within an order of magnitude of its industrial screening value (0.784 mg/kg).

The SRCs for groundwater consisted of a four volatile organics (1,1-dichloroethane; 1,1-dichloroethene; ethylbenzene; and total xylenes), two SVOCs (benzoic acid and naphthalene), and three RCRA metals (barium, chromium, and lead). 1,1-Dichloroethene; naphthalene; and chromium exceeded their respective screening values and are considered to be HHCOPCs in groundwater (Table 16).

The maximum concentration of naphthalene was within an order of magnitude of its screening value (3.4 μg/L vs. 0.6511 μg/L). The maximum concentration of 1,1-dichloroethene (8.6 μg/L) was two orders of magnitude above its industrial screening value (0.0436 μg/L). The maximum concentration of chromium was within the same order of magnitude as its screening value (31 μg/L vs. 10.95 μg/L).

1,1-Dichloroethane, pyrene, and five RCRA metals are SRCs in surface water. Of these, cadmium and lead exceeded their respective screening values and are considered to be HHCOPCs in surface water (Table 16).

The maximum concentrations of cadmium and lead were the same order of magnitude as their screening values (3.8 μg/L vs. 1.825 μg/L and 27.5 μg/L vs. 15 μg/L, respectively).

None of the maximum concentrations of SRCs in sediment exceeded their respective screening values (Table 16); therefore, there are no HHCOPCs in sediment.

7.5 UNCERTAINTIES

Surrogate values were used to screen acenaphthylene and phenanthrene in subsurface soil and phenanthrene in groundwater. Acenaphthylene was identified as an HHCOPC in subsurface soil. The actual toxicity of acenaphthylene may be lower than that of the surrogate chemical used, and this chemical may not present a potential threat to human health. In comparison, phenanthrene was eliminated as an HHCOPC in subsurface soils; however, if the toxicity of this compound is higher than that of the surrogate, this chemical may have been prematurely eliminated from the risk assessment process. Other human health uncertainties are addressed in Section 7.5 of the HHPRE (Chapter 7.0) of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

8.0 ECOLOGICAL PRELIMINARY RISK EVALUATION, SWMU 27H, BUILDING 1071

The EPRE was conducted in accordance with GEPD (1996) guidance [see Chapter 8.0 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)]. At sites where surface water, sediment, or groundwater was collected, an ecological screening value (ESV) comparison was conducted. If ECOPCs for aquatic biota were identified in surface water, sediment, or groundwater based on the ESV comparison (Step i), then further evaluation was required for those media. If no ECOPCs were identified based on the Step i screening of those media, then those ECOPCs were not considered further. At sites where surface soil was collected, substances detected in surface soil were evaluated in EPRE Steps ii through v because there are no ESVs for surface soil. The results of the five steps of the EPRE are presented below.

8.1 ECOLOGICAL SCREENING VALUE COMPARISON (STEP i)

Five RCRA metals—arsenic, barium, cadmium, chromium, and lead—were detected in surface water at concentrations exceeding the reference background criteria. One VOC and one SVOC were detected in surface water. The results of the ESV comparison are presented in Table 17. The ECOPCs identified by the ESV comparison for surface water were pyrene, barium, cadmium, and lead. There is no ESV for pyrene, so pyrene is an ECOPC by default (GEPD 1997). Barium, cadmium and lead were detected at concentrations exceeding ESVs.

Seven RCRA metals—barium, cadmium, chromium, lead, mercury, selenium, and silver—were detected in sediment at concentrations exceeding the reference background criteria. Two VOCs and three SVOCs were detected in sediment. Results of the ESV comparison are presented in Table 18. The ECOPCs identified by the ESV comparison for sediment were acetone, pyrene, barium, mercury and selenium. There are no ESVs for barium and selenium, so they are ECOPCs by default (GEPD 1997). Acetone, pyrene, and mercury were detected at concentrations exceeding the ESVs.

Three RCRA metals (barium, chromium, and lead) were detected in groundwater at concentrations exceeding reference background criteria. Four VOCs and two SVOCs were detected in groundwater. The results of the ESV comparison for groundwater are presented in Table 19. The ECOPCs identified by the ESV comparison for groundwater consisted of total xylenes, barium, and lead. Total xylenes, barium, and lead were detected at concentrations exceeding ESVs.

The entire site is covered with concrete, and no vegetation or exposed surface soil is present in the immediate area of the SWMU; therefore, there is no pathway to ecological receptors from surface soil. Surface soil was not evaluated in the EPRE.

8.2 PRELIMINARY PROBLEM FORMULATION (STEP ii)

The ecological habitat is described in Section 4.5 of this addendum. The preliminary assessment endpoints, ecological receptors, and surrogate species representative of those receptors selected for evaluation in the preliminary risk calculation are described in Section 8.2 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

8.3 PRELIMINARY EFFECTS (STEP iii)

In the EPRE, toxicity reference values (TRVs) were required for green herons ingesting biota exposed to sediment and for raccoons, mink, and green herons ingesting surface water or aquatic biota. The derivation of no observed adverse effect levels (NOAELs) for test species is shown in Table 20 for mammals and Table 21 for birds. The derivation of TRVs for surrogate species from the test species NOAELs is shown in Table 22 for raccoons, shrews, and mink and in Table 23 for the robins and green herons.

For the uncertainty discussion, the derivation of lowest observed adverse effect levels (LOAELs) for test species is shown in Table 24 for mammals and Table 25 for birds. The derivation of TRVs for surrogate species from the test species LOAELs is shown in Table 26 for shrews, raccoons, and mink and in Table 27 for robins and green herons.

8.4 PRELIMINARY EXPOSURE (STEP iv)

SWMU 27H, Building 1071 has been classified as an "industrialized area," and the terrestrial part of the SWMU is not capable of supporting an ecological habitat because the site is covered with concrete. However, ecological receptors are potentially exposed to ECOPCs in surface water and sediment in the drainage ditch by ingestion of water and biota and in groundwater by ingestion of aquatic biota or drinking water, if groundwater discharges to nearby surface water. The exposure parameters for the surrogate species—raccoons, mink, and green herons—are presented in Table 8-7 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

8.5 PRELIMINARY RISK CALCULATION (STEP v)

The preliminary risk calculation (Step v) uses hazard quotients (HQs), the ratios of the measured maximum concentrations and the TRVs, to evaluate the potential for risk. The HQs of ECOPCs with consistent modes of toxicity and effects endpoints are added to calculate a hazard index (HI). Metals are assumed to have distinct modes of toxicity and effects endpoints; therefore, HIs are calculated for only VOCs and SVOCs when no individual ECOPC has an HQ greater than one and HQs are calculated for more than one chemical. ECOPCs with HQs and HIs less than one indicate little to no likelihood of risk to the ecological receptors. An ERA using site-specific data is indicated for those ECOPCs with calculated HQs or HIs exceeding one (GEPD 1996).

Surface Water. The preliminary risk calculations for raccoons, mink, and green herons potentially exposed to ECOPCs detected in surface water are presented in Table 28. This table shows the maximum detected concentrations, average daily doses (ADDs), TRVs, and HQs for the receptors. HQs exceeding one are shown bordered by a double line. The ECOPCs present in surface water at concentrations resulting in ADDs exceeding the TRVs for the surrogate species are pyrene and lead. The pyrene HQ is 4.22 for the mink, and the lead HQ for the robin is 1.4.

Sediment. The preliminary risk calculations for green herons potentially exposed to ECOPCs detected in drainage ditch sediment are presented in Table 29. This table shows the maximum detected concentrations, ADDs, TRVs, and HQs for this receptor. There are no ECOPCs present in drainage ditch sediment at concentrations resulting in ADDs exceeding the TRVs for the surrogate species. There is no green heron TRV for acetone, so acetone is evaluated further in the discussion of uncertainties (Section 8.6) using the raccoon, which has an acetone TRV.

Groundwater. The preliminary risk calculations for raccoons, mink, and green herons potentially exposed to ECOPCs detected in groundwater are presented in Table 30. This table shows the maximum detected concentrations, ADDs, TRVs, and HQs for the receptors. There are no ECOPCs present in groundwater at concentrations resulting in ADDs exceeding the TRVs for the surrogate species.

8.6 UNCERTAINTIES

The risks to ecological receptors from ECOPCs in drainage ditch sediment and groundwater at SWMU 27H, Building 1071 are overestimated by the preliminary risk calculations. The risks to terrestrial wildlife receptors from ECOPCs in surface water are also overestimated.

The supplemental risk calculations for mink and green herons exposed to pyrene and lead, respectively, in surface water are presented in Tables 31 and 32, respectively. The ADDs calculated using a realistic diet (EPA 1993), the site-specific area use factor (AUF), and mean surface water concentrations of ECOPCs do not exceed LOAEL–based TRVs (see Tables 26 and 27) (i.e., HQs are less than one). Therefore, ECOPCs in surface water at SWMU 27H, Building 1071 do not pose a risk to wildlife receptors.

The supplemental risk calculations for raccoons exposed to acetone in sediment are presented in Table 33. The ADDs calculated using a realistic diet (EPA 1993), the site-specific AUF, and mean sediment concentrations of ECOPCs do not exceed LOAEL–based TRVs (see Table 26) (i.e., HQs are less than one). Therefore, ECOPCs in sediment at SWMU 27H, Building 1071 do not pose a risk to wildlife receptors.

The maximum concentrations of barium and lead occurred in the deep surficial groundwater (40 feet to 50 feet bgs). The closest potential surface water body that may intercept the deep surficial groundwater is approximately 1,500 feet to the southwest. Fate and transport analysis was used to estimate the concentrations of barium and lead that might migrate to this surface water body. The fate and transport analysis is presented in Attachment A of this addendum. Using the maximum detected concentrations of barium and lead in groundwater at SWMU 27H, Building 1071, the model estimated the concentrations of barium and lead to both be zero (0 µg/L) in surface water at the tributary to Mill Creek (see Table A-5 in Attachment A). Therefore, the ECOPCs in deep surficial groundwater at SWMU 27H, Building 1071 do not pose a risk to aquatic biota.

9.0 HUMAN HEALTH BASELINE RISK ASSESSMENT, SWMU 27H, BUILDING 1071

The purpose of the HHBRA is to quantify the potential risks associated with the COPCs identified in the previous screening assessments (i.e., fate and transport analysis and human health preliminary risk assessment). If the estimated risk value for a receptor exceeds the target risk values, constituents of concern (COCs) will be selected based on the risk value for that constituent. Remedial levels will be derived for each of the COCs identified.

The HHPRE identified HHCOPCs in surface soil, subsurface soil, groundwater, and surface water that may present a potential risk to human health. The fate and transport analysis identified CMCOPCs that may leach into groundwater at concentrations that could present a significant risk to human health as a result of using groundwater as a source of residential drinking water. Based on GEPD (1996) and EPA Region IV (EPA 1995) guidance, an HHBRA is required for those constituents identified as COPCs, which include both HHCOPCs and CMCOPCs.

The HHBRA given below quantifies the potential risk associated with constituents identified in the fate and transport analysis and the HHPRE as presenting a potential risk to human health. The potential risk for site-specific human receptor populations is quantified for those potential exposure pathways identified for each receptor population.

The HHBRA consists of five elements: (1) identification of COPCs, (2) exposure assessment, (3) toxicity assessment, (4) risk characterization, and (5) assessment of uncertainty. The discussion in the following sections presents the information required to evaluate the human health risks associated with COPCs at SWMU 27H, Building 1071. A detailed discussion of each of the five elements, including methodology, selection of exposure parameters, and analysis of inherent uncertainties, is provided in Appendix I of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

9.1 IDENTIFICATION OF COPCS

The CMCOPCs and HHCOPCs have been discussed in the sections on contaminant fate and transport (Chapter 6.0) and the HHPRE (Chapter 7.0), respectively. The following constituents were identified as CMCOPCs in soil: benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, cadmium, chromium, and mercury. The potential for these CMCOPCs to leach to groundwater was analyzed using leachate modeling. The results of the leachate modeling show that cadmium and chromium are likely to migrate to groundwater in concentrations that present a significant risk to human health (see Section 9.2.3); therefore, the potential risks associated with cadmium and chromium in soil leaching to groundwater were quantified. The remaining CMCOPCs [benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and mercury] are not considered to be CMCOPCs based on the results of the leachate modeling and were not evaluated further. The HHCOPCs and CMCOPCs are identified in Tables 34 and 35, respectively.

HHCOPCs were identified in surface soil, subsurface soil, groundwater, and surface water (see Section 7.4). HHCOPCs in soil included benzo(*a*)pyrene in both surface soil and subsurface soil and the following polycyclic aromatic hydrocarbons (PAHs) in surface soil: benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene. The HHCOPCs in groundwater included naphthalene; 1,1-dichloroethene; and chromium. Cadmium and lead were identified as HHCOPCs in surface water.

9.2 EXPOSURE ASSESSMENT

The exposure assessment quantifies the amount of a COPC an individual may come in contact with at each site. The exposure assessment considers all pathways of potential human exposure, the magnitude of exposure, and the frequency and duration of exposure. The process for estimating exposure consists of the following elements: (1) characterization of the exposure setting in terms of the physical and demographic characteristics of the site, (2) identification of receptor populations, (3) identification of the exposure pathways by which an individual may come in contact with a COPC, (4) estimation of the exposure point concentration, and (5) quantification of the intake or dose to which an individual may be exposed.

9.2.1 Exposure Setting

The exposure setting describes the physical features at the site that are important when identifying the human populations that may be exposed to COPCs, either currently or in the future.

The OWS is one of two OWSs that support vehicle maintenance at the DOL maintenance facilities located within the garrison area. The OWS is located adjacent to an open maintenance pad and is surrounded by an open area covered by concrete and asphalt. There is a drainage ditch approximately 50 feet southwest of the OWS and a boundary fence located approximately 40 feet from the OWS. The effluent from the OWS discharges directly to the IWTP. The drainage ditch receives runoff from a vehicle parking area and an outside storage area northeast of the OWS, from the asphalt road that borders the western side of the drainage ditch, and from other upstream industrial sources. During periods of heavy rainfall events, the surface water may potentially make it to Mill Creek.

Groundwater at this site migrates toward the west, in the direction of the drainage ditch located adjacent to the site. This drainage ditch is deep and is likely to receive groundwater discharge from the shallower portions of the aquifer. Constituents within the deeper portions of the surficial aquifer may migrate to Mill Creek. The results of the groundwater migration modeling for the deep portion of the surficial aquifer indicate that the COPCs present in the deeper groundwater will not migrate to Mill Creek (see Section 9.2.3). Migration of COPCs in the deeper portions of the surficial aquifer to surface water is not considered to be a viable migration pathway for this site. COPCs within the upper portions of the aquifer may migrate to the drainage ditch, and the risks associated with this migration pathway are addressed in this HHBRA.

9.2.2 Identification of Potential Receptor Populations and Exposure Pathways

A complete exposure pathway consists of four elements: (1) a source of contamination, (2) a transport or retention medium, (3) a point of contact with the chemical, and (4) a route of exposure (ingestion, dermal absorption, or inhalation) at the point of contact through which the chemical may be taken into the body. When all of these elements are present, the pathway is considered to be complete.

A detailed discussion of the potential exposure pathways for the various receptor populations identified for 16 SWMUs is given in Section I.2.2, Appendix I of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). The migration and exposure pathways for potential receptors at SWMU 27H, Building 1071 are presented in Figure 13.

Impacted environmental media at this site include surface soil, subsurface soil, groundwater, and surface water. Surface water present at the site exists outside the boundaries of the SWMU.

Current Land-use Populations. The on-site impacted environmental media include surface soil, subsurface soil, and groundwater. The surface soil and subsurface soil at the site is currently covered with concrete and asphalt. Groundwater is not currently used for any purpose. Given that COPCs present in surface soil, subsurface soil, and groundwater are effectively isolated, there are no current on-site receptor populations for COPCs in these media.

Current off-site receptors may be exposed to COPCs in surface water in the adjacent drainage ditch. A juvenile may play in the drainage ditch adjacent to the site; however, given that the drainage ditch provides minimal recreational appeal, this scenario is very unlikely. Installation personnel and other adults are not likely to receive chronic or repeated exposures to the surface water in the drainage ditch because there are no viable reasons for an adult to repeatedly go down into the ditch. Exposure is likely to be limited to a one-time event. For the purposes of this document, the juvenile playing in the drainage ditch will be referred to as a juvenile wader.

The drainage ditch does not support aquatic life sufficient to allow sport fishing; therefore, the type of receptor likely to be present would be limited to a juvenile trespasser playing in the ditch. Surface water in the drainage ditch discharges into Mill Creek during major rain events. A sportsman fishing in Mill Creek may be exposed to surface water COPCs. Potential exposure pathways include dermal contact, incidental ingestion of surface water, and ingestion of COPCs that have bioaccumulated in fish.

Future Land-use Receptor Populations. The potential receptor populations for the future land-use scenario include an on-site Installation worker, an on-site juvenile trespasser, an on-site construction worker, an off-site juvenile wader, and both an on-site and an off-site resident. Although no changes in land use are expected at this site, for the purposes of this risk assessment, it was assumed that groundwater drinking wells had been placed at the site and the concrete and asphalt covering the area had been removed, exposing the surface soil.

The on-site Installation worker may be exposed to COPCs in surface soil and groundwater. The potential exposure pathways for surface soil include ingestion, dermal contact, and inhalation of fugitive dust. The exposure pathway for groundwater would be ingestion of drinking water.

The on-site construction worker is used to evaluate the potential risks for an individual who comes into contact with subsurface soil as a result of working within an excavation. The only subsurface soil HHCOPC is benzo(*a*)pyrene, a semivolatile PAH. Given that this constituent is not a volatile compound, exposure via inhalation of vapors is not considered to be a viable exposure pathway; therefore, the exposure of the construction worker would be limited to incidental ingestion and dermal contact.

The on-site trespasser may be exposed to COPCs in surface soil and surface water. Exposure to COPCs in groundwater may occur when the constituents in groundwater migrate to surface water. The exposure pathways for surface soil include incidental ingestion, dermal contact, and inhalation of fugitive dust. Exposure pathways for COPCs within the drainage ditch include dermal contact with surface water and incidental ingestion of surface water.

The on-site resident is presented for baseline purposes and is not considered to be a viable receptor population. The on-site resident may be exposed to COPCs in surface soil and groundwater. Potential exposure pathways for the on-site resident include incidental ingestion of soil, dermal contact with soil, inhalation of fugitive dust, inhalation of volatile organics in groundwater, ingestion of groundwater, and dermal contact with groundwater. If the site was developed for residential purposes, it would be landscaped and vegetated; therefore, exposure via inhalation of fugitive dust is not a likely exposure pathway. However, as a conservative assumption, this pathway was evaluated.

Off-site migration includes fugitive dust and the migration of COPCs in groundwater. Future off-site receptor populations include an Installation worker, a resident, and a sportsman. A juvenile playing in the drainage ditch may be exposed to COPCs in surface water; this potential exposure scenario has been addressed in the future on-site juvenile trespasser scenario.

The off-site Installation worker may be exposed to COPCs in surface soil via inhalation of fugitive dust. This receptor may also be exposed to COPCs in groundwater via ingestion.

The off-site resident is likely to be exposed via inhalation of fugitive dust and exposure to COPCs in groundwater. Groundwater exposure pathways include ingestion, dermal contact, and inhalation of volatile organics.

The off-site sportsman may be exposed to COPCs in surface water. Exposure to COPCs in surface soil is not likely to occur because this receptor is located at Mill Creek, and exposure via inhalation of fugitive dust is not expected to be significant. Exposure to COPCs in the surface water may occur via incidental ingestion, dermal contact, and ingestion of COPCs that have bioaccumulated in fish.

9.2.3 Estimation of Exposure Concentrations

The estimation of exposure concentrations for on-site and off-site receptors to COPCs in surface soil, subsurface soil, groundwater, surface water, and fish is discussed in Appendix I, Section I.2.3 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). Exposure concentrations in abiotic media were calculated using either analytical results or environmental fate and transport models. For the purposes of estimating direct exposure of current receptor populations to COPCs in surface soil, subsurface soil, groundwater, and surface water, the analytical results for the respective media were used to estimate exposure concentrations. The exposure point concentrations are equal to 95 percent of the upper confidence limit of the mean, unless this value was greater than the maximum detected concentration. In that case, the exposure concentration defaulted to the maximum concentration. The selected exposure concentrations based on the analytical data or the 95 percent upper confidence limits are given in Table 34.

The off-site sportsman fishing in Mill Creek may be exposed to COPCs in surface water that has migrated from the drainage ditch to the creek. The drainage ditch discharges directly into Mill Creek; however, this occurs only after major rain events. In addition, the drainage ditch receives effluent from several other sources before reaching Mill Creek. Modeling of the concentrations of COPCs migrating from the drainage ditch to Mill Creek is difficult because (1) migration is likely to take place only after a major rain event when the concentrations of COPCs will be diluted by the precipitation, (2) the concentrations of COPCs in surface water will be diluted by other effluents before reaching Mill Creek, and (3) the COPC concentrations will be further diluted by Mill Creek. As a conservative measure, it was assumed that the off-site receptor fishes in the drainage ditch adjacent to the site. This is a very conservative assumption, given that fish populations are not found in this section of the drainage ditch, and the actual exposure concentrations for a sportsman fishing in Mill Creek are likely to be orders of magnitude less than the concentrations in the adjacent surface water. The concentrations of COPCs in fish were calculated by multiplying the surface water concentration by the chemical-specific bioaccumulation factor.

Exposure concentrations of fugitive dust in air were calculated using the formulas described in Appendix I, Section I.2.3 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). These values were based on the exposure concentrations for surface soil. For the purposes of estimating exposure of an off-site receptor to fugitive dust, it was assumed that no dilution of the air concentrations occurred and that the exposure concentrations for both on-site and off-site receptors were the same.

Similarly, the estimated concentrations for exposure of off-site receptors to COPCs in groundwater were assumed to be equal to the exposure concentrations for on-site receptors. For the purposes of this HHBRA, it was assumed that the off-site receptor was located at a point adjacent to and downgradient of the site.

Fate and transport modeling was performed for CMCOPCs in soil and for HHCOPCs in groundwater. The main purposes of the modeling were to estimate future groundwater concentrations from leachate beneath SWMU 27H, Building 1071 and to determine if HHCOPCs in groundwater within the lower portions of the surficial aquifer will migrate to Mill Creek, which is approximately 1,500 feet south of the SWMU. The procedures used to estimate groundwater and surface water concentrations are discussed in Chapter 6.0 and Appendix K of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

Migration to Groundwater beneath the Source. The estimated groundwater concentrations resulting from the leaching of benzo(*a*)anthracene, benzo(*a*)fluoranthene, dibenzo(*a,h*)anthracene, cadmium, chromium, and mercury from the soil above the water table were estimated using the Seasonal Soil Compartment (SESOIL) Model and a site-specific dilution factor. A discussion of the modeling parameters and application data used in SESOIL modeling is given in Attachment A.

The results of the SESOIL modeling are provided in Attachment A and are summarized in Table 35. The modeling results indicated that benzo(*a*)anthracene, benzo(*a*)fluoranthene, and dibenzo(*a,h*)anthracene will naturally attenuate before reaching the water table. The modeled concentration of mercury (0.001 mg/L) is below its respective MCL of 0.002 mg/L. The modeled concentrations of cadmium (0.006 mg/L) and chromium (0.180 mg/L) are above their respective MCLs, 0.005 mg/L and 0.1 mg/L (Attachment A, Figures A-1 and A-2). Benzo(*a*)anthracene, benzo(*a*)fluoranthene, dibenzo(*a,h*)anthracene, and mercury are not considered to CMCOPCs and are not addressed further in this HHBRA. The potential risks associated with the leaching of cadmium and chromium to groundwater will be assessed.

Migration of Groundwater to Surface Water. Analysis of the hydrogeologic conditions at this site indicates that COPCs in the upper and lower portions of the surficial aquifer are likely to migrate to different points of exposure. For the purposes of evaluating the risk associated with exposure to COPCs in groundwater, the surficial aquifer has been divided into a shallow and a deep section (see Section 5.3). The groundwater data from the different portions was screened, and HHCOPCs were identified for each section of the aquifer. The potential surface water concentrations and their associated risks were analyzed separately for the shallow and deep groundwater.

The HHCOPCs in the shallow groundwater included 1,1-dichloroethene and naphthalene (Table 36). The maximum concentration of chromium (6.2 µg/L) in the shallow surficial groundwater was below its screening value; therefore, chromium is not an HHCOPC in shallow groundwater. The HHCOPCs 1,1-dichloroethene and naphthalene in the shallow groundwater are likely to migrate to the drainage ditch, located approximately 50 feet from the OWS. For the purposes of this HHBRA, potential surface water concentrations of COPCs in the drainage ditch, under a future land-use scenario, were assumed to be equal to the groundwater concentration. The surface water exposure concentrations for naphthalene and 1,1-dichloroethene in the shallow groundwater are 4.23 µg/L and 3.4 µg/L, respectively (Table 36). The modeled groundwater concentrations of CMCOPCs were also assumed to migrate to surface water. The concentrations of groundwater COPCs in fish tissue were estimated by multiplying the estimated surface water concentration by the constituent-specific bioconcentration factor.

Constituents in the lower portion of the aquifer are likely to migrate beyond the drainage ditch. The closest surface water body that may potentially be a point of deep groundwater discharge is a tributary of Mill Creek located approximately 1,500 feet away from the site. Screening of the analytical data from samples collected from the deeper portions of the aquifer identified 1,1-dichloroethene and chromium as HHCOPCs (Table 37). Naphthalene was not detected in the deep surficial groundwater. The concentrations of groundwater HHCOPCs within the deeper portions of the groundwater aquifer were modeled to estimate potential concentrations of these COPCs in surface water in the tributary to Mill Creek.

The One-dimensional Solute Transport (ODAST) Model and the Analytical Transient 1-, 2-, 3-Dimensional (AT123D) Model were used to estimate the concentrations of chromium and 1,1-dichloroethene, respectively, in groundwater adjacent to the tributary. A discussion of the modeling procedures and parameters used for the ODAST and AT123D modeling are presented in Attachment A of this addendum. The results of the modeling are given in Attachment A and are summarized in Table 37.

The modeling results indicate that neither chromium nor 1,1-dichloroethene in deep surficial groundwater will migrate to the tributary of Mill Creek via the deep groundwater pathway; therefore, the risk associated with these HHCOPCs migrating to surface water is not addressed further in this HHBRA.

9.2.4 Quantification of Exposure

The equations and exposure factors used to estimate exposures to receptor populations are discussed in Appendix I, Section I.2.4 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). The exposure parameter values used to estimate potential exposures are given in Table 38. Potential noncarcinogenic and carcinogenic intakes were estimated, when appropriate, for each receptor population for all applicable pathways.

Surface soil at SWMU 27H, Building 1071 is currently covered by concrete and asphalt, and groundwater is not currently used for any purposes. Given that on-site contaminated media are effectively isolated from current receptors, there are no current on-site receptors. The estimated intakes for the current off-site receptors—an off-site juvenile wader and an off-site sportsman—are given in Tables 39 and 40, respectively.

Exposure to lead, a COPC in surface water, is not assessed based on the applied dose of the constituent, but on the blood lead concentrations. The blood lead concentration is estimated using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (EPA 1994a), which is based on daily exposure to lead in various environmental media. This model can be used to estimate blood levels in children 0 year to 7 years old. However, the receptor populations that are likely to be exposed to lead in surface water are limited to children playing in the surface water and receiving intermittent exposures.

For the purposes assessing the risk associated with exposure to lead in surface water, it was assumed that the juvenile trespasser is a child aged 6 years to 7 years. Given that the model can estimate blood lead concentrations based on only chronic exposures, it was assumed that the receptor is chronically exposed to surface water, ingesting 10 mL of surface water per day. The dietary intakes of lead for the various age groups are given in Table 41.

The sportsman may be exposed to lead in surface water via direct exposure as well as bioaccumulation in fish. For the purposes of this risk assessment, the exposure of children via ingestion of lead in fish was assessed. As previously discussed, the IEUBK model cannot be used to estimate blood-lead levels for intermittent exposure via incidental ingestion of surface water.

Blood-lead levels were estimated for various age groups ranging from 0.5 year to 1 year in age up to 6 years to 7 years in age. The blood-lead level was based on the intake of lead in the diet. For the purposes of this risk assessment, it was assumed that fish was the only source of lead in the diet. The U.S. Environmental Protection Agency's (EPA's) Exposure Factors Handbook (EPA 1997a) provides daily consumption rates of recreational fish for children ages 1 year to 5 years (5.63 g/day) and ages 6 years to 10 years (7.94 g/day). For the purposes of this risk assessment, the consumption rate for children aged 1 year to 5 years was used for all of the age groups between 0.5 year and 5 years of age. The consumption rate for ages 6 years to 10 years was used for the 6-year-old to 7-year-old age group. The dietary intakes of lead for the various age groups are given in Table 42.

Future on-site receptor populations include an Installation worker, a construction worker, a juvenile trespasser, and a resident. The estimated intakes for the on-site Installation worker, the on-site construction worker, and the on-site juvenile trespasser are given in Tables 43, 44, and 45, respectively. For the purposes of this risk assessment, it was assumed that the juvenile trespasser is exposed to COPCs in surface soil and COPCs in groundwater that has discharged into the adjacent surface water.

The resident population is divided into a resident child and a resident adult because the differences in behavior, exposure duration, and physiology between an adult and a child result in their receiving different doses of constituents in various environmental media. The child has a higher incidental soil ingestion rate because of the increased amount of hand-to-mouth behavior in children. This factor, coupled with the child's lower body weight, results in the child's receiving a higher dose of constituents in surface soil relative to the adult. The resident child is more sensitive to noncarcinogens than the resident adult. The increased exposure duration for the adult resident relative to the child resident results in a higher carcinogenic dose to the resident adult relative to the resident child; therefore, the resident adult is more sensitive to carcinogens in groundwater. However, the resident adult is not always more sensitive to exposure to carcinogens because this sensitivity changes with different environmental media. For the purposes of this risk assessment, the systemic and carcinogenic risks were estimated for both the resident child and the resident adult. The estimated intakes for the resident child and the resident adult are given in Tables 46 and 47, respectively.

Future off-site receptors include an Installation worker, a sportsman, a resident child, and a resident adult. The estimated intakes for the off-site Installation worker and the sportsman are given in Tables 48 and 49, respectively. The estimated intakes for the off-site resident child and resident adult are given in Tables 50 and 51, respectively.

9.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to determine the increased likelihood and magnitude of adverse human health effects based on the extent of exposure to contamination. The toxicity assessment for SWMU 27H, Building 1071 was carried out as described in Appendix I, Section I.3 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). Toxicity values for the COPCs addressed in this risk assessment are given in Table 52. Toxicity profiles for the COPCs are given in Attachment B of this addendum.

1,2-Dichloroethene exists as either a *cis* or *trans* isomer. However, the chemical analysis performed provided only a total concentration of both isomers. EPA's Health Effects Assessment Summary Tables (EPA 1997b) provide toxicity values based on toxicological studies done with mixtures of the two isomers. These toxicity values were used in this assessment.

Cadmium has two reference doses (RfDs), one for exposure via food and one for exposure via water. These two values reflect the differences in the absorption efficiencies of cadmium from the two different media. The RfD for water was used to quantify the risks associated with exposure to cadmium in groundwater.

Chromium may exist in two valence states, trivalent and hexavalent chromium. For the purposes of this risk assessment, it was assumed that all chromium was the more toxic hexavalent chromium.

No suitable dose-response values exist for assessing the risks associated with exposure to lead in groundwater via any of the three identified exposure pathways. EPA has developed the IEUBK model, which is used to estimate blood levels in children 0 year to 7 years old following exposure to lead in surface water. EPA has identified a blood level of 10 µg/dL as a concentration of concern that should be avoided (EPA 1994a). If the blood-lead levels for children are less than 10 µg/dL, it can be inferred that there is no substantial risk for older receptors.

9.4 RISK CHARACTERIZATION RESULTS

The risk characterization followed the procedures outlined in Appendix I, Section I.4 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). Quantitative estimates of noncarcinogenic and carcinogenic risks were calculated for the COPCs for each potentially complete exposure pathway.

The total HI and incremental lifetime cancer risk (ILCR) were calculated for each receptor, and these values were compared to a target risk value of 1.0 for the HI and 1×10^{-6} for the ILCR. If the risk values for a receptor exceeded these target risk values, then COCs were identified based on either the HI (HI greater than or equal to 0.1) or ILCR (ILCR greater than or equal to 1.0×10^{-6}).

Chromium was identified as a CMCOPC in soil and an HHCOPC in groundwater. Estimations of the potential risk associated with exposure to chromium concentrations in groundwater were calculated for both the estimated groundwater concentrations resulting from leaching from soil and from the measured concentrations in groundwater. For the purposes of estimating the total HI for chromium, the highest value for either the modeled groundwater concentration or the measured groundwater concentration was used in the calculation. This is a conservative measure that assumes that the receptor will be exposed to the maximum potential concentration. Should the HI for the receptor exceed the target value of 1.0, chromium will be evaluated separately as a potential contaminant migration constituent of concern (CMCOC) in soil or a human health constituent of concern (HHCOC) in groundwater. For example, if the HI for the modeled chromium concentration is 1.0 and the HI for chromium in groundwater is 0.05, then chromium will be considered to be a CMCOC in soil, but not an HHCOC in groundwater. If the HI exceeds 0.1 for both the modeled and the measured groundwater concentrations, then chromium will be considered to be a CMCOC and an HHCOC in groundwater.

9.4.1 Current Land-use Scenarios

There are no current on-site receptors. Current off-site receptors would include a juvenile wader playing in the drainage ditch adjacent to SWMU 27H, Building 1071. In addition, a sportsman may be exposed to COPCs that have migrated from the drainage ditch to Mill Creek. For the purposes of quantifying the potential risk to the sportsman, it was assumed that the point of exposure is in the drainage ditch adjacent to the site. Exposures of the current receptors are limited to HHCOPCs in the surface water. CMCOPCs and HHCOPCs in the shallow portions of the surficial aquifer may migrate to surface water and were assessed under the future land-use scenarios. The potential risks to each of these receptor populations are discussed below.

Off-site Juvenile Wader. The total HI for the juvenile trespasser is 4.33×10^{-3}, which is more than two orders of magnitude below the target value of 1.0 (Table 53); therefore, adverse systemic health risks are not expected for this receptor population.

The maximum estimated blood-lead level for children exposed to lead in surface water is 0.1 μg/dL (Table 54). This value is two orders of magnitude below the maximum acceptable level of 10 μg/dL; therefore, adverse health effects are not expected for receptors directly exposed to lead in surface water.

An ILCR could not be calculated for this receptor because there are no cancer slope factors available for the surface water HHCOPCs.

Off-site Sportsman. The total HI for the sportsman is 0.152, which is below the target value of 1.0 (Table 55); therefore, adverse systemic health risks are not expected for this receptor population.

The potential risk associated with exposure to lead in surface water was assessed by estimating the potential blood-lead levels in children as a result of consumption of fish that have bioaccumulated lead from the surface water. The blood-lead levels range from 6.4 μg/dL for the 5-year to 6-year and 6-year to 7-year age groups to 9.9 μg/dL for the 0.5-year to 1-year age group (Table 56). All of these values are below the target level of 10 μg/dL; therefore, exposure to lead in surface water is not likely to cause adverse health effects in exposed populations.

An ILCR could not be calculated for this receptor because there are no cancer slope factors available for the surface water HHCOPCs.

Summary of Results of Current Land-use Scenarios. The estimated risk values for the current receptor populations were below the respective target values. None of the COPCs were identified as COCs for the current receptor populations: the juvenile trespasser and/or the sportsman.

9.4.2 Future Land-use Scenarios

Future potential on-site receptors include an Installation worker, a construction worker, a juvenile trespasser, and a resident. Future off-site receptors include an Installation worker, a sportsman, and a resident. The potential risks to each of these receptor populations are discussed below.

On-site Installation Worker. The total HI for the on-site Installation worker is 0.710, which is below the target value of 1.0 (Table 57); therefore, adverse systemic health risks are not expected for this receptor population.

The total ILCR is 4.74×10^{-5}, which is greater than the target value of 1×10^{-6} (Table 57). The carcinogenic PAHs in surface soil represent the majority of the risk drivers for this site. Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil are the primary risk drivers with ILCRs of 2.09×10^{-5} and 1.41×10^{-5}, respectively. Other risk drivers include 1,1-dichloroethene in groundwater (ILCR = 7.6×10^{-6}) and the following PAHs in surface soil: benzo(*b*)fluoranthene (ILCR = 1.99×10^{-6}), benzo(*a*)anthracene (ILCR = 1.52×10^{-6}), and indeno(*1,2,3-cd*)pyrene (ILCR = 1.42×10^{-6}).

On-site Construction Worker. This receptor may be exposed to benzo(*a*)pyrene in subsurface soil. This constituent does not have an oral RfD; therefore, an HI could not be calculated for this receptor. The total ILCR is 9.18×10^{-7}, which is below the target value of 1×10^{-6} (Table 58); therefore, carcinogenic risks are within an acceptable range for this receptor.

On-site Juvenile Trespasser. The total HI for the on-site juvenile trespasser is 0.0871, which is more than an order of magnitude below the target value of 1.0 (Table 59); therefore, adverse systemic health risks are not expected for this receptor population.

The total ILCR is 2.95×10^{-6}, which is greater than the target value of 1×10^{-6} (Table 59). Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil are the primary risk drivers, with ILCRs of 1.49×10^{-6} and 1.01×10^{-6}, respectively. The ILCRs for the remaining COPCs are below 1×10^{-6}.

On-site Resident Child. The total HI for the on-site resident child is 5.12, which is greater than the target value of 1.0 (Table 60). Chromium in groundwater is the primary risk driver, with an HI of 4.28. Leaching of chromium from soil may be a continuing source of chromium in groundwater, given that the HI for the modeled concentration of chromium is 4.28. Cadmium in groundwater from leaching is also a risk driver, with an HI of 0.803. The HIs for the remaining COPCs are below 0.1.

The total ILCR is 7.31×10^{-5}, which is greater than the target value of 1×10^{-6} (Table 60). The carcinogenic PAHs in surface soil represent the majority of the risk drivers for this site. Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil are the primary risk drivers, with ILCRs of 3.19×10^{-5} and 2.15×10^{-5}, respectively. Other risk drivers include 1,1-dichloroethene in groundwater (ILCR = 1.21×10^{-5}) and the following PAHs in surface soil: benzo(*b*)fluoranthene (ILCR = 3.04×10^{-6}), benzo(*a*)anthracene (ILCR = 2.32×10^{-6}), and indeno(*1,2,3-cd*)pyrene (ILCR = 2.17×10^{-6}).

On-site Resident Adult. The total HI for the resident adult is 2.14, which is greater than the target value of 1.0 (Table 61). Chromium in groundwater is the primary risk driver, with an HI of 1.78. Leaching of chromium from soil may be a continuing source of chromium in groundwater, given that the HI for the modeled concentration of chromium is 1.78. Cadmium in groundwater from leaching is also a risk driver, with an HI of 0.340. The HIs for the remaining COPCs are below 0.1.

The total ILCR is 9.37×10^{-5}, which is greater than the target value of 1×10^{-6} (Table 61). The carcinogenic PAHs in surface soil represent the majority of the risk drivers for this site. Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil are the primary risk drivers, with ILCRs of 3.51×10^{-5} and 2.36×10^{-5}, respectively. Other risk drivers include 1,1-dichloroethene in groundwater (ILCR = 2.67×10^{-5}) and the following PAHs in surface soil: benzo(*b*)fluoranthene (ILCR = 3.34×10^{-6}), benzo(*a*)anthracene (ILCR = 2.55×10^{-6}), and indeno(*1,2,3-cd*)pyrene (ILCR = 2.39×10^{-6}).

Off-site Installation Worker. The total HI for the Installation worker is 0.710, which is below the target value of 1.0 (Table 62); therefore, adverse systemic health risks are not expected for this receptor population.

The total ILCR is 7.59×10^{-6}, which is greater than the target value of 1×10^{-6} (Table 62). 1,1-Dichloroethene in groundwater is the primary risk driver for this SWMU (ILCR = 7.59×10^{-6}). The remaining COPCs have ILCRs below 1×10^{-6}.

Off-site Sportsman. The total HI for this receptor is 5.01, which exceeds the target risk value of 1.0 (Table 63), resulting from chromium and cadmium from groundwater leaching and migrating to surface water. The total HI for exposure to chromium is 4.73, with an HQ of 4.63 resulting from bioaccumulation into fish and an HI of 0.105 resulting from direct exposure to surface water. Cadmium is also considered to be a COC (HI = 0.231) as a result of exposure via ingestion of fish. The HIs for the remaining COPCs are below 0.1.

The total ILCR is 6.29×10^{-6}, which exceeds the target risk value of 1×10^{-6} (Table 63). 1,1-Dichloroethene is the only carcinogenic constituent evaluated for this receptor population.

Off-site Resident Child. The total HI for the resident child is 5.12, which is greater than the target value of 1.0 (Table 64). Chromium in groundwater is the primary risk driver, with an HI of 4.28. Leaching of chromium from soil may be a continuing source of chromium in groundwater, given that the HI for the modeled concentration of chromium is 4.28. Cadmium in groundwater from leaching is also a risk driver, with an HI of 0.803. The HIs for the remaining COPCs are below 0.1.

The total ILCR is 1.37×10^{-5}, which is greater than the target value of 1×10^{-6} (Table 64). 1,1-Dichloroethene in groundwater is the primary risk driver (ILCR = 1.37×10^{-5}). The remaining COPCs have ILCRs below 1×10^{-6}.

On-site Resident Adult. The total HI for the resident adult is 2.14, which is greater than the target value of 1.0 (Table 65). Chromium in groundwater is the primary risk driver, with an HI of 1.78. Leaching of chromium from soil may be a continuing source of chromium in groundwater, given that the HI for the modeled concentration of chromium is 1.78. Cadmium in groundwater from leaching is also a risk driver, with an HI of 0.340. The HIs for the remaining COPCs are below 0.1.

The total ILCR is 2.67×10^{-5}, which is greater than the target value of 1×10^{-6} (Table 65). 1,1-Dichloroethene in groundwater is the primary risk driver (ILCR = 2.67×10^{-5}). The remaining COPCs have ILCRs below 1×10^{-6}.

Summary of Future Land-use Scenarios. The results of the risk characterization concluded that the following constituents are COCs: benzo(*a*)pyrene (surface soil); dibenzo(*a,h*)anthracene (surface soil); benzo(*a*)anthracene (surface soil); benzo(*b*)fluoranthene (surface soil); indeno(*1,2,3-cd*)pyrene (surface soil); 1,1-dichloroethene (groundwater); cadmium (groundwater and modeled surface water); and chromium (groundwater, modeled groundwater, and modeled surface water).

Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene were identified as COCs in surface soil based on the on-site Installation worker, on-site juvenile trespasser, and both on-site residential scenarios. Benzo(*a*)anthracene, benzo(*b*)fluoranthene, and indeno(*1,2,3-cd*)pyrene were also identified as surface soil COCs based on the on-site Installation worker and both on-site residential scenarios.

The COCs for groundwater include 1,1-dichloroethene; cadmium; and chromium. It should be noted that the on-site and off-site exposure scenarios for groundwater are the same; therefore, the potential risk values are equal, and the COC lists are the same. For example, the list of groundwater COCs for the on-site and the off-site resident child are the same (1,1-dichloroethene; cadmium; and chromium). 1,1-Dichloroethene was identified as a groundwater COC for the Installation worker, resident child, and resident adult. Cadmium was identified as a COC in groundwater based on both residential scenarios. In addition, groundwater modeling indicated that this constituent may also be a COC for the off-site sportsman as a result of bioaccumulation in fish. Chromium was identified as a COC in groundwater based on the on-site and off-site residential scenarios. Leachate modeling indicated that soil may serve as a continuing source of chromium in groundwater. In addition, groundwater modeling indicated that chromium may also be a COC for the off-site sportsman as a result of bioaccumulation in fish.

9.5 UNCERTAINTY ASSESSMENT

A discussion of the general uncertainties associated with the analysis of risks at sites within the 16 SWMUs is provided in Appendix I, Section I.5 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

It was assumed that the surface water concentrations in the adjacent ditch were equal to the groundwater concentrations. This is a conservative assumption that assumes that constituents in groundwater do not become diluted by the surface water present in the drainage ditch.

It was also conservatively assumed that a sportsman fishes in the drainage ditch because of the difficulty in estimating water concentrations at the actual points of exposure due to complexities in the nature of the drainage. This is a very conservative assumption, given that no fish populations exist in the drainage ditch and that the actual exposure concentrations are likely to be orders of magnitude below the concentrations used to quantify the potential exposures because the ditch discharges to Mill Creek only during rain events when the water levels are high enough to flow from the area. In addition, the larger volume of water in Mill Creek would dilute the discharge from the drainage ditch, thereby lowering the constituent concentrations.

The bioaccumulation of COPCs in fish is based on the assumption that all of the constituent is in a soluble form. Fish can bioaccumulate only a chemical that is in a soluble form and is available to cross the gill membrane. If the chemical is adsorbed to a particulate or exists as a colloid, the chemical is not available for uptake by the fish. It is unlikely that the estimated concentrations in surface water are totally available for bioaccumulation; therefore, the assumption is likely to overestimate the actual concentrations in fish.

The exact chemical forms of chromium are not known. As a conservative measure, it was assumed that chromium existed in the more toxic hexavalent state, although this form of chromium is very unstable and readily oxidizes to the less toxic trivalent state. This approach may overestimate the potential risks.

9.6 RISK SUMMARY

The purpose of this risk summary is to provide an overview of the risk assessment results, including identification of the COPCs assessed, the receptor populations, and the risk characterization results.

The HHBRA addressed the risks associated with exposure to HHCOPCs in surface soil [benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene], subsurface soil [benzo(*a*)pyrene], groundwater (1,1-dichloroethene; naphthalene; and chromium), and surface water (cadmium and lead). In addition, the following constituents were identified as CMCOPCs in soil: benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, cadmium, chromium, and mercury. The results of the leachate modeling indicated that benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and mercury are not likely to leach into groundwater at concentrations that would have an adverse impact upon human health. The risks associated with the leaching of cadmium and chromium were analyzed in the risk assessment.

Surface soil and subsurface soil at this site are currently covered by either concrete or asphalt, and groundwater is not currently used for any purpose. Given that COPCs present in surface soil, subsurface soil, and groundwater are effectively isolated, there are no current on-site receptor populations for COPCs in surface soil, subsurface soil, or groundwater. Current off-site receptor populations included a juvenile trespasser and a sportsman. The juvenile may be exposed while playing in the adjacent drainage ditch. During rain events the drainage ditch discharges into Mill Creek. The sportsman may be exposed to surface water COPCs that have migrated to Mill Creek. However, given the difficulties in modeling the COPC concentrations in Mill Creek, it was assumed that the sportsman fishes in the drainage ditch adjacent to the site and that this is the point of exposure for this receptor.

Receptor populations under the future land-use scenario include an Installation worker, a construction worker, a juvenile trespasser, a resident, and a sportsman. The Installation worker and the resident represent both on-site and off-site receptors. The juvenile trespasser represents an on-site receptor, although this receptor may be exposed to off-site COPCs in surface water. The sportsman is an off-site receptor.

The Installation worker and the resident may be exposed to COPCs in surface soil and groundwater. The construction worker is used to assess the potential risks associated with exposure to subsurface soil. The residential receptor population was divided into an adult and a child because the differences in behavior and physiology of these two receptors result in differing sensitivities to certain constituents or increased exposure to constituents in different environmental media. The reader is referred to Appendix I, Section I.2.2 ("Identification of Potential Receptor Populations and Associated Exposure Pathways") of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a) for a more detailed discussion on the potential exposure pathways and the differences between the exposure of the adult and child resident receptors. The on-site juvenile trespasser may be exposed to COPCs in surface water and surface soil.

The exposure pathways for the sportsman are the same as those previously described for the current off-site receptor. The off-site Installation worker and the off-site resident may be exposed to COPCs in surface soil (via inhalation only) and groundwater.

Analysis of the hydrology of the area indicates that constituents within the shallow portion of the surficial aquifer are likely to migrate to surface water in the adjacent drainage ditch. Constituents in the deeper portions of the surficial aquifer may migrate further, ultimately discharging into Mill Creek. Groundwater modeling was used to evaluate the potential for constituents in the deeper portion of the groundwater aquifer to migrate to Mill Creek or its tributaries. The modeling results indicate that constituents are not likely to migrate to Mill Creek. The risk assessment evaluated the potential risks associated with HHCOPCs in the shallow portion of the surficial aquifer and CMCOPCs migrating to the drainage ditch. It was assumed that surface water concentrations for the future receptor populations would be equal to the current groundwater concentrations for the shallow surficial aquifer or the estimated groundwater concentrations for CMCOPCs.

Lead and cadmium were identified as COPCs in surface water. The potential risks associated with exposure to lead were quantified based on the blood-lead levels resulting from exposure to lead in various media. EPA's IEUBK model (EPA 1994a) was used to estimate blood-lead levels resulting from daily exposure. This model was used to evaluate risks associated with exposure to lead in surface water. It was assumed that the daily incidental ingestion rate for surface water (20 ml per event) was a chronic or daily exposure. The blood-lead levels were estimated based on this exposure. Similarly, exposure via bioaccumulation in fish was estimated based on the daily fish consumption rate for the age groups that were evaluated using the IEUBK model. The exposures of an off-site sportsman and an on-site juvenile trespasser to lead and cadmium in surface water were below the target risk values; therefore, no adverse systematic health risks are expected for either receptor population.

Benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene were identified as COCs in surface soil. Exposure to these constituents exceeded the target risk value of 1×10^{-6} for the on-site Installation worker, on-site resident child, and on-site resident adult. The risks from exposure to benzo(*a*)pyrene and dibenzo(*a,h*)anthracene exceeded the target risk value of 1×10^{-6} for the on-site juvenile trespasser.

Chromium and 1,1-dichloroethene were identified as COCs in groundwater. Exposure to the measured exposure point concentration of chromium in groundwater resulted in an HI greater than 0.1 for all of the residential receptor populations (on-site resident child, on-site resident adult, off-site resident child, and off-site resident child).

Cadmium and chromium in soil were identified as CMCOCs. Exposure to the modeled exposure point concentration of cadmium and chromium in groundwater resulted in an HI greater than 0.1 for all of the residential receptor populations. In addition, the HI for a sportsman exposed as a result of the migration of these CMCOCs to surface water resulted in an HI greater than 0.1. Exposure via bioaccumulation of cadmium and chromium in fish is the predominant exposure pathway for the sportsman.

The COCs identified for this site are the following:

- benzo(*a*)pyrene in surface soil;
- benzo(*a*)anthracene in surface soil;
- benzo(*b*)fluoranthene in surface soil;
- dibenzo(*a,h*)anthracene in surface soil;
- indeno(*1,2,3-cd*)pyrene in surface soil;
- cadmium in soil, based on the potential to leach to groundwater;
- chromium in groundwater;

- chromium in soil, based on the potential to leach to groundwater; and
- 1,1-dichloroethene in groundwater.

9.7 REMEDIAL LEVELS

The first step in determining the remedial levels for a site is to derive remedial levels for each HHCOC and CMCOC based on regulatory and risk-based criteria. These remedial levels are reviewed, and a final remedial level for each COC is recommended. Remedial levels were derived for each HHCOC and CMCOC for all applicable environmental media at SWMU 27H, Building 1071.

9.7.1 Derivation of Remedial Levels

Remedial levels were derived for the HHCOCs in groundwater (chromium and 1,1-dichloroethene) and surface soil [benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene]. Remedial levels for CMCOCs were derived based on the protection of groundwater (chromium) and migration to surface water (cadmium and chromium). The development of remedial levels followed the protocols given in Appendix I, Section I.6 I of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a).

Risk-based remedial values were derived for the most sensitive receptor population. By protecting the most sensitive receptor, other less sensitive receptor populations will also be protected. If the most sensitive receptor population was not well defined, then remedial levels were derived for those populations that were considered to be representative of the sensitive receptors.

Remedial levels for groundwater take into consideration both regulatory limits and risk-based values. If a constituent had an MCL, this value was used as the remedial value. Given that chromium and 1,1-dichloroethene have MCLs, no risk-based remedial values were calculated (Table 66).

The remedial levels for surface soil were based upon the resident adult. The PAHs in surface soil were identified as COCs based on their carcinogenic risks for this receptor. The HIs for this constituent were all below the target risk value of 0.1; therefore, the risk-based remedial levels were calculated based on only the carcinogenic risks (Table 67).

The remedial level for a CMCOC represents that soil concentration that is unlikely to leach into groundwater or migrate to surface water in concentrations that present a significant threat to human health. The potential risk associated with CMCOCs is not direct exposure to soil, but exposure to the constituents in either groundwater or surface water; therefore, the remedial levels in soil are based upon target groundwater concentrations. These values are the concentrations of a CMCOC in either groundwater or surface water that present a defined risk to a receptor. For example, if the target groundwater concentration is based on an HI of 1.0, the risk value of 1.0 represents the potential risk to a receptor population exposed to the risk-based target concentration of the CMCOC in groundwater. The corresponding risk-based soil remedial value would represent the concentration of the CMCOC in soil that is likely to leach into groundwater, resulting in a CMCOC groundwater concentration equal to the target groundwater concentration.

The most sensitive receptor population for CMCOCs in groundwater is the on-site resident. The HI for the resident child is higher than the HI for the resident adult, indicating that the resident child is the most sensitive receptor population based on noncarcinogenic risks; therefore, the on-site resident child scenario was used to calculate risk-based remedial levels based on noncarcinogenic risks.

Two CMCOCs, cadmium and chromium, are risk drivers for the off-site sportsman as a result of migration of these CMCOCs to surface water in the drainage ditch. The target groundwater concentrations for these receptors represent the concentrations of the CMCOCs in groundwater underlying the site that, upon migration and discharge into the drainage ditch, present defined levels of risk to the sportsman.

The target groundwater concentrations are given in Table 68.

9.7.2 Remedial Level Recommendations

The selection of a remedial level must take into consideration the following factors:

- regulatory standards,
- target risk values for risk-based remedial levels, and
- background concentrations of inorganic COCs.

Regulatory standards that are considered for remedial levels must be derived based on the potential risk to receptors. If regulatory standards are not used for the recommended remedial levels, then risk-based remedial values are recommended based on a target risk value for the receptor population. Finally, the background concentrations of inorganic COCs must be taken into consideration because the remedial actions cannot reduce the concentration of a constituent to levels below the background concentration.

9.7.2.1 Regulatory standards

MCLs are used as the remedial levels for groundwater HHCOCs. The MCL takes into consideration both the potential human health risks associated with exposure to the contaminant in drinking water and the technological limitations in removing that contaminant from water; therefore, these values are appropriate for use as remedial levels, given that if a risk-based concentration cannot be obtained as a result of technological limitations, the lowest attainable concentration is used as the target concentration.

The selection of a target groundwater concentration for a CMCOC based on an on-site resident must take into consideration the MCL, if available, and the potential risks associated with the presence of all CMCOCs and groundwater HHCOCs. The MCL takes into consideration both the potential human health risks associated with exposure to the contaminant in drinking water and the technological limitations in removing that contaminant from water. An MCL that is derived based on the acceptable human health risks, as defined in the Safe Drinking Water Act, may be more stringent than the possible target risk values allowed under the current GEPD RCRA guidance (GEPD 1996); therefore, the recommended target groundwater concentration does not exceed the MCL, if available.

9.7.2.2 Target risk values for risk-based remedial levels

The selection of a target risk value for remedial levels must take into account the total risk for that receptor population from all of the potential COCs present at the site. The total potential risks associated with the COCs should not result in a cumulative HI that exceeds 3.0 or an ILCR greater than 1×10^{-4} (GEPD 1996). The recommended target risk values for the derivation of the risk-based remedial levels for the on-site resident and the off-site sportsman are discussed below.

On-site Resident. The on-site resident may be exposed to PAHs in surface soil [benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene] as well as cadmium (a CMCOC); chromium; and 1,1-dichloroethene in groundwater. Chromium was identified as a CMCOC in addition to being a HHCOC in groundwater. Benzo(*a*)pyrene; benzo(*a*)anthracene; benzo(*b*)fluoranthene; dibenzo(*a,h*)anthracene; indeno(*1,2,3-cd*)pyrene; and 1,1-dichloroethene are carcinogens and would contribute to the total carcinogenic risks for the on-site resident. It is recommended that the risk-based remedial values for carcinogens be based upon an ILCR of 1×10^{-5}. The resulting total risk associated with exposure to the remedial levels of the COCs would be 6×10^{-5}, which is below the maximum total acceptable ILCR of 1×10^{-4}.

There are two constituents (cadmium and chromium) that would contribute to the total HI for the on-site resident. The risk-based remedial values should be based on an HI of 1.0. The resulting total HI associated with exposure to the remedial levels of the COCs would be 2.0, which is below the maximum acceptable total HI of 3.0.

Off-site Sportsman. The COCs identified for the off-site sportsman include cadmium; chromium; and 1,1-dichloroethene, which may migrate to surface water via groundwater discharge. 1,1-Dichloroethene is the only COPC that presents a potential carcinogenic risk to this receptor. It is recommended that the risk-based remedial values for carcinogens be based upon an ILCR of 1×10^{-5}, which is an order of magnitude below the maximum total acceptable ILCR of 1×10^{-4}.

Two constituents would contribute to the total HI for the off-site sportsman—cadmium and chromium. The total HI associated with exposure to the remedial levels of the COCs would be 2.0, which is below the maximum acceptable total HI of 3.0.

9.7.2.3 Background concentrations of inorganic constituents of concern

The recommended remedial levels for inorganic COCs were compared to the reference background concentrations. If the remedial level was lower than the reference background concentration, then the remedial level defaulted to background. The recommended remedial levels for CMCOCs in soil were compared to the reference background levels for subsurface soil. Given the comparative thickness of subsurface soil and its proximity to groundwater relative to surface soil, the amount of a constituent leaching to groundwater from the subsurface soil is likely to be much greater than the contribution from surface soil. The concentration of a CMCOC should be evaluated relative to the soil stratum that contributes the greatest amount of an inorganic to groundwater; therefore, the subsurface soil reference background concentrations may be used as the remedial levels for CMCOCs.

9.7.2.4 Recommended remedial levels for the constituents of concern

The selection of the recommended remedial levels takes into consideration the MCLs, risk-based remedial levels, and reference background concentrations of inorganics. The recommended remedial level for each COC is discussed in the following paragraphs.

Benzo(*a*)pyrene. Benzo(*a*)pyrene was identified as an HHCOC in surface soil. This COC does not have an RfD; therefore, the recommended risk-based remedial value is 0.89 mg/kg, based on an ILCR of 1.0×10^{-5} (Table 67).

Benzo(*a*)anthracene. Benzo(*a*)anthracene was identified as an HHCOC in surface soil. This COC does not have an RfD; therefore, the recommended risk-based remedial value is 8.93 mg/kg, based on an ILCR of 1.0×10^{-5} (Table 67).

Given that the recommended remedial value for benzo(*a*)anthracene (8.93 mg/kg) is higher than the maximum detected value of 2.87 mg/kg, no further study is required for this constituent.

Benzo(*b*)fluoranthene. Benzo(*b*)fluoranthene was identified as an HHCOC in surface soil. This COC does not have an RfD; therefore, the recommended risk-based remedial value is 8.93 mg/kg, based on an ILCR of 1.0×10^{-5} (Table 67).

Given that the recommended remedial value for benzo(*b*)fluoranthene (8.93 mg/kg) is higher than the maximum detected value of 3.64 mg/kg, no further study is required for this constituent.

Dibenzo(*a,h*)anthracene. Dibenzo(*a,h*)anthracene was identified as an HHCOC in surface soil. This COC does not have an RfD; therefore, the recommended risk-based remedial value is 0.89 mg/kg, based on an ILCR of 1.0×10^{-5} (Table 67).

Indeno(*1,2,3-cd*)pyrene. Indeno(*1,2,3-cd*)pyrene was identified as an HHCOC in surface soil. This COC does not have an RfD; therefore, the recommended risk-based remedial value is 8.93 mg/kg, based on an ILCR of 1.0×10^{-5} (Table 67).

Given that the recommended remedial value for indeno(*1,2,3-cd*)pyrene (8.93 mg/kg) is higher than the maximum detected value of 2.46 mg/kg, no further study is required for this constituent.

Cadmium. Cadmium in soil was identified as a CMCOC for groundwater and surface water. Cadmium is not a carcinogen; therefore, the recommended target groundwater concentrations are based on an HI of 1.0. The target groundwater concentrations are 7.5 µg/L for exposure of a resident and 25.0 µg/L for exposure of a sportsman (Table 68). Both of these values exceed the MCL (5 µg/L); therefore, the MCL will be used as the target groundwater value. The risk-based remedial level for soil, based on this target groundwater concentration, is 0.63 mg/kg (Table 69).

Chromium. Chromium was identified as an HHCOC in groundwater and a CMCOC for groundwater and surface water. The MCL for chromium (100 µg/L) was used as the remedial level for groundwater (Table 66).

Chromium is not a carcinogen; therefore, the recommended target groundwater concentrations are based on an HI of 1.0. The target groundwater concentrations are 42.1 µg/L for exposure of a resident and 38.0 µg/L for exposure of a sportsman (Table 68). As a conservative measure, the lesser of the two values, 38.0 µg/L, will be used as the target groundwater concentration. The risk-based remedial level for this target groundwater concentration is 0.63 mg/kg; however, this value is below the subsurface soil background concentration, 11.6 mg/kg. The subsurface soil background concentration is recommended as the remedial level for cadmium in soil.

The recommended remedial value for groundwater (100 µg/L) is higher than the maximum detected value of 31 µg/L (Table 66). Similarly, the recommended remedial value for soil (11.6 mg/kg) is higher than the maximum detected value of 7.40 mg/kg (Table 69). Given that the recommended remedial values for chromium in groundwater and soil are higher than the respective maximum detected values, no further study is required for this constituent.

1,1-Dichloroethene. 1,1-Dichloroethene was identified as an HHCOC in groundwater. The MCL for 1,1-dichloroethene (7 µg/L) will be used as the remedial level for groundwater (Table 66).

9.7.2.5 Summary of recommended remedial levels

The recommended remedial levels for HHCOCs in groundwater, HHCOCs in surface soil, and CMCOCs in soil are given in Tables 66, 67, and 69, respectively. The following remedial levels are recommended:

- benzo(*a*)pyrene in surface soil: 0.89 mg/kg,
- dibenzo(*a,h*)anthracene in surface soil: 0.89 mg/kg,
- cadmium in soil: 0.63 mg/kg, and
- 1,1-dichloroethene in groundwater: 7 µg/L.

The maximum concentrations of benzo(*a*)anthracene, benzo(*b*)fluoranthene, and indeno(*1,2,3-cd*)pyrene in surface soil were below their recommended remedial levels; therefore, no further investigation is required for these constituents. Similarly, the maximum concentrations of chromium in groundwater and soil were below their recommended remedial levels; therefore, no further investigation is required for chromium.

10.0 SUPPLEMENTAL GROUNDWATER CHARACTERIZATION

As a result of the Phase II RFI conducted in 1999, it was recommended that the monitoring wells at SWMU 27H, Building 1071 be resampled for 1,1-dichloroethene only. With the concurrence of GEPD, the supplemental characterization of groundwater at SWMU 27H, Building 1071 was performed in October/November 2000. Based on the results of the supplemental groundwater sampling, the conclusions and recommendations made in the *Addendum for SWMU 27H: DOL Maintenance, Building 1071 to the Revised Final Phase II RCRA Facility Investigation Report for the 16 Solid Waste Management Units at Fort Stewart, Georgia* (SAIC 2000b) have been revised in Chapter 11.0 of this document.

10.1 SUMMARY OF INVESTIGATION ACTIVITIES

10.1.1 Sampling Methodology

The supplemental groundwater sampling at SWMU 27H, Building 1071 was conducted on October 31 and November 1, 2000, using micropurging sampling techniques. Prior to installing the sampling pump, the static water level was recorded at each monitoring well. Monitoring wells were sampled using low-flow micropurging techniques to minimize the volume of purge water and the disturbance of the aquifer. Field parameters (pH, conductivity, temperature, DO, and Redox) were monitored during micropurging. Turbidity was not measured because the constituent of interest was a VOC, which is not dependent on turbidity. The purge rate was adjusted, as necessary, to avoid purging any well to dryness and to equal the recharge of the aquifer. Purging was considered complete when the field parameters stabilized within plus or minus 10 percent over a minimum of three readings at 5-minute intervals. Purging times varied, requiring from 10 to 28 minutes to purge. Results of field parameter measurements made at the end of purging in each well are listed in Table 70.

Sampling of each monitoring well began immediately after completion of purging, using the same micropurging pump. Groundwater samples were transferred directly into laboratory sample containers. Groundwater samples were then sent off-site for laboratory analysis for 1,1-dichloroehene.

10.1.2 Data Quality Assessment

Quality assurance (QA)/quality control (QC) activities to achieve the desired data quality were as described in the Phase II RFI SAP for 16 SWMUs (SAIC 1997). One field QC trip blank was analyzed. The project produced acceptable results for more than 99 percent of the data. The overall quality of the laboratory data meets the established project objectives, and the data are acceptable for use.

10.2 SUMMARY OF SUPPLEMENTAL CHARACTERIZATION RESULTS

10.2.1 Potentiometric Map

Water table measurements were taken in each of the eight wells on October 30, 2000, prior to sampling. Table 71 lists the measured depth below top of casing and the corresponding water elevation. The potentiometric maps for the shallow and deep surficial aquifer are shown in Figures 14 and 15, respectively. The shallow surficial groundwater flow direction across the site is to the west. The deep surficial groundwater flow direction is southwest to south. The hydraulic gradients of the shallow and deep surficial groundwater are 0.0075 foot/foot and 0.0143 foot/foot, respectively.

10.2.2 Results of Supplemental Groundwater Analyses

In response to GEPD comments on the Phase II RFI Report for 16 SWMUs, analyte values reported below the project reporting levels were qualified as nondetects based on poor accuracy and precision (SAIC 1999a). The rationale and acceptance for this data interpretation are discussed in the Quality Control Summary Report (QCSR) [Appendix C of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)] and in the comment response table and the minutes of the September 14, 1999, meeting with GEPD [Appendix L of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)]. The same set of criteria were applied to evaluation of the data collected during the supplemental groundwater characterization.

As described in the QCSR, analyte values that were reported and estimated (qualified with a "J") below the project reporting levels were qualified as nondetects based on poor accuracy and precision. Values for volatile organics below 2 µg/L were considered to be artifacts of the sampling and analysis process and evaluated as nondetects at the previous reporting level. Due to method and procedural variables, the accuracy and precision of low-level concentrations are not dependable and should not be used.

Analytical results for groundwater samples from the eight monitoring wells are presented in Attachment C and Table 72. As indicated in Attachment C, 1,1-dichloroethene was detected at 1.2 µg/L in MW2 and estimated to be present at 0.2J µg/L in MW4. However, based on the data evaluation criteria implemented during the Phase II RFI for 16 SWMUs, the values are considered nondetects, as shown in Table 72.

11.0 CONCLUSIONS AND RISK MANAGEMENT AND SITE RECOMMENDATIONS, SWMU 27H, BUILDING 1071

11.1 SUMMARY OF FINDINGS

The Phase II RFI presented in this addendum report was conducted to collect additional analytical data for determining the nature and extent of contamination in environmental media and the potential adverse effects to human health and the environment in the vicinity of SWMU 27H, Building 1071. The data were derived from a series of screening and primary samples collected from surface soil, subsurface soil, groundwater, surface water, and sediment in the study area during the Phase I (January 1998) and Phase II (October 1999) RFIs. The samples collected were analyzed for VOCs, SVOCs, and RCRA metals.

The following sections summarize the significant findings of the Phase I (January 1998) and Phase II (October 1999) RFI sampling and analysis activities.

11.1.1 Surface Soil

Six VOCs and 17 SVOCs were detected in surface soil across SWMU 27H, with the most elevated levels in the area of MW5. The relatively widespread surface soil contamination may be the result of practices at the DOL maintenance area and not specifically from releases from the OWS. Specific conclusions on the nature of the potential contamination are presented below.

- 2-Butanone, acetone, carbon disulfide, ethylbenzene, styrene, and total xylenes are considered to be SRCs in surface soil.

- 2-Methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(*a*)anthracene, benzo(*a*)pyrene benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, chrysene, dibenzo(*a,h*)anthracene, fluoranthene, fluorene, indeno(*1,2,3-cd*)pyrene, naphthalene, phenanthrene, and pyrene are considered to be SRCs in surface soil.

- Barium, cadmium, chromium, and lead were detected above reference background criteria and are SRCs in surface soil.

11.1.2 Subsurface Soil

Four VOCs and 11 SVOCs were detected in subsurface soil. The SVOCs were detected in subsurface soil primarily at one location, MW7. Specific conclusions on the nature of potential contamination are presented below.

- 2-Butanone, acetone, ethylbenzene, and total xylenes are SRCs in subsurface soil.

- 2-Methylnaphthalene, acenaphthylene, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, benzo(*g,h,i*)perylene, benzo(*k*)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, indeno(*1,2,3-cd*)pyrene, naphthalene, phenanthrene, and pyrene are considered to be SRCs in subsurface soil.

- Cadmium, lead, and mercury were detected above reference background criteria and are considered to be SRCs in subsurface soil based on the Phase II RFI.

11.1.3 Groundwater

Groundwater was encountered at approximately 8 feet to 10 feet bgs in the monitoring wells during the Phase II RFI. The shallow surficial groundwater flow direction across the site is to the west. The deep surficial groundwater flow direction is southwest to south. The hydraulic gradient of the shallow and deep surficial groundwater is 0.007 foot/foot and 0.017 foot/foot, respectively. The shallow surficial groundwater flow may intercept the man-made drainage ditch located approximately 50 feet to the southwest of the OWS. The deeper surficial groundwater may potentially intercept a tributary of Mill Creek located approximately 1,500 feet to the south. Specific conclusions on potential groundwater contamination are presented below.

- 1,1-Dichloroethane; 1,1-dichloroethene; ethylbenzene; total xylenes; benzoic acid; and naphthalene are considered to be organic SRCs in groundwater.

- Barium, chromium, and lead were detected above reference background criteria and are considered to be SRCs in groundwater. The elevated metals concentrations were associated with groundwater collected from deep monitoring well locations that were installed to approximately 43 feet bgs, just extended into the Hawthorn confining (clay) layer. Except for those of barium, all the filtered metals concentrations at the locations indicating elevated metals were either nondetect or below the reference background criteria. Elevated turbidities were also associated with these groundwater samples. These results indicate that the elevated metals were probably the result of particulates or colloids in the groundwater.

11.1.4 Surface Water and Sediment

There is a man-made drainage ditch separated from the site by a boundary fence approximately 50 feet southwest of the OWS. The drainage ditch receives runoff from the armor vehicle parking area and outside storage area surrounding the OWS, from the adjacent asphalt road that borders the western side of the drainage ditch, and from other upstream industrial sources. The water in the drainage ditch is usually stagnant, except during rainfall events. The surface water in the drainage ditch ultimately discharges into Mill Creek, approximately 2,600 feet to the west. The OWS discharges directly to the IWTP; however, the adjacent drainage ditch is rather deep and may potentially intercept groundwater from the relatively shallow portion of the surficial aquifer. The deeper surficial groundwater may potentially migrate to a tributary of Mill Creek located approximately 1,500 feet to the south. Because the surface water in the drainage ditch received significant contributions from other sources and was stagnant, the site reference background criteria for surface water were taken from Mill Creek (SWS1) from the Phase II RFI for the 724th Tanker Purging Station (SWMU 26) (SAIC 1998).

- 1,1-Dichloroethane and pyrene are SRCs in surface water.

- Arsenic, barium, cadmium, chromium, and lead were detected above reference background criteria and are considered to be SRCs in surface water.

- 2-Butanone, acetone, fluoranthene, phenanthrene, and pyrene are organic SRCs in sediment.

- Barium, cadmium, chromium, lead, mercury, silver, and selenium were detected above reference background criteria and are considered to be SRCs in sediment.

11.2 CONCLUSIONS

Several assessments were conducted to determine the significance of the contaminant concentrations found at SWMU 27H, Building 1071 with respect to their impact on human health and the environment. The assessments included those listed below.

- An analysis of contaminant fate and transport (Chapter 6.0) evaluated the potential for SRCs to migrate from one environmental medium to another (e.g., leaching of constituents from soil or sediment into groundwater), resulting in a potential risk to human health and the environment.
- An HHPRE (Chapter 7.0), which used a Step 1 risk screening, identified HHCOPCs.
- An EPRE (Chapter 8.0) was performed for terrestrial and aquatic receptors in the study area.
- An HHBRA (Chapter 9.0) was performed for CMCOPCs identified in the fate and transport analysis and HHCOPCs identified in the HHPRE.

11.2.1 Fate and Transport Analysis

The potential for soil contaminants to migrate (i.e., their leachability) to groundwater was evaluated by comparing the maximum concentrations of soil and sediment SRCs to their respective GSSLs. Below are the conclusions regarding contaminant fate and transport.

- Of the SRCs identified in surface and subsurface soil, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene cadmium, chromium, and mercury exceeded their respective GSSLs and are considered to be CMCOPCs based on leaching to groundwater.
- Of the SRCs identified in sediment, none of the analytes exceeded their respective GSSLs; therefore, there are no CMCOPCs in sediment at SWMU 27H, Building 1071 based on leaching to groundwater.

11.2.2 Human Health Preliminary Risk Evaluation

Based on the results of the screening and a weight-of-evidence analysis, HHCOPCs have been identified for surface and subsurface soil, groundwater, and surface water. The results of the human health risk screening are given below.

- Of the SRCs for surface soil, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene exceeded their respective screening values and are considered to be HHCOPCs in surface soil.
- Only benzo(*a*)pyrene exceeded its screening value and is considered to be an HHCOPC in subsurface soil.
- 1,1-Dichloroethene; naphthalene; and chromium exceeded their respective screening values and are considered to be HHCOPCs in groundwater.
- Cadmium and lead exceeded their respective screening values and are considered to be HHCOPCs in surface water.
- There are no HHCOPCs in sediment.

11.2.3 Ecological Preliminary Risk Evaluation

Based on the results of the EPRE screening analysis, ECOPCs were identified in groundwater, surface water, and sediment. Those constituents identified as ECOPCs were further evaluated using realistic exposure factors, mean site concentrations or predicted maximum groundwater discharge concentrations at downgradient surface water bodies, and LOAEL–based TRVs, as compared to NOAEL–based TRVs. The results of the EPRE are summarized below.

- Barium, cadmium, and lead in surface water and acetone, pyrene, and mercury in sediment are ECOPCs for aquatic biota because they exceed EPA Region IV ESVs (EPA 1996a). There are no ESVs for pyrene in surface water or for barium and selenium in sediment, so these constituents are ECOPCs by default. These ECOPCs pose a potential hazard to aquatic biota if surface water in the ditch adjacent to SWMU 27H, Building 1071 is transported to Mill Creek or any of its tributaries that support aquatic biota.

- Pyrene and lead in drainage ditch surface water are ECOPCs for terrestrial receptors because the preliminary HQs exceed one. The supplemental risk calculations for these ECOPCs result in HQs less than one for mink and herons; therefore, pyrene and lead are unlikely to pose a risk to terrestrial receptors.

- No ECOPCs were identified for terrestrial receptors exposed to drainage ditch sediment or groundwater.

- Total xylenes in shallow groundwater are ECOPCs for aquatic biota because they exceed EPA Region IV ESVs (EPA 1996a). These ECOPCs are potential hazards to aquatic biota if groundwater discharges to nearby surface water bodies.

- Barium and lead in deep groundwater are ECOPCs for aquatic biota because they exceed EPA Region IV ESVs (EPA 1996a). These ECOPCs are potential hazards to aquatic biota if deep groundwater discharges to downgradient surface water bodies. Barium and lead in deep groundwater are unlikely to be potential hazards to aquatic biota living in downgradient surface water because the predicted maximum discharge concentrations do not exceed the ESVs.

- SWMU 27H, Building 1071 is covered with concrete, and no vegetation or surface soil is present in the immediate area; therefore, there is no pathway to ecological receptors from surface soil.

11.2.4 Human Health Baseline Risk Assessment

An HHBRA was performed to assess CMCOPCs identified in soil in the fate and transport analysis and HHCOPCs identified in surface and subsurface soil, groundwater, surface water, and sediment in the HHPRE. The following constituents were identified as CMCOPCs in soil: benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, cadmium, chromium, and mercury. The potential for these CMCOPCs to leach to groundwater was analyzed using leachate modeling. The results of the leachate modeling showed that cadmium and chromium are likely to migrate to groundwater in concentrations that present a potentially significant risk to human health; therefore, the potential risks associated with cadmium and chromium in soil leaching to groundwater were quantified. The remaining CMCOPCs [benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and mercury] were not considered to be CMCOPCs based on the results of the leachate modeling and were not evaluated further.

HHCOPCs in soil included benzo(*a*)pyrene in both surface soil and subsurface soil and the following PAHs in surface soil: benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene. The HHCOPCs in groundwater included naphthalene; 1,1-dichloroethene; and chromium.

Cadmium and lead were identified as HHCOPCs in surface water. The bullets below present the conclusions of the HHBRA.

- Chromium and 1,1-dichloroethene in the lower (deep) portion of the surficial groundwater may potentially migrate to surface water, a tributary of Mill Creek located approximately 1,500 feet south of the site. Naphthalene was not detected in the groundwater from the deep surficial aquifer. Modeling results indicated, however, that chromium and 1,1-dichloroethene will not migrate to this potential point of discharge (receptor point); therefore, the risk associated with cadmium and 1,1-dichloroethene migrating to surface water was not addressed.

- Lead and cadmium were identified as HHCOPCs in surface water. The potential risk associated with exposure to these constituents was evaluated based on a juvenile wader playing in the drainage ditch and a sportsman fishing in the drainage ditch adjacent to SWMU 27H, Building 1071. The potential risks associated with exposure to lead were quantified based on the blood-lead levels resulting from exposure to lead in various media using EPA's IEUBK model (EPA 1994a). The potential risks associated with exposure to cadmium and lead in surface water were below the target risk values; therefore, no adverse systemic health risks are expected for either receptor population. No further evaluation and/or investigation is required.

- Benzo(*a*)pyrene was identified as an HHCOPC in subsurface soil. Because the site is covered with concrete and asphalt and presently there are no plans for removal of the concrete/asphalt cover, the only potential receptor is a future on-site construction worker. Benzo(*a*)pyrene does not have an oral RfD; therefore, an HI could not be calculated for this receptor. The total ILCR was below the target value of 1×10^{-6}; therefore, carcinogenic risks are within an acceptable range for this receptor, and no further evaluation and/or investigation is required for benzo(*a*)pyrene in subsurface soil.

- HHCOPCs in surface soil and groundwater consisted primarily of PAHs; however, chromium and 1,1-dichloroethene were identified as HHCOPCs in groundwater. In addition, chromium and cadmium were identified as CMCOPCs. The site is predominantly covered by concrete and asphalt, with limited areas of exposed soil covered with grass. The groundwater is not currently used for any purpose. Given that the surface soil is covered and the groundwater is not used, there are no current receptor populations for surface soil HHCOPCs, groundwater HHCOPCs, or CMCOPCs. The future land-use scenario assumed that all of the surface soil was exposed and that groundwater drinking wells had been placed within the shallow aquifer. Future land-use populations include an Installation worker, a juvenile trespasser, and a resident. The Installation worker and the resident represent both on-site and off-site receptors. The juvenile trespasser is an on-site receptor only. The residential population was divided into an adult and a child because the adult receptor is generally at greater risk from exposure to carcinogens, while the child is at greater risk from exposure to noncarcinogens. Benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene in surface soil had ILCRs that exceeded the target risk value of 1×10^{-6} for the on-site Installation worker, on-site resident child, and on-site resident adult. Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil also exceeded the target risk value for the on-site juvenile trespasser. Benzo(*a*)pyrene, benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene are COCs in surface soil. Chromium and 1,1-dichloroethene were identified as COCs in groundwater based on the residential exposure scenarios. Cadmium and chromium leaching to groundwater were identified as CMCOCs based on exposure of the resident child and resident adult. In addition, migration of these constituents was identified as a COC based on exposure of an off-site sportsman through discharge of groundwater to surface water. Remedial levels were developed for the CMCOCs and COCs.

- The development of the remedial levels took into account regulatory values, target risk values, and background reference values for inorganic COCs. Regulatory standards that are considered for remedial levels must be derived based on the potential risk to receptors. If regulatory standards were not used for the recommended remedial levels, then risk-based remedial values were recommended based on target risk values for the receptor populations. Risk-based remedial values were derived for the most sensitive receptor population. By protecting the most sensitive receptor, other less sensitive receptor populations will also be protected. Finally, the background concentrations of inorganic COCs must be taken into consideration because the remedial actions cannot reduce the concentration of a constituent to levels below the background concentrations. Risk-based remedial values were derived for surface soil COCs. The COCs (all PAHs) in surface soil were identified as COCs based on their carcinogenic risk for the most sensitive receptor; therefore, the risk-based remedial levels were calculated based on only the carcinogenic risks. The remedial levels were calculated based on an ILCR of 1×10^{-5} for an on-site resident adult (the most sensitive receptor population). Remedial levels for groundwater take into consideration both regulatory limits and risk-based values. All the groundwater HHCOCs had MCLs, so these values were used as the remedial levels. The remedial level for a CMCOC represents that soil concentration that is unlikely to leach into groundwater or migrate to surface water in concentrations that present a significant threat to human health; therefore, the remedial levels in soil were based upon target groundwater concentrations (i.e., represent a defined risk to a receptor). The CMCOCs (cadmium and chromium) were identified as COCs based on their systemic risk; therefore, the risk-based remedial levels were calculated based on only the noncarcinogenic risks. The target groundwater value represents either the MCL or the risk-based concentration based on an HI of 1.0 for an on-site resident child (the most sensitive receptor population). As a conservative measure, the lowest of these two values was selected as the target groundwater concentration. If the soil remedial level was lower than the reference background concentration, then the remedial level defaulted to background. The recommended remedial levels for CMCOCs in soils were compared to the reference background levels for subsurface soil. Given the comparative thickness of subsurface soil and its proximity to groundwater relative to surface soil, the amount of a constituent leaching to groundwater from the subsurface soil is likely to be much greater than the contribution from surface soil. The concentration of a CMCOC should be evaluated relative to the soil stratum that contributes the greatest amount of an inorganic to groundwater; therefore, the subsurface soil reference background concentrations may be used as the remedial levels for CMCOCs.

- The maximum concentrations of benzo(*a*)anthracene (2.87 mg/kg), benzo(*b*)fluoranthene (3.64 mg/kg), and indeno(*1,2,3-cd*)pyrene (2.46 mg/kg) in surface soil were below their recommended remedial levels (8.93 mg/kg); therefore, no further investigation is required for these constituents. The recommended remedial value for both benzo(*a*)pyrene and dibenzo(*a,h*)anthracene in surface soil is 0.89 mg/kg.

- The maximum concentration of chromium (31 µg/L) in groundwater was below its remedial level (100 µg/L); therefore, no further investigation is required for chromium in groundwater. The recommended remedial level for 1,1-dichloroethene is its MCL, 7 µg/L.

- The subsurface soil background concentration (11.6 mg/kg) is recommended as the remedial level for cadmium in soil. Given that the recommended remedial value for chromium in soil is higher than the maximum detected value (7.4 mg/kg), no further study is required for chromium in soil. The risk-based remedial level for cadmium in soil, based on this target groundwater concentration (MCL of 5 µg/L), is 0.63 mg/kg.

11.2.5 Supplemental Groundwater Characterization (October/November 2000)

The following conclusions have been made based on the results of the supplemental groundwater investigation:

- 1,1-Dichloroethene was not detected in the eight wells sampled in October/November 2000; therefore, 1,1-dichloroethene is not an SRC in groundwater.

11.3 RISK MANAGEMENT AND SITE RECOMMENDATIONS

- Cadmium was identified as a possible COC in surface soil based on its potential to leach to groundwater, resulting in a risk to human health. Cadmium was detected in only one of eight surface soil samples at a concentration of 0.76 mg/kg, which is slightly above its remedial level (0.63 mg/kg). Cadmium was not detected in groundwater. The estimated groundwater concentration of 6 µg/L will be reached only after 500 years, assuming that the source of chromium remains constant during the 500-year time period. In addition, the groundwater concentration (6 µg/L) estimated from the conservative leachate model (SESOIL) was only slightly above its target groundwater concentration (5 µg/L). Given the conservatism of the leachate modeling and the fact that cadmium was not detected in groundwater, the potential threat to human health as a result of exposure via groundwater is likely to be minimal; therefore, cadmium in surface soil does not require further investigation and/or evaluation.

- Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene were identified as HHCOCs in surface soil. Because the contamination is primarily associated with surface soil, it seems to be the result of operations of the maintenance facility rather than an underground release from the OWS. The area around SWMU 27H, Building 1071 is covered by concrete; therefore, receptors on the site would not be exposed to constituents present in the surface soil. The results of the leachate modeling indicated that neither of these constituents is likely to migrate to groundwater at a concentration that presents a significant risk to human health. Benzo(*a*)pyrene and dibenzo(*a,h*)anthracene do not present risks to human health because these constituents are effectively isolated from current receptors. As long as the present land use (industrialized site under federal control) is maintained and the concrete cover remains, these constituents will not present a risk to human health.

- 1,1-Dichloroethene was detected in only two of 16 groundwater samples (including background samples) during the Phase II investigation in 1999. Only one of these detections (8.6 µg/L at MW3) was slightly above its remedial level (7 µg/L). Supplemental groundwater sampling in October/November 2000 indicated that 1,1-dichloroethene was not present at the site; therefore, groundwater does not require further investigation and/or evaluation.

- Based on the information provided in this section, Fort Stewart respectfully requests that SWMU 27H, Building 1071 be assigned an NFA status. If approved by GEPD, the Installation's Subpart B permit should be amended to annotate this change in investigative status.

- Fort Stewart proposes that the eight monitoring wells installed for the Phase II RFI be left in place in the event that a release occurs in the future. The site is active, and a future release is a possibility. By leaving the monitoring wells in place, Fort Stewart will maintain the ability to sample the site as required.

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Table 1. Summary of Phase I RFI Analytes Detected in Subsurface Soil, SWMU 27H, Building 1071

Station	**Reference Background Criteria**	**7NGP1**	**7NGP2**	**7NGP3**	**7NGP4**
Sample ID		**7N1111**	**7N1211**	**7N1311**	**7N1411**
Date		**01/21/98**	**01/21/98**	**02/04/98**	**01/21/98**
Depth (feet)		**6 to 8**	**6 to 8**	**6 to 8**	**6 to 8**
Sample Type		**Grab**	**Grab**	**Grab**	**Grab**
Volatile Organic Compounds (mg/kg)					
Acetone	0.00				**0.0512**
Toluene	0.00				**0.0163**
Semivolatile Organic Compounds (mg/kg)					
Acenaphthylene	0.00		**1.37**		**0.796**
Benzo(*a*)anthracene	0.00		**5.24**	**1.86**	**3.72**
Benzo(*a*)pyrene	0.00		**5.04**	**1.79**	**3.44**
Benzo(*b*)fluoranthene	0.00		**5.15**	**1.76**	**3.49**
Benzo(*g,h,i*)perylene	0.00		**3.56**	**0.948**	**2.18**
Benzo(*k*)fluoranthene	0.00		**4.72**	**1.42**	**3.4**
Chrysene	0.00		**6.21**	**1.94**	**4.48**
Fluoranthene	0.00		**4.93**	**2.18**	**3.03**
Indeno(*1,2,3-cd*)pyrene	0.00		**3.31**	**0.986**	**2**
Phenanthrene	0.00		**1.86**		
Pyrene	0.00		**10.6**	**3.35**	**7.06**
Metals (mg/kg)					
Arsenic	8.04	0.42			0.45
Barium	17.00	1.9	4.2	3.2	13.4
Cadmium	0.24				0.22
Chromium	11.60	6.8	3.2	7.3	4.9
Lead	11.10	2.9	4.2	5.4	**47.3**
Mercury	0.06			**0.09**	
Selenium	1.12			0.21	

Bold indicates concentrations above reference background criteria.

Table 2. Summary of Phase I RFI Analytes Detected in Groundwater, SWMU 27H, Building 1071

Station	**Reference Background Criteria**	**MCL**	**7NGP1**	**7NGP2**	**7NGP3**	**7NGP4**
Sample ID			**7N4111**	**7N4211**	**7N4311**	**7N4411**
Date			**01/21/98**	**01/21/98**	**02/04/98**	**01/21/98**
Sample Type			**Grab**	**Grab**	**Grab**	**Grab**
Volatile Organic Compounds (µg/L)						
Acetone	0.00			**141**		
Semivolatile Organic Compounds (µg/L)						
Benzo(*a*)anthracene	0.00					**13.3**
Benzo(*a*)pyrene	0.00	0.2				***11.5***
Benzo(*b*)fluoranthene	0.00					**18.4**
Benzo(*g,h,i*)perylene	0.00					**6**
Chrysene	0.00					**18.6**
Fluoranthene	0.00					**18.8**
Indeno(*1,2,3-cd*)pyrene	0.00					**5.8**
Phenanthrene	0.00					**11.7**
Pyrene	0.00					**30.4**
Metals (µg/L)						
Barium	71.72	2,000	17.9	11.9	27	7.4
Chromium	3.56	100	0.68	0.72	0.96	1.9

Bold indicates concentrations above reference background criteria.
Boxed *italic* indicates concentrations above MCLs.

Table 3. Monitoring Well Construction Summary, SWMU 27H, Building 1071

Well No.	**Date Installed**	**Size/Type**	**Coordinates**	**Total Depth (feet)**	**Screen Interval (feet bgs)**	**Top of Filter Pack Elevation (feet bgs)**	**Top of Casing Elevation (feet)**
27H-MW1	10/08/99	2-inch PVC	N 677550.27 E 826580.39	15.0	3.65 to 13.65	1.75	83.7
27H-MW2	10/07/99	2-inch PVC	N 677552.07 E 826582.50	48.0	34.75 to 44.75	32	83.73
27H-MW3	10/07/99	2-inch PVC	N 677503.53 E 826531.33	15.0	3.75 to 13.75	0.5	83.34
27H-MW4	10/07/99	2-inch PVC	N 677561.80 E 826515.37	15.0	3.15 to 13.15	1	83.59
27H-MW5	10/08/99	2-inch PVC	N 677563.73 E 826517.57	48.0	34.75 to 44.75	31.5	83.68
27H-MW6	10/08/99	2-inch PVC	N 677621.31 E 826421.29	15.0	4.20 to 14.20	2.5	83.47
27H-MW7	10/08/99	2-inch PVC	N 677619.50 E 826419.72	45.0	33.90 to 43.90	31	83.41
27H-MW8	10/08/99	2-inch PVC	N 677543.67 E 826426.54	45.0	33.70 to 43.70	30.5	81.52

Note: All elevations are National Geodetic Vertical Datum 1929.
PVC = Polyvinyl chloride.

Table 4. Summary of Geotechnical Analyses, SWMU 27H, Building 1071

Station	**27H-MW1**	**27H-MW2**	**27H-MW3**	**27H-MW4**	**27H-MW5**	**27H-MW6**	**27H-MW7**	**27H-MW8**
Sample ID	**7N1173**	**7N1273**	**7N1373**	**7N1473**	**7N1573**	**7N1673**	**7N1773**	**7N1873**
Depth (feet)	**5 to 7**	**35 to 40**	**8 to 10**	**8 to 13**	**40 to 42**	**5 to 15**	**35 to 45**	**35 to 45**
Moisture content (%)	22.6	25.96	28.82	16.68	25.13	19.02	19.69	25.91
Liquid limit	NP	NP	NP	NP	NP	NP	NP	NP
Plastic limit	NP	NP	NP	NP	NP	NP	NP	NP
Plasticity index	NP	NP	NP	NP	NP	NP	NP	NP
Class	NP	NP	NP	NP	NP	NP	NP	NP
Gravel (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sand (%)	85.53	93.71	89.81	89.53	95.11	80.17	94.48	94.79
Fines (%)	14.47	6.29	10.19	10.47	4.89	19.83	5.52	5.21
Specific gravity	2.65	NA	NA	NA	NA	NA	NA	NA
Soil porosity	0.41	NA	NA	NA	NA	NA	NA	NA
Bulk density (pcf)	98.35	NA	NA	NA	NA	NA	NA	NA
Permeability (cm/sec)	3.50E-04	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (mg/kg)	NA	24,400	28,900	NA	NA	NA	NA	NA

NA = Not analyzed.
NP = Non-plastic.
pcf = Pounds per cubic foot.

Table 5. Well Development Summary, SWMU 27H, Building 1071

Well No.	Date	Total Development Time (hours)	Total Volume Removed (gallons)	Final Turbidity Reading (NTUs)	Total Well Depth (feet)
27H-MW1	10/12/99	3 hours, 35 minutes	70	7.1	13.8
27H-MW2	10/12/99	10 hours, 15 minutes	115	Off scale[a]	40.78
27H-MW3	10/11/99	2 hours, 30 minutes	110	9.6	15
27H-MW4	10/11/99	10 hours, 45 minutes	95	9.6	13.31
27H-MW5	10/11/99	12 hours, 35 minutes	480	Off scale[a]	44.7
27H-MW6	10/12/99	8 hours, 50 minutes	230	8.6	14.22
27H-MW7	10/13/99	10 hours, 45 minutes	350	9.7	43.54
27H-MW8	10/14/99	6 hours, 15 minutes	265	292[a]	44.79

[a] MW2, MW5, and MW8 were deep monitoring wells installed to approximately 43 feet bgs and extended into the Hawthorn clay layer.

Table 6. Field Parameter Measurements during Groundwater Sampling, SWMU 27H, Building 1071

Location	Date	pH (su)	Conductivity (mS/cm)	Temperature (°C)	Turbidity (NTUs)	DO (mg/L)	Redox (mV)
27H-MW1[a]	10/28/99	4.82	113.0	26.03	9.5	2.46	174.9
27H-MW2[a]	11/02/99	4.45	70.0	25.95	830[b]	1.88	68.3
27H-MW3	10/28/99	4.70	90.0	25.99	2.7	7.07	32.5
27H-MW4	10/29/99	4.59	624.0	23.64	59.3	17.33	-40.3
27H-MW5	11/01/99	5.04	26.0	24.46	257[b]	1.73	178.6
27H-MW6	10/28/99	5.19	151.0	18.49	40.7	0.58	16.9
27H-MW7	11/01/99	4.31	88.0	24.17	9.8	5.96	225.1
27H-MW8	11/03/99	4.81	71.0	17.59	95.7[b]	5.76	78.7
Average[c]		4.77					
27H-SWS1	10/06/99	5.63	43.0	23.33	NA	26.5	97.0
27H-SWS2	10/06/99	5.73	41.0	23.09	NA	61.2	151.5
27H-SWS3	10/06/99	5.71	1.0	22.12	NA	78.7	188.5
Average		5.69					

[a] Site-specific background location.

[b] MW2, MW5, and MW8 were deep monitoring wells installed to approximately 43 feet bgs and extended into the Hawthorn clay layer.

[c] Site-specific background location not included in average.

Table 7. Summary of Phase II RFI Analytes Detected in Surface Soil, SWMU 27H, Building 1071

Station	Reference Background Criteria	27H-MW1[a]	27H-MW2[a]	27H-MW3	27H-MW4	27H-MW5	27H-MW6	27F-MW7	27H-MW8
Sample ID		7N1171	7N1271	7N1371	7N1471	7N1571	7N1671	7N1771	7N1871
Date		10/08/99	10/07/99	10/07/99	10/07/99	10/08/99	10/08/99	10/08/99	10/08/99
Depth (feet)		1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	0 to 1
Sample Type		Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Volatile Organic Compounds (mg/kg)									
2-Butanone	0.00		R	R	R	0.0097			
Acetone	0.00		R		R	0.0361			
Carbon disulfide	0.00	0.0049	0.0039	0.003		0.0141	0.003	0.006	0.0038
Ethylbenzene	0.00				0.338	0.0333			
Styrene	0.00					0.0036			
Xylenes, total	0.00				3.97	0.318			
Semivolatile Organic Compounds (mg/kg)									
2-Methylnaphthalene	0.00					0.329			
Acenaphthene	0.00					0.235			
Acenaphthylene	0.00	0.0459			2.04	0.543	0.291	0.409	
Anthracene	0.00					0.304	0.0841		
Benzo(*a*)anthracene	0.00	0.441				2.87	1.17	2.04	
Benzo(*a*)pyrene	0.00	0.53				4.06	1.59	3.14	
Benzo(*b*)fluoranthene	0.00	0.54				3.64	2.16	2.89	
Benzo(*g,h,i*)perylene	0.00	0.241				1.98	1.02	1.41	
Benzo(*k*)fluoranthene	0.00	0.56				4.61	1.39	3.21	
Chrysene	0.00	0.534				4.25	1.28	2.89	
Dibenzo(*a,h*)anthracene	0.00				2.77				
Fluoranthene	0.00	0.25	0.0281		5.13	3.76	0.667	1.44	
Fluorene	0.00				2.09	0.201			
Indeno(*1,2,3-cd*)pyrene	0.00	0.307				2.46	0.93	2.16	
Naphthalene	0.00					0.366			
Phenanthrene	0.00	0.0251			1.04	0.926	0.0478		
Pyrene	0.00	0.502			9.17	7.04	1.94	4.17	

Note: Footnotes appear on page 50.

Table 7. Summary of Phase II RFI Analytes Detected in Surface Soil, SWMU 27H, Building 1071 (continued)

Station	Reference Background Criteria	27H-MW1[a]	27H-MW2[a]	27H-MW3	27H-MW4	27H-MW5	27H-MW6	27F-MW7	27H-MW8
Sample ID		7N1171	7N1271	7N1371	7N1471	7N1571	7N1671	7N1771	7N1871
Date		10/08/99	10/07/99	10/07/99	10/07/99	10/08/99	10/08/99	10/08/99	10/08/99
Depth (feet)		1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	0 to 1
Sample Type		Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Metals (mg/kg)									
Arsenic	2.1	0.4			0.42	0.77			
Barium	14.7	3.4	1.4	**29.2**	10.5	9.2	2.5	3.8	4.4
Cadmium	0.18			0.17	**0.76**	**0.22**	0.06	0.06	0.17
Chromium	6.21	1.8	0.5	3.8	2.7	**7.4**	1.4	1	0.92
Lead	8.81	2.6	1.1	**23**	**31.9**	**32.2**	3.1	5.7	**15.6**
Mercury	0.03	0.02		0.02			0.01	0.01	0.02
Silver	0.15		0.11	0.14					

[a] Site-specific background location.

R = Acetone and 2-butanone values were qualified as nondetected by the laboratory. The nondetect values were rejected during validation due to poor initial or continuing instrument response factors for these compounds during their analyses.

Bold indicates concentrations above reference background criteria.

Table 8. Summary of Phase II RFI Analytes Detected in Subsurface Soil, SWMU 27H, Building 1071

Station	Reference Background Criteria	27H-MW1[a]	27H-MW2[a]	27H-MW3	27H-MW4	27H-MW5	27H-MW6	27H-MW7	27H-MW8
Sample ID		7N1172	7N1272	7N1372	7N1472	7N1572	7N1672	7N1772	7N1872
Date		10/08/99	10/07/99	10/07/99	10/07/99	10/08/99	10/08/99	10/08/998	10/8/1999
Depth (feet)		3 to 5	9 to 10	5 to 8	5 to 8	3 to 5	5 to 8	2 to 4	1 to 4
Sample Type		Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Volatile Organic Compounds (mg/kg)									
2-Butanone	0.00	**0.0022**	R	R	R	**0.008**	**0.0033**		
Acetone	0.00		R			**0.038**			
Ethylbenzene	0.00					**0.0094**			
Xylenes, total	0.00					**0.107**			
Semivolatile Organic Compounds (mg/kg)									
2-Methylnaphthalene	0.00					**0.102**			
Acenaphthylene	0.00							**0.529**	
Benzo(*a*)anthracene	0.00							**2.31**	
Benzo(*a*)pyrene	0.00							**3.06**	
Benzo(*b*)fluoranthene	0.00							**2.91**	
Benzo(*k*)fluoranthene	0.00							**2.79**	
Bis(2-ethylhexyl)phthalate	0.00								**15.4**
Chrysene	0.00							**3.12**	
Fluoranthene	0.00							**1.93**	
Naphthalene	0.00					**0.0627**			
Pyrene	0.00							**3.9**	
Metals (mg/kg)									
Arsenic	8.04		0.43				0.32		
Barium	17	2	2.9	1.4	1.9	4.2	3.4	8.4	3
Cadmium	0.23							**0.35**	
Chromium	11.6	4.9	9.4	8.1	8	3.9	4.2	1.8	2.3
Lead	11.1	2.3	7.7	4.9	5.6	2.2	2.2	**18.4**	1.4
Mercury	0.05	0.04	**0.12**	**0.18**	**0.08**	0.04	0.04		0.03
Selenium	1.12		0.74	0.61					
Silver	0.45			0.12	0.14				
Miscellaneous (mg/kg)									
Total organic carbon	2,200	NA	24,400	28,900	NA	NA	NA	NA	NA

[a] Site-specific background location.

NA = Not analyzed.

R = Acetone and 2-butanone values were qualified as nondetected by the laboratory. The nondetect values were rejected during validation due to poor initial or continuing instrument response factors for these compounds during their analyses.

Bold indicates concentrations above reference background criteria.

Table 9. Summary of Phase II RFI Analytes Detected in Groundwater in Geoprobes/Vertical Profiles, SWMU 27H, Building 1071

Station	Reference Background Criteria	Maximum Contaminant Level	27H-GP5	27H-GP6	27H-GP7	27H-GP8	27H-GP9	27H-GP10	27H-GP11	27H-VP1
Sample ID			7N4551	7N4651	7N4751	7N4851	7N4951B	7N4A51	7N4B51	7N4951A
Date			09/23/99	09/23/99	09/22/99	09/22/99	09/29/99	09/29/99	09/29/99	09/27/99
Depth (feet)			0 to 12.8	0 to 11.7	0 to 11.18	0 to 11.5	0 to 10	0 to 11	0 to 11	12 to 16
Sample Type			Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Volatile Organic Compounds (µg/L)										
Ethylbenzene	0.00	700				5.8	2.1			2.7
Xylenes, total	0.00	10,000				56.9	17.6	7		32.4

Bold indicates concentrations above reference background criteria.

Table 10. Summary of Phase II RFI Analytes Detected in Groundwater in Monitoring Wells, SWMU 27H, Building 1071

Station	Reference Background Criteria	Maximum Contaminant Level	27H-MW1[a]	27H-MW3	27H-MW4	27H-MW4	27H-MW6
Sample ID			7N4171	7N4371	7N4471	7N4471	7N4671
Date			10/28/99	10/28/99	10/29/99	10/29/99	10/28/99
Depth			Shallow	Shallow	Shallow	Shallow	Shallow
Depth (feet)			0 to 14	0 to 14.1	0 to 13.5	0 to 13.5	0 to 14.6
Filtered			Total	Total	Total	Filtered	Total
Sample Type			Grab	Grab	Grab	Grab	Grab
Volatile Organic Compounds (µg/L)							
1,1-Dichloroethane	0.00			9.6			
1,1-Dichloroethene	0.00	7		8.6			
Ethylbenzene	0.00	700			4		
Xylenes, total	0.00	10,000			28.6		
Semivolatile Organic Compounds (µg/L)							
Benzoic acid	0.00				15		
Naphthalene	0.00				3.4		
Metals (µg/L)							
Arsenic	3.02	50					
Barium	71.72	2,000	37.7	19.2	69.4	66.8	50.5
Chromium	3.56	100			6.2		
Lead	4.69	15					
Selenium	1.9	50					

Note: Footnotes appear on page 53.

Table 10. Summary of Phase II RFI Analytes Detected in Groundwater in Monitoring Wells, SWMU 27H, Building 1071 (continued)

Station	Reference Background Criteria	Maximum Contaminant Level	27H-MW2[a]	27H-MW2[a]	27H-MW5	27H-MW5	27H-MW7	27H-MW8	27H-MW8
Sample ID			7N4271	7N4271	7N4571	7N4571	7N4771	7N4871	7N4871
Date			11/02/99	11/02/99	11/01/99	11/01/99	11/01/99	11/03/99	11/03/99
Depth			Deep	Deep	Deep	Deep	Deep	Deep	Deep
Depth (feet)			0 to 45.1	0 to 45.1	0 to 45.1	0 to 45.1	0 to 44.3	0 to 44.1	0 to 44.1
Filtered			Total	Filtered	Total	Filtered	Total	Total	Filtered
Sample Type			Grab	Grab	Grab	Grab	Grab	Grab	Grab
Volatile Organic Compounds (μg/L)									
1,1-Dichloroethane	0.00							**3.4**	
1,1-Dichloroethene	0.00	7						**2.7**	
Ethylbenzene	0.00	700							
Xylenes, total	0.00	10,000							
Semivolatile Organic Compounds (μg/L)									
Benzoic acid	0.00								
Naphthalene	0.00								
Metals (μg/L)									
Arsenic	3.02	50	**15.8**						
Barium	71.72	2,000	**170**	**126**	55.4	22.3	38.4	**155**	**152**
Chromium	3.56	100	**48.1**		**31**				
Lead	4.69	15	**27.7**		**9.6**	1.3	1.1		
Selenium	1.9	50	**5.7**						

[a] Site-specific background location.

Bold indicates concentrations above reference background criteria.

Table 11. Summary of Phase II RFI Analytes Detected in Surface Water, SWMU 27H, Building 1071

Station	Reference Background Criteria[a]	27H-SWS1[b]	27H-SWS2	27H-SWS3
Sample ID		7N3111	7N3211	7N3311
Date		10/06/99	10/06/99	10/06/99
Sample Type		Grab	Grab	Grab
Volatile Organic Compounds (μg/L)				
1,1-Dichloroethane	0.00	**2.1**		**2.3**
Semivolatile Organic Compounds (μg/L)				
Pyrene	0.00		**2.1**	
Metals (μg/L)				
Arsenic	0.94		**4.5**	
Barium	44.8	42.4	**49.2**	36.2
Cadmium	0.2	**0.91**	**3.8**	**1.1**
Chromium	0.6	**2.8**	**6**	**1.9**
Lead	5.2	**9.3**	**27.5**	**6.6**

[a] Site reference background is SWS1 in Mill Creek from 724th Tanker Purging Station, SWMU 26.

[b] Site-specific background location.

Bold indicates concentrations above reference background criteria (Tanker Purging Station).

Table 12. Summary of Phase II RFI Analytes Detected in Sediment, SWMU 27H, Building 1071

Station	Reference Background Criteria[a]	27H-SWS1[b]	27H-SWS2	27H-SWS3
Sample ID		7N2111	7N2211	7N2311
Date		10/06/99	10/06/99	10/06/99
Sample Type		Grab	Grab	Grab
Volatile Organic Compounds (mg/kg)				
2-Butanone	0.00	R[c]	R[c]	**0.0209**
Acetone	0.00			**0.307**
Semivolatile Organic Compounds (mg/kg)				
Fluoranthene	0.00	**0.0544**	**0.0422**	**0.265**
Phenanthrene	0.00			**0.109**
Pyrene	0.00	**0.0878**	**0.0762**	**0.408**
Metals (mg/kg)				
Barium	3	1.4	**8**	**3.6**
Cadmium	0.12	**0.14**	**1**	**0.26**
Chromium	0.37	**11**	**7.1**	**3.6**
Lead	1.38	**8.3**	**14.9**	**14**
Mercury	0.02	**0.15**	0.01	R[d]
Selenium	0.24	**0.46**		
Silver	0.17	**0.3**	**0.34**	**0.3**

[a] Site reference background is SWS1 in Mill Creek from 724th Tanker Purging Station, SWMU 26.

[b] Site-specific background location.

Bold indicates concentrations above reference background criteria (Tanker Purging Station).

[c] R = 2-Butanone values were qualified as nondetected by the laboratory. The nondetect values were rejected during validation due to poor initial or continuing instrument response factors for these compounds during their analyses.

[d] R = The mercury value was qualified as nondetected by the laboratory. The nondetect value was rejected during validation because associated continuing calibration blank values had negative results more than twice the instrument detection limit.

Table 13. Summary of Site-related Contaminants, SWMU 27H, Building 1071

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
1,1-Dichloroethane	ND	ND	ND	9.6	2.3
1,1-Dichloroethene	ND	ND	ND	8.6	ND
2-Butanone	0.0097	0.008	0.0209	ND	ND
Acetone	0.0361	0.0512[a]	0.307	ND	ND
Carbon disulfide	0.0141	ND	ND	ND	ND
Ethylbenzene	0.338	0.0094	ND	5.8	ND
Styrene	0.0036	ND	ND	ND	ND
Xylenes, total	3.97	0.107	ND	56.9	ND
Semivolatile Organic Compounds					
2-Methylnaphthalene	0.329	0.102	ND	ND	ND
Acenaphthene	0.235	ND	ND	ND	ND
Acenaphthylene	2.04	1.37[a]	ND	ND	ND
Anthracene	0.304	ND	ND	ND	ND
Benzo(*a*)anthracene	2.87	5.24[a]	ND	ND	ND
Benzo(*a*)pyrene	4.06	5.04[a]	ND	ND	ND
Benzo(*b*)fluoranthene	3.64	5.15[a]	ND	ND	ND
Benzo(*g,h,i*)perylene	1.98	3.56[a]	ND	ND	ND
Benzo(*k*)fluoranthene	4.61	4.72[a]	ND	ND	ND
Benzoic acid	ND	ND	ND	15	ND
Bis(2-ethylhexyl)phthalate	ND	15.4	ND	ND	ND
Chrysene	4.25	6.21[a]	ND	ND	ND
Dibenzo(*a,h*)anthracene	2.77	ND	ND	ND	ND
Fluoranthene	5.13	4.93[a]	0.265	ND	ND
Fluorene	2.09	ND	ND	ND	ND
Indeno(*1,2,3-cd*)pyrene	2.46	3.31[a]	ND	ND	ND
Naphthalene	0.366	0.0627	ND	3.4	ND
Phenanthrene	1.04	1.86[a]	0.109	ND	ND
Pyrene	9.17	10.6[a]	0.408	ND	2.1
Metals					
Arsenic	BRBC	BRBC	ND	ND	4.5
Barium	29.2	BRBC	8	155	49.2
Cadmium	0.76	0.35	1	ND	3.8
Chromium	7.4	BRBC	11	31	6
Lead	32.2	47.3[a]	14.9	9.6	27.5
Mercury	BRBC	0.18	0.15	ND	ND
Selenium	ND	BRBC	0.46	ND	ND
Silver	BRBC	BRBC	0.34	ND	ND

[a] Phase I RFI data.

BRBC = Below reference background criteria.

ND = Not detected above reference background criteria.

Table 14. GSSL Screening of Site-related Contaminants in Soil, SWMU 27H, Building 1071

Site-related Contaminant	Maximum Concentration	GSSL[a]	CMCOPC?
Volatile Organic Compounds (mg/kg)			
2-Butanone	0.0097	7.685	No
Acetone	0.0512	16	No
Carbon disulfide	0.0141	32	No
Ethylbenzene	0.338	13	No
Styrene	0.0036	4	No
Xylenes, total	3.97	190	No
Semivolatile Organic Compounds (mg/kg)			
2-Methylnaphthalene[b]	0.329	22.574	No
Acenaphthene	0.235		No
Acenaphthylene[b,c]	2.04	111	No
Anthracene	0.304	12,000	No
Benzo(*a*)anthracene	5.24	2	Yes
Benzo(*a*)pyrene	5.04	8	No
Benzo(*b*)fluoranthene	5.15	5	Yes
Benzo(*g,h,i*)perylene[b,d]	3.56	394	No
Benzo(*k*)fluoranthene	4.72	49	No
Bis(2-ethylhexyl)phthalate	15.4	3,600	No
Chrysene	6.21	160	No
Dibenzo(*a,h*)anthracene	2.77	2	Yes
Fluoranthene	5.13	4,300	No
Fluorene	2.09	560	No
Indeno(*1,2,3-cd*)pyrene	2.46	14	No
Naphthalene	0.366	84	No
Phenanthrene[b,e]	1.86	80.4	No
Pyrene	10.6	4,200	No
Metals (mg/kg)			
Barium	29.2	82	No
Cadmium	0.76	0.4	Yes
Chromium	7.4	2	Yes
Lead[f]	47.3	400	No
Mercury	0.18	0.1	Yes

[a] GSSL = EPA GSSL with a dilution attenuation factor (DAF) of 1 for inorganics and a DAF of 20 for volatile and semivolatile organics. A DAF of 1 for inorganics was used because average pH of groundwater is less than 5 (Table 6); unless otherwise indicated (SAIC 1999). GSSL is taken from *Soil Screening Guidance: Technical Background Document* (EPA 1996b).

[b] EPA-suggested GSSL is not available; GSSL is calculated following *Soil Screening Guidance: Technical Background Document* (EPA 1996b). GSSLs are back-calculated from MCL, if available; otherwise, GSSLs are back-calculated based on EPA Region III RBCs corresponding to 10^{-6} risk or HQ = 1 (SAIC 1999).

[c] The RBC for acenaphthene was used to develop the GSSL for acenaphthylene.

[d] An RBC was not available for benzo(*g,h,i*)perylene; therefore, an RBC was calculated based on a toxicity equivalence factor of 0.01 [see Section 7.3 of the revised final Phase II RFI Report (SAIC 2000a)] and was used to develop the GSSL.

[e] The RBC for pyrene was used to develop the GSSL for phenanthrene.

[f] A screening level of 400 mg/kg is used for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA 1994b).

Table 15. GSSL Screening of Site-related Contaminants in Sediment Using Mill Creek as Background, SWMU 27H, Building 1071

Site-related Contaminant	Maximum Concentration	GSSL[a]	CMCOPC?
Volatile Organic Compounds (mg/kg)			
2-Butanone	0.0209	7.685	No
Acetone	0.307	16	No
Semivolatile Organic Compounds (mg/kg)			
Fluoranthene	0.265	4,300	No
Phenanthrene[b,c]	0.109	80.4	No
Pyrene	0.408	4,200	No
Metals (mg/kg)			
Barium	8	1,600	No
Cadmium	1	8	No
Chromium	11	38	No
Lead[d]	14.9	400	No
Mercury	0.15	2	No
Selenium	0.46	5	No
Silver	0.34	34	No

[a] GSSL = EPA GSSL with a dilution attenuation factor (DAF) of 20 for inorganics and volatile and semivolatile organics. A DAF of 20 for inorganics was used because average pH of surface water is greater than 5 (Table 6); unless otherwise indicated (SAIC 1999), GSSL is taken from *Soil Screening Guidance: Technical Background Document* (EPA 1996b).

[b] EPA–suggested GSSL is not available; GSSL is calculated following *Soil Screening Guidance: Technical Background Document* (EPA 1996b). GSSLs are back-calculated from MCL, if available; otherwise, GSSLs are back-calculated based on EPA Region III RBCs corresponding to 10^{-6} risk or HQ = 1 (SAIC 1999).

[c] RBC of pyrene was used to develop GSSL for phenanthrene.

[d] A screening level of 400 mg/kg is used for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA 1994b).

Table 16. Human Health Risk Screening for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment, SWMU 27H, Building 1071

SURFACE SOIL						
Analyte	Results> Detection Limit	Minimum Detect	Maximum Detect	EPA Region III Residential	HHCOPC?	Justification
Volatile Organic Compounds (mg/kg)						
2-Butanone	1/4	0.0097	0.0097	4,693	No	Max Detect < Risk Criteria
Acetone	1/5	0.0361	0.0361	782.1	No	Max Detect < Risk Criteria
Carbon disulfide	5/6	0.003	0.0141	782.1	No	Max Detect < Risk Criteria
Ethylbenzene	2/6	0.0333	0.338	782.1	No	Max Detect < Risk Criteria
Styrene	1/6	0.0036	0.0036	1,564	No	Max Detect < Risk Criteria
Xylenes, total	2/6	0.318	3.97	15,640	No	Max Detect < Risk Criteria
Semivolatile Organic Compounds (mg/kg)						
2-Methylnaphthalene	1/6	0.329	0.329	156.4	No	Max Detect < Risk Criteria
Acenaphthene	1/6	0.235	0.235	469.3	No	Max Detect < Risk Criteria
Acenaphthylene[a]	4/6	0.291	2.04	234.6	No	Max Detect < Risk Criteria
Anthracene	2/6	0.0841	0.304	2,346	No	Max Detect < Risk Criteria
Benzo(*a*)anthracene	3/6	1.17	2.87	0.875	Yes	Max Detect > Risk Criteria
Benzo(*a*)pyrene	3/6	1.59	4.06	0.0875	Yes	Max Detect > Risk Criteria
Benzo(*b*)fluoranthene	3/6	2.16	3.64	0.875	Yes	Max Detect > Risk Criteria
Benzo(*g,h,i*)perylene[b]	3/6	1.02	1.98	8.75	No	Max Detect < Risk Criteria
Benzo(*k*)fluoranthene	3/6	1.39	4.61	8.75	No	Max Detect < Risk Criteria
Chrysene	3/6	1.28	4.25	87.5	No	Max Detect < Risk Criteria
Dibenzo(*a,h*)anthracene	1/6	2.77	2.77	0.0875	Yes	Max Detect > Risk Criteria
Fluoranthene	4/6	0.667	5.13	312.9	No	Max Detect < Risk Criteria
Fluorene	2/6	0.201	2.09	312.9	No	Max Detect < Risk Criteria
Indeno(*1,2,3-cd*)pyrene	3/6	0.93	2.46	0.875	Yes	Max Detect > Risk Criteria
Naphthalene	1/6	0.366	0.366	156.4	No	Max Detect < Risk Criteria
Phenanthrene[a]	3/6	0.0478	1.04	234.6	No	Max Detect < Risk Criteria
Pyrene	4/6	1.94	9.17	234.6	No	Max Detect < Risk Criteria
Metals (mg/kg)						
Barium	6/6	2.5	29.2	547.5	No	Max Detect < Risk Criteria
Cadmium	6/6	0.06	0.76	7.821	No	Max Detect < Risk Criteria
Chromium	6/6	0.92	7.4	23.46	No	Max Detect < Risk Criteria
Lead	6/6	3.1	32.2	400	No	Max Detect < Risk Criteria

Note: Footnotes appear on page 61.

Table 16. Human Health Risk Screening for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment, SWMU 27H, Building 1071 (continued)

SUBSURFACE SOIL							
Analyte	**Results> Detection Limit**	**Minimum Detect**	**Maximum Detect**	**EPA Region III Residential**	**EPA Region III Industrial**	**HHCOPC?**	**Justification**
Volatile Organic Compounds (mg/kg)							
2-Butanone	2/7	0.0033	0.008	4,693	NA	No	Max Detect < Risk Criteria
Acetone	2/10	0.038	0.0512	782.1	NA	No	Max Detect < Risk Criteria
Ethylbenzene	1/10	0.0094	0.0094	782.1	NA	No	Max Detect < Risk Criteria
Xylenes, total	1/10	0.107	0.107	15,640	NA	No	Max Detect < Risk Criteria
Semivolatile Organic Compounds (mg/kg)							
2-Methylnaphthalene	1/10	0.102	0.102	156.4	NA	No	Max Detect < Risk Criteria
Acenaphthylene[a]	3/10	0.529	1.37	234.6	NA	No	Max Detect < Risk Criteria
Benzo(*a*)anthracene	4/10	1.86	5.24	0.875	7.84	No	Max Detect < Risk Criteria
Benzo(*a*)pyrene	4/10	1.79	5.04	0.0875	0.784	Yes	Max Detect > Risk Criteria
Benzo(*b*)fluoranthene	4/10	1.76	5.15	0.875	7.84	No	Max Detect < Risk Criteria
Benzo(*g,h,i*)perylene[b]	3/10	0.948	3.56	8.75	NA	No	Max Detect < Risk Criteria
Benzo(*k*)fluoranthene	4/10	1.42	4.72	8.75	NA	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	1/10	15.4	15.4	45.62	NA	No	Max Detect < Risk Criteria
Chrysene	4/10	1.94	6.21	87.5	NA	No	Max Detect < Risk Criteria
Fluoranthene	4/10	1.93	4.93	312.9	NA	No	Max Detect < Risk Criteria
Indeno(*1,2,3-cd*)pyrene	3/10	0.986	3.31	0.875	7.84	No	Max Detect < Risk Criteria
Naphthalene	1/10	0.0627	0.0627	156.4	NA	No	Max Detect < Risk Criteria
Phenanthrene[a]	1/10	1.86	1.86	234.6	NA	No	Max Detect < Risk Criteria
Pyrene	4/10	3.35	10.6	234.6	NA	No	Max Detect < Risk Criteria
Metals (mg/kg)							
Cadmium	2/10	0.22	0.35	7.821	NA	No	Max Detect < Risk Criteria
Lead	10/10	1.4	47.3	400	NA	No	Max Detect < Risk Criteria
Mercury[c]	6/10	0.03	0.18	2.346	NA	No	Max Detect < Risk Criteria

Note: Footnotes appear on page 61.

Table 16. Human Health Risk Screening for Surface Soil, Subsurface Soil, Groundwater, Surface Water, Sediment, SWMU 27H, Building 1071 (continued)

GROUNDWATER						
Analyte	**Freq. of Detection**	**Minimum Detected**	**Maximum Detected**	**Human Health Criteria**	**HHCOPC?**	**Justification**
Volatile Organic Compounds (μg/L)						
1,1-Dichloroethane	2/14	3.4	9.6	79.84	No	Max Detect < Risk Criteria
1,1-Dichloroethene	2/14	2.7	8.6	0.0436	Yes	Max Detect > Risk Criteria
Ethylbenzene	4/14	2.1	5.8	134	No	Max Detect < Risk Criteria
Xylenes, total	5/14	7	56.9	1,217	No	Max Detect < Risk Criteria
Semivolatile Organic Compounds (μg/L)						
Benzoic acid	1/6	15	15	14,600	No	Max Detect < Risk Criteria
Naphthalene	1/6	3.4	3.4	0.6511	Yes	Max Detect > Risk Criteria
Metals (μg/L)						
Barium	6/6	19.2	155	255.5	No	Max Detect < Risk Criteria
Chromium	2/6	6.2	31	10.95	Yes	Max Detect > Risk Criteria
Lead	2/6	1.1	9.6	15	No	Max Detect < Risk Criteria

SURFACE WATER							
Analyte	**Results > Detection Limit**	**Minimum Detect**	**Maximum Detect**	**EPA Region III Tap Water**	**AWQC**	**COPC?**	**Justification**
Volatile Organic Compounds (μg/L)							
1,1-Dichloroethane	2/3	2.1	2.3	79.84		No	Max Detect < Risk Criteria
Semivolatile Organic Compounds (μg/L)							
Pyrene	1/3	2.1	2.1	NA[d]	960	No	Max Detect < Risk Criteria
Metals (μg/L)							
Arsenic	1/3	4.5	4.5	NA[d]		No	Max Detect < Risk Criteria
Barium	3/3	36.2	49.2	255.5		No	Max Detect < Risk Criteria
Cadmium	3/3	0.91	3.8	1.825		Yes	Max Detect >Risk Criteria
Chromium	3/3	1.9	6	10.95		No	Max Detect < Risk Criteria
Lead	3/3	6.6	27.5	15		Yes	Max Detect > Risk Criteria

Note: Footnotes appear on page 61.

Table 16. Human Health Risk Screening for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment, SWMU 27H, Building 1071 (continued)

SEDIMENT						
Analyte	**Results> Detection Limit**	**Minimum Detect**	**Maximum Detect**	**EPA Region III Residential**	**HHCOPC?**	**Justification**
Volatile Organic Compounds (mg/kg)						
2-Butanone	1/1	0.0209	0.0209	4,693	No	Max Detect < Risk Criteria
Acetone	1/3	0.307	0.307	782.1	No	Max Detect < Risk Criteria
Semivolatile Organic Compounds (mg/kg)						
Fluoranthene	3/3	0.0422	0.265	312.9	No	Max Detect < Risk Criteria
Phenanthrene	1/3	0.109	0.109		No	Max Detect < Risk Criteria
Pyrene	3/3	0.0762	0.408	234.6	No	Max Detect < Risk Criteria
Metals (mg/kg)						
Barium	3/3	1.4	8	547.5	No	Max Detect < Risk Criteria
Cadmium	3/3	0.14	1	7.821	No	Max Detect < Risk Criteria
Chromium	3/3	3.6	11	23.46	No	Max Detect < Risk Criteria
Lead	3/3	8.3	14.9	400	No	Max Detect < Risk Criteria
Mercury	2/2	0.01	0.15	2.346	No	Max Detect < Risk Criteria
Selenium	1/3	0.46	0.46	39.11	No	Max Detect < Risk Criteria
Silver	3/3	0.3	0.34	39.11	No	Max Detect < Risk Criteria

[a] Screening value for pyrene was used.

[b] Screening value derived using a toxicity equivalence factor of 0.01 based on benzo(*a*)pyrene.

[c] Screening value for mercuric chloride was used.

[d] NA = Not applicable; this constituent has an AWQC value.

AWQC = Ambient Water Quality Criterion.

NA = Not applicable.

Table 17. Ecological Screening Value Comparison for Analytes Detected in Surface Water, SWMU 27H, Building 1071

Analyte	SWMU 27H, Building 1071 Maximum	ESV	ECOPC Aquatic Biota?	Justification
Volatile Organic Compounds (µg/L)				
1,1-Dichloroethane	2.3	47[a]	No	Max Detect < ESV
Semivolatile Organic Compounds (µg/L)				
Pyrene	2.1	No ESV	Yes	ECOPC by default
Metals (µg/L)				
Arsenic	4.5	190	No	Max Detect < ESV
Barium	49.2	4[a]	Yes	Max Detect > ESV
Cadmium	3.8	0.66[b]	Yes	Max Detect > ESV
Chromium	6	117.32[b]	No	Max Detect < ESV
Lead	27.5	1.32[b]	Yes	Max Detect > ESV

[a] Chronic National Ambient Water Quality Criteria or Tier II values as reported in Suter and Tsao (1996), Table 1 or Table 3.

[b] Hardness dependent; assumes 50 mg/L $CaCO_3$.

ESV = EPA Region IV ESVs (EPA 1996a) and, where indicated, alternative values for analytes without ESVs.

Cells with double borders indicate concentrations exceeding ESV or, when there is no ESV, compounds that become ECOPCs by default.

Table 18. Ecological Screening Value Comparison for Analytes Detected in Sediment, SWMU 27H, Building 1071

Analyte	SWMU 27H, Building 1071Maximum	ESV	ECOPC Aquatic Biota?	Justification
Volatile Organic Compounds (mg/kg)				
2-Butanone	0.0209	0.273[a]	No	Max Detect < ESV
Acetone	0.307	0.00863[a]	Yes	Max Detect > ESV
Semivolatile Organic Compounds (mg/kg)				
Fluoranthene	0.265	0.33	No	Max Detect < ESV
Phenanthrene	0.109	0.33	No	Max Detect < ESV
Pyrene	0.408	0.33	Yes	Max Detect > ESV
Metals (mg/kg)				
Barium	8	No ESV	Yes	ECOPC by Default
Cadmium	1	1	No	Max Detect < ESV
Chromium	11	52.3	No	Max Detect < ESV
Lead	14.9	30.2	No	Max Detect < ESV
Mercury	0.15	0.1	Yes	Max Detect > ESV
Selenium	0.46	No ESV	Yes	ECOPC by Default
Silver	0.34	2	No	Max Detect < ESV

[a] Site-specific sediment quality benchmarks (SQBs) calculated as K_{ow} × surface water ESV × f_{oc}, assuming $f_{oc} = 0.01$ (see table below).

ESV = EPA Region IV ESVs (EPA 1996a) and, where indicated, alternative values for analytes without ESVs.

Cells with double borders indicate concentrations exceeding ESV or, when there is no ESV, compounds that become ECOPCs by default.

For calculation of SQBs:

Compound	K_{ow} (L/kg)	Surface Water ESV (mg/L)	Source of Surface Water ESV
Acetone	0.5754	1.5	Chronic Tier II value (Suter and Tsao 1996)
2-Butanone	1.95	14	Chronic Tier II value (Suter and Tsao 1996)

Table 19. Ecological Screening Value Comparison for Analytes Detected in Groundwater, SWMU 27H, Building 1071

Analyte	SWMU 27H, Building 1071 Maximum	ESV	ECOPC Aquatic Biota?	Justification
Volatile Organic Compounds (µg/L)				
1,1-Dichloroethane	9.6	47[a]	No	Max Detect < ESV
1,1-Dichloroethene	8.6	303	No	Max Detect < ESV
Ethylbenzene	5.8	453	No	Max Detect < ESV
Xylenes, total	56.9	1.8[a]	Yes	Max Detect > ESV
Semivolatile Organic Compounds (µg/L)				
Benzoic acid	15	41.6[a]	No	Max Detect < ESV
Naphthalene	3.4	62	No	Max Detect < ESV
Metals (µg/L)				
Barium	155	4[a]	Yes	Max Detect > ESV
Chromium	31	117.32[b]	No	Max Detect < ESV
Lead	9.6	1.32[b]	Yes	Max Detect > ESV

[a] Chronic National Ambient Water Quality Criteria or Tier II values as reported in Suter and Tsao (1996), Table 1 or Table 3.

[b] Hardness dependent; assumes 50 mg/L $CaCO_3$.

ESV = EPA Region IV ESVs (EPA 1996a) and, where indicated, alternative values for analytes without ESVs.

Cells with double borders indicate concentrations exceeding ESV or, when there is no ESV, compounds that become ECOPCs by default.

Table 20. Derivation of NOAELs for Mammal Test Species, SWMU 27H, Building 1071

ECOPC	Test Species	Test Species Body Weight (kg) BW_t	Benchmark (mg/kg/day)	Test Duration	Endpoint	Effect	Source	Duration Conversion Factor (DCF)	Endpoint Conversion Factor (ECF)	NOAEL (mg/kg/day) Benchmark × DCF × ECF
INORGANICS										
Metals										
Barium	Rat	4.35E-01	5.06E-00	Chronic	NOAEL	Growth	Perry et al. (1983) in [1]	1.0	1.0	5.06E-00
Cadmium	Rat	3.03E-01	1.00E-00	Chronic	NOAEL	Reproduction	Sutou et al. (1980b) in [1]	1.0	1.0	1.00E-00
Lead[a]	Rat	3.50E-01	8.00E-00	Chronic	NOAEL	Reproduction	Azar et al. (1973) in [1]	1.0	1.0	8.00E-00
Mercury	Mink	1.00E-00	1.01E-00	Chronic	NOAEL	Reproduction	Aulerich et al. (1974) in [1]	1.0	1.0	1.01E-00
Selenium	Rat	3.50E-01	2.00E-01	Chronic	NOAEL	Reproduction	Rosenfeld and Beath (1954) in [1]	1.0	1.0	2.00E-01
ORGANICS										
Volatile Organic Compounds										
Acetone	Rat	3.50E-01	1.00E+02	Subchronic	NOAEL	Reproduction	EPA (1986c) in [1]	0.1	1.0	1.00E+01
Xylenes, total	Mouse	3.00E-02	2.06E-00	Chronic	NOAEL	Reproduction	Marks et al. (1982) in [1]	1.0	1.0	2.06E-00
Semivolatile Organic Compounds										
Pyrene	Mouse	3.00E-02	1.00E+01	Chronic	LOAEL	Reproduction	Opresko (1995) in [2]	1.0	0.1	1.00E-00

[a] = Lead acetate.

DCF = 1 if chronic, 0.1 if subchronic (Sample, Opresko, and Suter 1996).

ECF = 1 if NOAEL, 0.1 if LOAEL (Sample, Opresko, and Suter 1996).

[1] = Sample, Opresko, and Suter (1996).

[2] = QST (1997); all values assumed to be chronic.

Table 21. Derivation of NOAELs for Bird Test Species, SWMU 27H, Building 1071

ECOPC	Test Species	Test Species Body Weight (kg) BW_t	Benchmark (mg/kg/day)	Test Duration	Endpoint	Effect	Source	Duration Conversion Factor (DCF)	Endpoint Conversion Factor (ECF)	NOAEL (mg/kg/day) Benchmark × DCF × ECF
INORGANICS										
Metals										
Barium	Chick (14 days old)	1.21E-01	2.08E+02	Subchronic	NOAEL	Mortality	Johnson et al. (1960) in [1]	0.1	1.0	2.08E+01
Cadmium	Mallard duck	1.15E+00	1.45E+00	Chronic	NOAEL	Reproduction	White and Finley (1978) in [1]	1.0	1.0	1.45E+00
Lead[a]	Quail	1.50E-01	1.13E+00	Chronic	NOAEL	Reproduction	Edens et al. (1976) in [1]	1.0	1.0	1.13E+00
Mercury	Quail	1.50E-01	4.50E-01	Chronic	NOAEL	Reproduction	Hill and Schaffner (1976) in [1]	1.0	1.0	4.50E-01
Selenium	Mallard duck	1.00E+00	5.00E-01	Chronic	NOAEL	Reproduction	Heinz et al. (1989) in [1]	1.0	1.0	5.00E-01
ORGANICS										
Volatile Organic Compounds										
Acetone	None	None	None	None	None	None	None	None	None	No NOAEL
Xylenes, total	None	None	None	None	None	None	None	None	None	No NOAEL
Semivolatile Organic Compounds										
Pyrene	Composite bird	8.50E-01	9.97E+00	Chronic	NOAEL	None	Shortelle et al. (1997) in [2]	1.0	1.0	9.97E+00

[a] = Lead acetate.

DCF = 1 if chronic, 0.1 if subchronic (Sample, Opresko, and Suter 1996).

ECF = 1 if NOAEL, 0.1 if LOAEL (Sample, Opresko, and Suter 1996).

[1] = Sample, Opresko, and Suter 1996.

[2] = QST (1997).

Table 22. Derivation of NOAELs and Screening Toxicity Reference Values for Mammal Receptors, SWMU 27H, Building 1071

Analyte	Test Species	Test Species Body Weight (kg) BW_t	Test Species $NOAEL_t$ (mg/kg/day)	Raccoon		Short-tailed Shrew		Mink	
				Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	NOAEL (mg/kg/day) $NOAEL_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	NOAEL (mg/kg/day) $NOAEL_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	NOAEL (mg/kg/day) $NOAEL_t \times BW_{conv}$
INORGANICS									
Metals									
Barium	Rat	4.35E-01	5.06E+00	5.19E-01	2.63E+00	2.32E+00	1.17E+01	8.12E-01	4.11E+00
Cadmium	Rat	3.03E-01	1.00E+00	4.74E-01	4.74E-01	2.12E+00	2.12E+00	7.42E-01	7.42E-01
Lead	Rat	3.50E-01	8.00E+00	4.92E-01	3.93E+00	2.20E+00	1.76E+01	7.69E-01	6.15E+00
Mercury	Mink	1.00E+00	1.01E+00	6.39E-01	6.46E-01	2.86E+00	2.89E+00	1.00E+00	1.01E+00
Selenium	Rat	3.50E-01	2.00E-01	4.92E-01	9.84E-02	2.20E+00	4.40E-01	7.69E-01	1.54E-01
ORGANICS									
Volatile Organic Compounds									
Acetone	Rat	3.50E-01	1.00E+01	4.92E-01	4.92E+00	2.20E+00	2.20E+01	7.69E-01	7.69E+00
Xylenes, total	Mouse	3.00E-02	2.06E+00	2.66E-01	5.48E-01	1.19E+00	2.45E+00	4.16E-01	8.57E-01
Semivolatile Organic Compounds									
Pyrene	Mouse	3.00E-02	1.00E+00	2.66E-01	2.66E-01	1.19E+00	1.19E+00	4.16E-01	4.16E-01

BW (kg) Raccoon = 5.98.
BW (kg) Shrew = 0.015.
BW (kg) Mink = 1.0.

Table 23. Derivation of NOAELs and Screening Toxicity Reference Values for Bird Receptors, SWMU 27H, Building 1071

Analyte	Test Species	Test Species Body Weight (kg) BW_t	Test Species $NOAEL_t$ (mg/kg/day)	American Robin		Green Heron	
				Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^0$	NOAEL (mg/kg/day) $NOAEL_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^0$	NOAEL (mg/kg/day) $NOAEL_t \times BW_{conv}$
INORGANICS							
Metals							
Barium	Chick (14 days old)	1.21E-01	2.08E+01	1.00E+00	2.08E+01	1.00E+00	2.08E+01
Cadmium	Mallard duck	1.15E+00	1.45E+00	1.00E+00	1.45E+00	1.00E+00	1.45E+00
Lead	Quail	1.50E-01	1.13E+00	1.00E+00	1.13E+00	1.00E+00	1.13E+00
Mercury	Quail	1.50E-01	4.50E-01	1.00E+00	4.50E-01	1.00E+00	4.50E-01
Selenium	Mallard duck	1.00E+00	5.00E-01	1.00E+00	5.00E-01	1.00E+00	5.00E-01
ORGANICS							
Volatile Organic Compounds							
Acetone	None	None	No NOAEL	None	No NOAEL	None	No NOAEL
Xylenes, total	None	None	No NOAEL	None	No NOAEL	None	No NOAEL
Semivolatile Organic Compounds							
Pyrene	Composite bird	8.50E-01	9.97E+00	1.00E+00	9.97E+00	1.00E+00	9.97E+00

BW (kg) Robin = 0.08.

BW (kg) Green heron = 0.25.

Table 24. Derivation of LOAEL Toxicity Reference Values for Mammal Test Species, SWMU 27H, Building 1071

ECOPC	Test Species	Test Species Body Weight (kg) BW,	Benchmark (mg/kg/day)	Test Duration	Endpoint	Effect	Source	Duration Conversion Factor (DCF)	Endpoint Conversion Factor (ECF)	TRV (mg/kg/day) Benchmark × DCF × ECF
INORGANICS										
Metals										
Lead	Rat	3.50E-01	8.00E+01	Chronic	LOAEL	Reproduction	Azar et al. (1973) in [1]	1.0	1.0	8.00E+01
ORGANICS										
Volatile Organic Compounds										
Acetone	Rat	3.50E-01	5.00E+01	Subchronic	LOAEL	Hepatotoxicity	EPA (1986c) in [1]	0.1	1.0	5.00E-00
Semivolatile Organic Compounds										
Pyrene	Mouse	3.00E-02	1.00E+01	Chronic	LOAEL	Reproduction	Surrogate from benzo(*a*)pyrene	1.0	1.0	1.00E+01

DCF = 1 if chronic, 0.1 if subchronic (Sample, Opresko, and Suter 1996).

ECF = 10 if NOAEL, 1.0 if LOAEL (Sample, Opresko, and Suter 1996).

[1] = Sample, Opresko, and Suter (1996).

Table 25. Derivation of LOAEL Toxicity Reference Values for Bird Test Species, SWMU 27H, Building 1071

ECOPC	Test Species	Test Species Body Weight (kg) BW'	Benchmark (mg/kg/day)	Test Duration	Endpoint	Effect	Source	Duration Conversion Factor (DCF)	Endpoint Conversion Factor (ECF)	TRV (mg/kg/day) Benchmark × DCF × ECF
INORGANICS										
Metals										
Lead	Quail	1.50E-01	1.13E+01	Chronic	LOAEL	Reproduction	Edens et al. (1976) in [1]	1.0	1.0	1.13E+01
ORGANICS										
Volatile Organic Compounds										
Acetone	None	None	None	None	None	None		None	None	No TRV
Semivolatile Organic Compounds										
Pyrene	Composite bird	8.50E-01	9.97E+00	Chronic	NOAEL	None	Shortelle et al. (1997) in [2]	1.0	10.0	9.97E+01

DCF = Duration conversion factor; 1 if chronic, 0.1 if subchronic (Sample, Opresko, and Suter 1996).

ECF = Endpoint conversion factor; 10 if NOAEL, 1.0 if LOAEL (Sample, Opresko, and Suter 1996).

[1] = Sample, Opresko, and Suter (1996).

[2] = QST (1997).

Table 26. Derivation of LOAEL Toxicity Reference Values for Mammal Receptors, SWMU 27H, Building 1071

				Raccoon		Short-tailed Shrew		Mink	
ECOPC	Test Species	Test Species Body Weight BW_t (kg)	TRV_t (mg/kg/day)	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	TRV (mg/kg/day) $TRV_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	TRV (mg/kg/day) $TRV_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^{0.25}$	TRV (mg/kg/day) $TRV_t \times BW_{conv}$
INORGANICS									
Metals									
Lead	Rat	3.50E-01	8.00E+01	5.84E-01	4.68E+01	2.20E-00	1.76E+02	7.69E-01	6.15E+01
ORGANICS									
Volatile Organic Compounds									
Acetone	Rat	3.50E-01	5.00E-00	5.84E-01	2.92E-00	2.20E-00	1.10E+01	7.69E-01	3.85E-00
Semivolatile Organic Compounds									
Pyrene	Mouse	3.00E-02	1.00E+01	3.16E-01	3.16E+00	1.19E+00	1.19E+01	4.16E-01	4.16E+00

BW (kg) Raccoon = 3 per Rod Stafford (GEPD), September 1999.
BW (kg) Short-tailed shrew = 0.015 per Sample, Opresko, and Suter (1996), Table B.1.
BW (kg) Mink = 1 per Sample, Opresko, and Suter (1996), Table B.1.

Table 27. Derivation of LOAEL Toxicity Reference Values for Bird Receptors, SWMU 27H, Building 1071

				American Robin		Green Heron	
ECOPC	Test Species	Test Species Body Weight BW_t (kg)	TRV_t (mg/kg/day)	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^0$	TRV (mg/kg/day) $TRV_t \times BW_{conv}$	Body-weight Conversion Factor BW_{conv} $(BW_t / BW)^0$	TRV (mg/kg/day) $TRV_t \times BW_{conv}$
INORGANICS							
Metals							
Lead	Quail	1.50E-01	1.13E+01	1.00E-00	1.13E+01	1.00E-00	1.13E+01
ORGANICS							
Volatile Organic Compounds							
Acetone	None	None	No TRV	None	None	None	None
Semivolatile Organic Compounds							
Pyrene	Composite bird	8.50E-01	9.97E+01	1.00E+00	9.97E+01	1.00E+00	9.97E+01

BW (kg) American robin = 0.077 (Sample, Opresko, and Suter 1996; Table B.1).
BW (kg) Green heron = 0.241 (*Birds of North America*, No. 129, 1994).

Table 28. Preliminary Risk Calculations for ECOPCs in Surface Water, SWMU 27H, Building 1071

			Raccoon			Mink			Green Heron		
ECOPC	**C_{max} (µg/L)**	**BCF**	**ADD (mg/kg/day) = C_{Max} × 0.001 × IR_w**	**TRV (mg/kg/day)**	**HQ = ADD/TRV**	**ADD (mg/kg/day) = C_{Max} × 0.001 × BCF × IR_M**	**TRV (mg/kg/day)**	**HQ = ADD/TRV**	**ADD (mg/kg/day) = C_{Max} × 0.001 × BCF × IR_H**	**TRV (mg/kg/day)**	**HQ =ADD/TRV**
Semivolatile Organic Compounds											
Pyrene	2.1	6.10E+03	1.68E-04	2.66E-01	6.31E-04	1.75E+00	4.16E-01	4.22E+00	2.46E+00	9.97E+00	2.47E-01
Metals											
Barium	49.2	4.00E+00	3.94E-03	2.63E+00	1.50E-03	2.70E-02	4.11E+00	6.56E-03	3.78E-02	2.08E+01	1.81E-03
Cadmium	3.8	5.00E+01	3.04E-04	4.74E-01	6.41E-04	2.60E-02	7.42E-01	3.51E-02	3.65E-02	1.45E+00	2.52E-02
Lead	27.5	3.00E+02	2.20E-03	3.93E+00	5.59E-04	1.13E+00	6.15E+00	1.84E-01	1.58E+00	1.13E+00	1.40E+00

0.001 (mg/µg) = Conversion from µg to mg.
ADD = Average daily dose (mg/kg/day).
BCF = Water-to-fish bioconcentration factor (HAZWRAP 1994).
C_{Max} = Maximum detected concentration (µg/L).
HQ = Hazard quotient.
IR_H = Heron food ingestion rate (kg/kg/day) = 0.192.
IR_M = Mink food ingestion rate (kg/kg/day) = 0.137.
IR_w = Raccoon water ingestion rate (kg/kg/day) = 0.08.
TRV = Toxicity reference value = NOAEL (mg/kg/day); see Tables 22 and 23.
Cells with double borders indicate HQ > 1.

Table 29. Preliminary Risk Calculations for ECOPCs in Drainage Ditch Sediment, SWMU 27H, Building 1071

ECOPC	C_{Max} (mg/kg)	BAF_i	Green Heron		
			ADD (mg/kg/day) $= C_{Max} \times BAF_i \times IR_H$	TRV (mg/kg/day)	HQ =ADD/TRV
Volatile Organic Compounds					
Acetone	0.307	5.00E-02	2.95E-03	No TRV	No HQ
Semivolatile Organic Compounds					
Pyrene	0.408	5.00E-02	3.92E-03	9.97E+00	3.93E-04
Metals					
Barium	8	7.50E-03	1.15E-02	2.08E+01	5.53E-04
Mercury	0.15	3.40E-01	9.79E-03	4.50E-01	2.18E-02
Selenium	0.46	7.60E-01	6.71E-02	5.00E-01	1.34E-01

ADD = Average daily dose (mg/kg/day).
BAF_i = Soil-to-invertebrate bioaccumulation factor (HAZWRAP 1994).
C_{Max} = Maximum detected surface soil concentration (mg/kg).
IR_H = Heron food ingestion rate (kg/kg/day) = 0.192.
TRV = Toxicity reference value = NOAEL (mg/kg/day); see Table 23.
HQ = Hazard quotient.

Table 30. Preliminary Risk Calculations for ECOPCs in Groundwater, SWMU 27H, Building 1071

ECOPC	C_{Max} (µg/L)	BCF	Raccoon ADD (mg/kg/day) = C_{Max} × 0.001 x IR_w	Raccoon TRV (mg/kg/day)	Raccoon HQ = ADD/TRV	Mink ADD (mg/kg/day) = C_{Max} × 0.001 × BCF × IR_M	Mink TRV (mg/kg/day)	Mink HQ = ADD/TRV	Green Heron ADD (mg/kg/day) = C_{Max} × 0.001 × BCF × IR_H	Green Heron TRV (mg/kg/day)	Green Heron HQ = ADD/TRV
Volatile Organic Compounds											
Xylenes, total	56.9	1.70E+01	4.55E-03	5.48E-01	8.30E-03	1.33E-01	8.57E-01	1.55E-01	1.86E-01	No TRV	No HQ
Metals											
Barium	155	4.00E+00	1.24E-02	2.63E+00	4.72E-03	8.49E-02	4.11E+00	2.07E-02	1.19E-01	2.08E+01	5.72E-03
Lead	9.6	3.00E+02	7.68E-04	3.93E+00	1.95E-04	3.95E-01	6.15E+00	6.41E-02	5.53E-01	1.13E+00	4.89E-01

0.001 (mg/µg) = Conversion from µg to mg.
ADD = Average daily dose (mg/kg/day).
BCF = Water-to-fish bioconcentration factor (HAZWRAP 1994).
C_{Max} = Maximum detected concentration (µg/L).
HQ = Hazard quotient.
IR_H = Heron food ingestion rate (kg/kg/day) = 0.192.
IR_M = Mink food ingestion rate (kg/kg/day) = 0.137.
IR_w = Raccoon water ingestion rate (kg/kg/day) = 0.08.
TRV = Toxicity reference value = NOAEL (mg/kg/day); see Tables 22 and 23.

Table 31. Supplemental Risk Calculations for ECOPCs in Surface Water for Mink, SWMU 27H, Building 1071

ECOPC	Site Concentration Mean (µg/L)	BCF	Mink				
			ADD_A (mg/kg/day) = Mean × 0.001 × BCF × I_A × AUF	ADD_W (mg/kg/day) = Mean × 0.001 × IR_W × AUF	ADD_{total} (mg/kg/day) = ADD_A + ADD_W	LOAEL TRV (mg/kg/day)	HQ = ADD_{total}/TRV
Semivolatile Organic Compounds							
Pyrene	4.07E+00	6.10E+03	2.72E-01	3.22E-05	2.72E-01	4.16[a]	6.54E-02

[a] Surrogate value for benzo(*a*)pyrene (see Table 26).

0.001 = Conversion from µg/L to mg/L.
ADD_A = Average daily dose; animal.
ADD_W = Average daily dose; drinking water.
ADD_{total} = Average daily dose; total.
AF = Animal fraction.
AUF = 8.00E-02; AUF assumes 328 feet (100 meters) of stream are contaminated at mean concentration.
BCF = Water-to-fish bioconcentration factor (HAZWRAP 1994).
HQ = Hazard quotient.
I_A = Animal tissue ingestion rate (kg/kg/day) = 1.37E-01.
I_A = TUF × IR_f × AF.
IR_f = Food ingestion rate.
IR_W = water ingestion rate (L/kg/day) = 9.90E-02.
TRV = Toxicity reference value = LOAEL (mg/kg/day); see Table 26.
TUF = Temporal use factor.

Table 32. Supplemental Risk Calculations for ECOPCs in Surface Water for Green Heron, SWMU 27H, Building 1071

ECOPC	Site Concentration Mean (µg/L)	BCF	Green Heron				
			ADD_A (mg/kg/day) = Mean × 0.001 × BCF × I_A × AUF	ADD_W (mg/kg/day) = Mean × 0.001 × IR_W × AUF	ADD_{total} (mg/kg/day) = ADD_A + ADD_W	LOAEL TRV (mg/kg/day)	HQ = ADD_{total}/TRV
Metals							
Lead	1.45E+01	3.00E+02	1.13E+00	1.36E-03	1.13E+00	1.13E+01	1.00E-01

0.001 = Conversion from µg/L to mg/L.
ADD_A = Average daily dose; animal.
ADD_W = Average daily dose; drinking water.
ADD_{total} = Average daily dose; total.
AF = Animal fraction.
AUF = 1; AUF assumes 328 feet (100 meters) of stream are contaminated at mean concentration.
BCF = Water-to-fish bioconcentration factor (HAZWRAP 1994).
HQ = Hazard quotient.
I_A = Animal tissue ingestion rate (kg/kg/day) = 2.60E-01.
I_A = TUF × IR_f × AF.
IR_f = Food ingestion rate.
IR_W = Water ingestion rate (L/kg/day) = 9.40E-02.
TRV = Toxicity reference value = LOAEL (mg/kg/day); see Table 27.
TUF = Temporal use factor.

Table 33. Supplemental Risk Calculations for ECOPCs in Sediment for Raccoon, SWMU 27H, Building 1071

ECOPC	Site Concentration Mean (mg/kg)	BAF_i	Raccoon		
			ADD (mg/kg/day) = Mean × BAF_i × I_A × AUF	**LOAEL TRV (mg/kg/day)**	**HQ = ADD/TRV**
Volatile Organic Compounds					
Acetone	1.08E-01	5.00E-02	4.62E-06	2.92E+00	1.58E-06

ADD = Average daily dose.
AF = Animal fraction.
AUF = 8.55E-04.
BAF_i = Soil-to-invertebrate bioaccumulation factor (HAZWRAP 1994).
HQ = Hazard quotient.
I_A = Animal tissue ingestion rate (kg/kg/day) = 9.96E-02.
I_A = TUF × IR_f × AF.
IR_f = Food ingestion rate.
TUF = Temporal use factor.
TRV = Toxicity reference value = LOAEL (mg/kg/day); see Table 26.

Table 34. Selected Exposure Concentrations, SWMU 27H, Building 1071

Medium/Units	Analyte	Maximum Detected Concentration	95 Percent Upper Confidence Limit
Surface soil (mg/kg)	Benzo(*a*)anthracene	2.87	**2.28**
Surface soil (mg/kg)	Benzo(*a*)pyrene	4.06	**3.13**
Surface soil (mg/kg)	Benzo(*b*)fluoranthene	3.64	**2.98**
Surface soil (mg/kg)	Dibenzo(*a,h*)anthracene	2.77	**2.11**
Surface soil (mg/kg)	Indeno(*1,2,3-cd*)pyrene	2.46	**2.13**
Subsurface soil (mg/kg)	Benzo(*a*)pyrene	5.04	**2.49**
Groundwater (µg/L)	1,1-Dichloroethene	8.6	**3.62**
Groundwater (µg/L)	Naphthalene	**3.4**	5.54
Groundwater (µg/L)	Chromium	31	**16.7**
Surface water (µg/L)	Cadmium	**3.8**	4.66
Surface water (µg/L)	Lead	**27.5**	33.6

Bold indicates exposure concentrations selected.

Table 35. Summary of Leachate Modeling Results, SWMU 27H, Building 1071

Preliminary CMCOPCs[a]	Modeled Groundwater Concentration (mg/L)	Groundwater Target Concentration (mg/L)	Source[b]	CMCOPC?
Organics				
Benzo(*a*)anthracene	0.0	NA	R	No
Benzo(*b*)fluoranthene	0.0	NA	R	No
Dibenzo(*a,h*)anthracene	0.0	NA	R	No
Inorganics				
Cadmium	0.006	0.005	M	Yes
Chromium	0.180	0.1	M	Yes
Mercury	0.001	0.002	M	No

[a] These constituents were selected for SESOIL modeling from this site.

[b] M = MCL; R = risk-based value.

NA = Not applicable.

Table 36. Screening of Human Health Contaminants of Potential Concern in Shallow Surficial Aquifer, SWMU 27H, Building 1071

Analyte	Units	Results > Detection Limit[a]	Maximum Detect	EPA Region III Tap Water	COPC?	Justification	95 Percent Upper Confidence Limit	Surface Water Exposure Concentration[b]
1,1-Dichloroethene	µg/L	1/11	8.6	0.0436	Yes	Max Detect > Risk Criteria	4.23	4.23
Naphthalene	µg/L	1/3	3.4	0.6511	Yes	Max Detect > Risk Criteria	6.32	3.4
Chromium	µg/L	1/3	6.2	10.95	No	Max Detect ≤ Risk Criteria	NA	NA

[a] Screening of shallow surficial groundwater included GP5 through GP11, VP1 (12 feet to 16 feet bgs), MW3, MW4, and MW6. (Note: SVOCs and RCRA metals only performed on groundwater samples from monitoring wells.)

[b] Surface water exposure in adjacent drainage ditch is assumed to be equal to groundwater concentration (measured or 95 percent upper confidence limit).

NA = Not applicable; this constituent is not a COPC.

Table 37. Screening of Human Health Contaminants of Potential Concern in Deep Surficial Aquifer, SWMU 27H, Building 1071

Analyte	Units	Results > Detection Limit[a]	Maximum Detect	EPA Region III Tap Water	COPC?	Justification	Modeled Groundwater Concentration at Point of Surface Water Discharge[b]	HHCOPC Surface Water?
1,1-Dichloroethene	µg/L	1/3	2.7	0.0436	Yes	Max Detect > Risk Criteria	0	No
Chromium	µg/L	1/3	31	10.95	Yes	Max Detect > Risk Criteria	0	No
Naphthalene	µg/L	0/3	ND	0.6511	NA	Not Detected	NA	NA

[a] Screening of deep surficial groundwater included MW5, MW7, and MW8.

[b] Surface water discharge point is a tributary of Mill Creek located approximately 1,500 feet from the site.

NA = Not applicable.

ND = Not detected.

Table 38. Exposure Parameters for Potential Receptor Populations, SWMU 27H, Building 1071

Parameter	Units	Installation Worker	Future On-site Trespasser	On-site Resident Adult	On-site Resident Child	Construction Worker	Off-site Installation Worker	Off-site Resident Adult	Off-site Resident Child	Off-site Sportsman
SURFACE SOIL										
Incidental Ingestion										
Soil ingestion rate	g/day	0.1	0.1	0.1	0.2	NA	NA	NA	NA	NA
Fraction ingested from area	unitless	1	0.25	1	1	NA	NA	NA	NA	NA
Exposure frequency	days/year	250	52	350	350	NA	NA	NA	NA	NA
Exposure duration	years	25	10	30	6	NA	NA	NA	NA	NA
Body weight	kg	70	45	70	15	NA	NA	NA	NA	NA
Carcinogen averaging time	days	25,550	25,550	25,550	25,550	NA	NA	NA	NA	NA
Noncarcinogen averaging time	days	9,125	3,650	10,950	2,190	NA	NA	NA	NA	NA
Dermal Contact										
Skin area	cm^2/event	5,000	3,700	5,000	1,700	NA	NA	NA	NA	NA
Adherence factor	mg/cm^2	1	1	1	1	NA	NA	NA	NA	NA
Exposure frequency	events/year	250	52	350	350	NA	NA	NA	NA	NA
Exposure duration	years	25	10	30	6	NA	NA	NA	NA	NA
Body weight	kg	70	45	70	15	NA	NA	NA	NA	NA
Carcinogen averaging time	days	25,550	25,550	25,550	25,550	NA	NA	NA	NA	NA
Noncarcinogen averaging time	days	9,125	3,650	10,950	2,190	NA	NA	NA	NA	NA
Inhalation of Dust										
Inhalation rate	m^3/hour	2.5	1.90	0.80	0.68	NA	2.5	0.80	0.68	NA
Exposure time	hours/day	8	6	18.4	18.4	NA	8	18.4	18.4	NA
Exposure frequency	days/year	250	52	350	350	NA	250	350	350	NA
Exposure duration	years	25	10	30	6	NA	25	30	6	NA
Body weight	kg	70	45	70	15	NA	70	70	15	NA
Carcinogen averaging time	days	25,550	25,550	25,550	25,550	NA	25,550	25,550	25,550	NA
Noncarcinogen averaging time	days	9,125	3,650	10,950	2,190	NA	9,125	10,950	2,190	NA
SUBSURFACE SOIL										
Incidental Ingestion										
Soil ingestion rate	g/day	NA	NA	NA	NA	0.2	NA	NA	NA	NA
Fraction ingested from area	unitless	NA	NA	NA	NA	1	NA	NA	NA	NA
Exposure frequency	days/year	NA	NA	NA	NA	250	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	1	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	70	NA	NA	NA	NA

Note: Footnotes appear on page 81.

Table 38. Exposure Parameters for Potential Receptor Populations, SWMU 27H, Building 1071 (continued)

Parameter	Units	Installation Worker	Future On-site Trespasser	On-site Resident Adult	On-site Resident Child	Construction Worker	Off-site Installation Worker	Off-site Resident Adult	Off-site Resident Child	Off-site Sportsman
Carcinogen averaging time	days	NA	NA	NA	NA	25,550	NA	NA	NA	NA
Noncarcinogen averaging time	days	NA	NA	NA	NA	365	NA	NA	NA	NA
Dermal Contact										
Skin area	cm^2/event	NA	NA	NA	NA	5,000	NA	NA	NA	NA
Adherence factor	mg/cm^2	NA	NA	NA	NA	1	NA	NA	NA	NA
Exposure frequency	events/year	NA	NA	NA	NA	250	NA	NA	NA	NA
Exposure duration	years	NA	NA	NA	NA	1	NA	NA	NA	NA
Body weight	kg	NA	NA	NA	NA	70	NA	NA	NA	NA
Carcinogen averaging time	days	NA	NA	NA	NA	25,550	NA	NA	NA	NA
Noncarcinogen averaging time	days	NA	NA	NA	NA	365	NA	NA	NA	NA
SURFACE WATER										
Incidental Ingestion										
Water ingestion rate	mL/hour	NA	10	NA	NA	NA	NA	NA	NA	0.01
Exposure time	hours/day	NA	2	NA	NA	NA	NA	NA	NA	4
Exposure frequency	days/year	NA	52	NA	NA	NA	NA	NA	NA	52
Exposure duration	years	NA	10	NA	NA	NA	NA	NA	NA	30
Body weight	kg	NA	45	NA	NA	NA	NA	NA	NA	70
Carcinogen averaging time	days	NA	25,550	NA	NA	NA	NA	NA	NA	25,550
Noncarcinogen averaging time	days	NA	3,650	NA	NA	NA	NA	NA	NA	10,950
Dermal Contact while Wading										
Skin area	m^2	NA	0.17	NA	NA	NA	NA	NA	NA	0.41
Exposure time	hours/day	NA	2	NA	NA	NA	NA	NA	NA	4
Exposure frequency	days/year	NA	52	NA	NA	NA	NA	NA	NA	52
Exposure duration	years	NA	10	NA	NA	NA	NA	NA	NA	30
Body weight	kg	NA	45	NA	NA	NA	NA	NA	NA	70
Carcinogen averaging time	days	NA	25,550	NA	NA	NA	NA	NA	NA	25,550
Noncarcinogen averaging time	days	NA	3,650	NA	NA	NA	NA	NA	NA	10,950
GROUNDWATER										
Drinking Water Ingestion										
Drinking water ingestion	L/day	1	NA	2	1	NA	1	2	1	NA
Fraction ingested from area	unitless	1	NA	1	1	NA	1	1	1	NA
Exposure frequency	days/year	250	NA	350	350	NA	250	350	350	NA

Note: Footnotes appear on page 81.

Table 38. Exposure Parameters for Potential Receptor Populations, SWMU 27H, Building 1071 (continued)

Parameter	Units	Installation Worker	Future On-site Trespasser	On-site Resident Adult	On-site Resident Child	Construction Worker	Off-site Installation Worker	Off-site Resident Adult	Off-site Resident Child	Off-site Sportsman
Exposure duration	years	25	NA	30	6	NA	25	30	6	NA
Body weight	kg	70	NA	70	15	NA	70	70	15	NA
Carcinogen averaging time	days	25,550	NA	25,550	25,550	NA	25,550	25,550	25,550	NA
Noncarcinogen averaging time	days	9,125	NA	10,950	2,190	NA	9,125	10,950	2,190	NA
Inhalation of VOCs										
Inhalation rate	m^3/hr	NA	NA	0.4	NA	NA	NA	0.4	NA	NA
Exposure time	hours/day	NA	NA	0.17	NA	NA	NA	0.17	NA	NA
Exposure frequency	days/year	NA	NA	350	NA	NA	NA	350	NA	NA
Exposure duration	years	NA	NA	30	NA	NA	NA	30	NA	NA
Body weight	kg	NA	NA	70	NA	NA	NA	70	NA	NA
Carcinogen averaging time	days	NA	NA	25,550	NA	NA	NA	25,550	NA	NA
Noncarcinogen averaging time	days	NA	NA	10,950	NA	NA	NA	10,950	NA	NA
Dermal Contact while Bathing										
Skin area	m^2	NA	NA	2	0.700	NA	NA	2	0.700	NA
Exposure time	hours/day	NA	NA	0.17	0.33	NA	NA	0.17	0.33	NA
Exposure frequency	days/year	NA	NA	350	350	NA	NA	350	350	NA
Exposure duration	years	NA	NA	30	6	NA	NA	30	6	NA
Body weight	kg	NA	NA	70	15	NA	NA	70	15	NA
Carcinogen averaging time	days	NA	NA	25,550	25,550	NA	NA	25,550	25,550	NA
Noncarcinogen averaging time	days	NA	NA	10,950	2,190	NA	NA	10,950	2,190	NA
BIOTA										
Ingestion of Fish										
Ingestion rate	kg/day	NA	NA	NA	NA	NA	NA	NA	NA	0.027
Fraction ingested from area	unitless	NA	NA	NA	NA	NA	NA	NA	NA	1
Exposure frequency	days/year	NA	NA	NA	NA	NA	NA	NA	NA	365
Exposure duration	years	NA	NA	NA	NA	NA	NA	NA	NA	30
Body weight	kg	NA	NA	NA	NA	NA	NA	NA	NA	70
Carcinogen averaging time	days	NA	NA	NA	NA	NA	NA	NA	NA	25,550
Noncarcinogen averaging time	days	NA	NA	NA	NA	NA	NA	NA	NA	10,950

NA = Not applicable.

Table 39. Estimated Intakes for Current Off-site Juvenile Wader, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a] Average Daily Dose for Noncarcinogens (mg/kg/day)	Oral Exposure[a] Average Daily Dose for Carcinogens (mg/kg/day)	Dermal Exposure[a] Average Daily Dose for Noncarcinogens (mg/kg/day)	Dermal Exposure[a] Average Daily Dose for Carcinogens (mg/kg/day)
Surface water	Cadmium	3.80E-03	mg/L	3.44E-08	ND	1.37E-08	1.37E-08
Surface water	Lead	2.75E+01	mg/L	NA	NA	NA	NA

[a] The equations used to calculate oral and dermal exposures for surface water are presented in Appendix I, Section I.2.4.4 of the revised final Phase II RFI Report (SAIC 2000a).

NA = Not applicable: lead is evaluated separately using a biokinetic uptake model.

ND = Toxicity data are not available.

Table 40. Estimated Intakes for Current Off-site Sportsman, SWMU 27H, Building 1071

Environmental Medium	Chemical	Fish Bioaccumulation Factor (L/mg)	Exposure Concentration	Units	Oral Exposure[a] Average Daily Dose for Noncarcinogens (mg/kg/day)	Oral Exposure[a] Average Daily Dose for Carcinogens (mg/kg/day)	Dermal Exposure[a] Average Daily Dose for Noncarcinogens (mg/kg/day)	Dermal Exposure[a] Average Daily Dose for Carcinogens (mg/kg/day)
Surface water	Cadmium	NA[b]	3.80E-03	mg/L	1.33E-07	ND	5.44E-08	ND
Surface water	Lead	NA[b]	2.75E-02	mg/L	NA[c]	NA[c]	NA[c]	NA[c]
Fish tissue	Cadmium	5.00E+01	1.90E-01	mg/kg	7.33E-05	ND	NA[d]	NA[d]
Fish tissue	Lead	3.00E+02	8.25E+00	mg/kg	NA[c]	NA[c]	NA[d]	NA[d]

[a] The equations used to calculate oral and dermal exposures for surface water and fish tissue are presented in Appendix I, Sections I.2.4.4 and I.2.4.6, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; fish bioaccumulation factor is used to estimate the fish tissue concentrations.

[c] NA = Not applicable; lead is evaluated separately using a biokinetic uptake model.

[d] NA = Not applicable; this pathway was not assessed for this environmental medium.

ND = Toxicity data are not available.

Table 41. Estimated Uptake of Lead from Incidental Surface Water Ingestion, SWMU 27H, Building 1071

Age Group	Water Consumption (L/day)	Lead Concentration Surface Water (µg/L)	Water Uptake (µg/day)
0.5 to 1	0.01	27.5	0.14
1 to 2	0.01	27.5	0.14
2 to 3	0.01	27.5	0.14
3 to 4	0.01	27.5	0.14
4 to 5	0.01	27.5	0.14
5 to 6	0.01	27.5	0.14
6 to 7	0.01	27.5	0.14

Table 42. Estimated Uptake of Lead from Incidental Surface Water Ingestion and Fish Ingestion by Children, SWMU 27H, Building 1071

Age Group	Water Consumption (L/day)	Lead Concentration Surface Water (µg/L)	Lead Concentration Fish Tissue (µg/g)	Lead Ingestion from Diet (µg/day)	Water Uptake (µg/day)	Diet Uptake (µg/day)	Total Uptake (µg/day)
0.5 to 1	0.01	27.5	8.25	46.4	0.11	18.63	18.74
1 to 2	0.01	27.5	8.25	46.4	0.11	19.47	19.58
2 to 3	0.01	27.5	8.25	46.4	0.11	19.93	20.04
3 to 4	0.01	27.5	8.25	46.4	0.11	20.33	20.44
4 to 5	0.01	27.5	8.25	46.4	0.11	20.67	20.78
5 to 6	0.01	27.5	8.25	46.4	0.11	20.92	21.03
6 to 7	0.01	27.5	8.25	65.5	0.12	28.73	28.85

Table 43. Estimated Intakes for Future On-site Installation Worker, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	ND	7.97E-07	ND	3.98E-07	ND	2.96E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	ND	1.09E-06	ND	5.47E-07	ND	4.06E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	ND	1.04E-06	ND	5.21E-07	ND	3.87E-11
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	ND	7.37E-07	ND	3.69E-07	ND	2.74E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	ND	7.44E-07	ND	3.72E-07	ND	2.76E-11
Groundwater	Chromium	1.67E-02	mg/L	1.63E-04	ND	NA[b]	NA[b]	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	3.54E-05	1.27E-05	NA[b]	NA[b]	NA[b]	NA[b]
Groundwater	Naphthalene	3.40E-03	mg/L	3.33E-05	ND	NA[b]	NA[b]	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	5.87E-05	ND	NA[b]	NA[b]	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	1.76E-03	ND	NA[b]	NA[b]	NA[b]	NA[b]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and groundwater are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this receptor.

ND = Toxicity data are not available.

Table 44. Estimated Intakes for Future On-site Construction Worker, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Subsurface soil	Benzo(*a*)pyrene	2.49E+00	mg/kg	ND	6.96E-08	ND	1.74E-08

[a] The equations used to calculate oral and dermal exposures for subsurface soil are presented in Appendix I, Section I.2.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

ND = Toxicity data are not available.

Table 45. Estimated Intakes for Future On-site Juvenile Trespasser, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	ND	2.58E-08	ND	3.82E-08	ND	2.18E-12
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	ND	3.54E-08	ND	5.24E-08	ND	3.00E-12
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	ND	3.37E-08	ND	4.99E-08	ND	2.85E-12
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	ND	2.39E-08	ND	3.53E-08	ND	2.02E-12
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	ND	2.41E-08	ND	3.56E-08	ND	2.04E-12
Surface water from shallow groundwater[b]	1,1-Dichloroethene	4.23E-03	mg/L	2.68E-07	3.83E-08	9.53E-07	1.36E-07	NA[c]	NA[c]
Surface water from shallow groundwater[b]	Naphthalene	3.40E-03	mg/L	2.15E-07	ND	5.94E-06	ND	NA[c]	NA[c]
Surface water from modeled surface water[d]	Cadmium	6.00E-03	mg/L	3.80E-07	ND	1.52E-07	ND	NA[c]	NA[c]
Surface water from modeled surface water[d]	Chromium	1.80E-01	mg/L	1.14E-05	ND	4.56E-06	ND	NA[c]	NA[c]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and surface water are presented in Appendix I, Sections I.2.4.2 and I.2.4.4, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] Source of surface water concentration is the concentration of constituent in the shallow surficial aquifer.

[c] NA = Not applicable; this pathway was not assessed for this environmental medium.

[d] Source of surface water concentration is the modeled concentration of constituent in groundwater as a result of leaching.

ND = Toxicity data are not available.

Table 46. Estimated Intakes for Future On-site Resident Child, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	ND	2.50E-06	ND	2.12E-07	ND	2.90E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	ND	3.43E-06	ND	2.92E-07	ND	3.99E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	ND	3.27E-06	ND	2.78E-07	ND	3.79E-11
Surface soil	Dibenzo(a,h)anthracene	2.11E+00	mg/kg	ND	2.31E-06	ND	1.97E-07	ND	2.69E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	ND	2.33E-06	ND	1.98E-07	ND	2.71E-11
Groundwater	Chromium	1.67E-02	mg/L	1.07E-03	ND	2.47E-06	ND	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	2.31E-04	1.98E-05	4.76E-06	4.08E-07	NA[b]	NA[b]
Groundwater	Naphthalene	3.40E-03	mg/L	2.20E-04	ND	3.50E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	3.84E-04	ND	8.86E-07	ND	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	1.15E-02	ND	2.66E-05	ND	NA[b]	NA[b]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and groundwater are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this receptor.

ND = Toxicity data are not available.

Table 47. Estimated Intakes for Future On-site Resident Adult, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	ND	1.34E-06	ND	6.69E-07	ND	3.66E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	ND	1.84E-06	ND	9.19E-07	ND	5.02E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	ND	1.75E-06	ND	8.75E-07	ND	4.78E-11
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	ND	1.24E-06	ND	6.19E-07	ND	3.39E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	ND	1.25E-06	ND	6.25E-07	ND	3.42E-11
Groundwater	Chromium	1.67E-02	mg/L	4.58E-04	ND	7.63E-07	ND	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	9.92E-05	4.25E-05	1.47E-06	6.30E-07	ND	7.23E-07
Groundwater	Naphthalene	3.40E-03	mg/L	9.32E-05	ND	1.07E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	1.64E-04	ND	2.74E-07	ND	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	4.93E-03	ND	8.22E-06	ND	NA[b]	NA[b]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and groundwater are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this chemical.

ND = Toxicity data are not available.

Table 48. Estimated Intakes for Future Off-site Installation Worker, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	NA[b]	NA[b]	ND	2.96E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	NA[b]	NA[b]	ND	4.06E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	NA[b]	NA[b]	ND	3.87E-11
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	NA[b]	NA[b]	ND	2.74E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	NA[b]	NA[b]	ND	2.76E-11
Groundwater	Chromium	1.67E-02	mg/L	1.63E-04	ND	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	3.54E-05	1.27E-05	NA[b]	NA[b]
Groundwater	Naphthalene	3.40E-03	mg/L	3.33E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	5.87E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	1.76E-03	ND	NA[b]	NA[b]

[a] The equations used to calculate oral and inhalation exposures for surface soil and groundwater tissue are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this receptor.

ND = Toxicity data are not available.

Table 49. Estimated Intakes for Future Off-site Sportsman, SWMU 27H, Building 1071

Environmental Medium	Chemical	Fish Bioaccumulation Factor (L/mg)	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]	
					Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Shallow groundwater	1,1-Dichloroethene	NA[b]	4.23E-03	mg/L	3.44E-07	1.48E-07	1.26E-06	5.39E-07
Shallow groundwater	Naphthalene	NA[b]	3.40E-03	mg/L	2.77E-07	ND	7.83E-06	ND
Surface water (modeled)	Cadmium	NA[b]	6.00E-03	mg/L	4.88E-07	ND	2.00E-07	ND
Surface water (modeled)	Chromium	NA[b]	1.80E-01	mg/L	1.47E-05	ND	6.01E-06	ND
Fish tissue[b]	1,1-Dichloroethene	1.40E+01	5.92E-02	mg/kg	2.28E-05	9.79E-06	NA[c]	NA[c]
Fish tissue[b]	Naphthalene	4.30E+02	1.46E+00	mg/kg	5.64E-04	ND	NA[c]	NA[c]
Fish tissue[d] (modeled)	Cadmium	5.00E+01	3.00E-01	mg/kg	1.16E-04	ND	NA[c]	NA[c]
Fish tissue[d] (modeled)	Chromium	2.00E+02	3.60E+01	mg/kg	1.39E-02	ND	NA[c]	NA[c]

[a] The equations used to calculate oral and dermal exposures for groundwater, surface water, and fish tissue are presented in Appendix I, Sections I.2.4.3, I.2.4.4, and I.2.4.6, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] The fish tissue concentrations are based on measured groundwater concentrations and chemical-specific bioaccumulation factors.

[c] NA = Not applicable; this pathway was not assessed for this environmental medium.

[d] The fish tissue concentrations are based on modeled groundwater concentrations and chemical-specific bioaccumulation factors.

ND = Toxicity data are not available.

Table 50. Estimated Intakes for Future Off-site Resident Child, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	3.39E-10	2.90E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	4.65E-10	3.99E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	4.43E-10	3.79E-11
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	3.13E-10	2.69E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	3.16E-10	2.71E-11
Groundwater	Chromium	1.67E-02	mg/L	1.07E-03	ND	2.47E-06	ND	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	2.31E-04	1.98E-05	4.76E-06	4.08E-07	NA[b]	NA[b]
Groundwater	Naphthalene	3.40E-03	mg/L	2.17E-04	ND	3.46E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	3.84E-04	ND	8.86E-07	ND	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	1.15E-02	ND	2.66E-05	ND	NA[b]	NA[b]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and groundwater are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this receptor.

ND = Toxicity data are not available.

Table 51. Estimated Intakes for Future Off-site Resident Adult, SWMU 27H, Building 1071

Environmental Medium	Chemical	Exposure Concentration	Units	Oral Exposure[a]		Dermal Exposure[a]		Inhalation Exposure[a]	
				Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)	Average Daily Dose for Noncarcinogens (mg/kg/day)	Average Daily Dose for Carcinogens (mg/kg/day)
Surface soil	Benzo(*a*)anthracene	2.28E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	ND	3.66E-11
Surface soil	Benzo(*a*)pyrene	3.13E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	ND	5.02E-11
Surface soil	Benzo(*b*)fluoranthene	2.98E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	ND	4.78E-11
Surface soil	Dibenzo(*a,h*)anthracene	2.11E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	ND	3.39E-11
Surface soil	Indeno(*1,2,3-cd*)pyrene	2.13E+00	mg/kg	NA[b]	NA[b]	NA[b]	NA[b]	ND	3.42E-11
Groundwater	Chromium	1.67E-02	mg/L	4.58E-04	ND	7.63E-07	ND	NA[b]	NA[b]
Groundwater	1,1-Dichloroethene	3.62E-03	mg/L	9.92E-05	4.25E-05	1.47E-06	6.30E-07	ND	7.23E-07
Groundwater	Naphthalene	3.40E-03	mg/L	9.32E-05	ND	1.07E-05	ND	NA[b]	NA[b]
Groundwater (modeled)	Cadmium	6.00E-03	mg/L	1.64E-04	ND	2.74E-07	ND	NA[b]	NA[b]
Groundwater (modeled)	Chromium	1.80E-01	mg/L	4.93E-03	ND	8.22E-06	ND	NA[b]	NA[b]

[a] The equations used to calculate oral, dermal, and inhalation exposures for surface soil and groundwater are presented in Appendix I, Sections I.2.4.2 and I.2.4.3, respectively, of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this pathway was not assessed for this receptor.

ND = Toxicity data are not available.

Table 52. Toxicity Values for Constituents of Concern, SWMU 27H, Building 1071

Chemical	Oral Reference Dose (mg/kg/day)	Ref[a]	Oral Cancer Slope Factor (mg/kg/day)$^{-1}$	Ref[a]	Gastrointestinal Absorption Factor[b]	Dermal Reference Dose[c] (mg/kg/day)	Dermal Cancer Slope Factor[d] (mg/kg/day)$^{-1}$	Inhalation Reference Dose (mg/kg/day)	Ref[a]	Inhalation Cancer Slope Factor (mg/kg/day)$^{-1}$	Ref[a]
Benzo(*a*)anthracene	ND		7.30E-01	E	0.31	ND	2.35E+00	ND		ND	
Benzo(b)fluoranthene	ND		7.30E-01	E	0.31	ND	2.35E+00	ND		ND	
Cadmium–water	5.00E-04	I	ND		0.01	1.00E-05	ND	5.70E-05	E	6.30E+00	I
Chromium VI	3.00E-03	I	ND		0.02	6.00E-05	ND	3.00E-05	I	4.10E+01	H
Dibenzo(*a,h*)anthracene	ND		7.30E+00	E	0.31	ND	2.35E+00	ND		ND	
1,1-Dichloroethene	9.00E-03	I	6.00E-01	I	1.00	9.00E-03	6.67E+01	ND		1.75E-01	I
Lead	ND		ND			ND	ND	ND		ND	
Naphthalene	2.00E-02	I	ND		0.80	1.60E-02	ND	9.00E-04	I	ND	
Benzo(*a*)pyrene	ND		7.30E+00	I	0.31	ND	2.35E+01	ND		3.10E+00	E
Indeno(*1,2,3-c,d*)pyrene	ND		7.30E-01	E	0.31	ND	2.35E+00	ND		3.10E+00	E

[a] References:
H = Health Effects Assessment Summary Tables (EPA 1997b).
E = EPA National Center for Environmental Assessment (EPA 2000a).
I = Integrated Risk Information System (EPA 2000b).

[b] ORNL 2000.

[c] Dermal reference dose calculated by multiplying the oral reference dose by the gastrointestinal absorption factor.

[d] Dermal cancer slope factor calculated by dividing the oral cancer slope factor by the gastrointestinal absorption factor.

ND = No data.

Table 53. Hazard Indices and Carcinogenic Risks for Current Off-site Juvenile Wader, SWMU 27H, Building 1071

Chemical	Surface Water[a]		Total Hazard Index[a]
	Oral HQ	Dermal HQ	
Cadmium	4.81E-04	3.85E-03	4.33E-03
Lead	NA[b]	NA[b]	—
Pathway Total	**4.81E-04**	**3.85E-03**	**4.33E-03**

Chemical	Surface Water[c]		Total Cancer Risk[c]
	Oral ILCR	Dermal ILCR	
Cadmium	ND	ND	ND
Lead	ND	ND	ND
Pathway Total	—	—	—

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; lead is assessed based on blood-lead concentration.

[c] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 54. Estimated Blood-lead Level Resulting from Incidental Ingestion of Surface Water, SWMU 27H, Building 1071

Age Group	Blood-lead Level (µg/dL)
0.5 to 1	0.1
1 to 2	0.1
2 to 3	0.1
3 to 4	<0.1
4 to 5	<0.1
5 to 6	<0.1
6 to 7	<0.1

Table 55. Hazard Indices and Carcinogenic Risks for Current Off-site Sportsman, SWMU 27H, Building 1071

Chemical	Surface Water[a]			Fish Tissue[a]		Total Hazard Index[a]
	Oral HQ	Dermal HQ	Total	Oral HQ	Total	
Cadmium	6.19E-04	5.07E-03	5.69E-03	1.47E-01	1.47E-01	1.52E-01
Lead	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Pathway Total	**6.19E-04**	**5.07E-03**	**5.69E-03**	**1.47E-01**	**1.47E-01**	**1.52E-01**

Chemical	Surface Water[c]			Fish Tissue[c]		Total Cancer Risk[c]
	Oral ILCR	Dermal ILCR	Total	Ingestion	Total	
Cadmium	ND	ND	ND	ND	ND	—
Lead	ND	ND	ND	ND	ND	—
Pathway Total	—	—	—	—	—	—

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section 1.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; lead is assessed based on blood-lead concentration.

[c] The equations used to calculate carcinogenic risk are presented in Appendix I, Section 1.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 56. Estimated Blood-lead Level Resulting from Incidental Ingestion of Surface Water and Fish Ingestion, SWMU 27H, Building 1071

Age Group	Blood-lead Level (μg/dL)
0.5 to 1	9.9
1 to 2	8.5
2 to 3	7.4
3 to 4	7.1
4 to 5	6.8
5 to 6	6.4
6 to 7	7.3

Table 57. Hazard Indices and Carcinogenic Risks for Future On-site Installation Worker, SWMU 27H, Building 1071

Chemical	Surface Soil[a]				Groundwater Measured Concentrations[a]		Groundwater Modeled Concentrations[a]		Total Hazard Index[a]
	Ingestion HI	Dermal HI	Inhalation HI	Total	Ingestion HI	Total	Ingestion HI	Total	
Benzo(*a*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	5.45E-02	5.45E-02	5.87E-01	5.87E-01	5.87E-01[c]
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	3.94E-03	3.94E-03	NA[d]	NA[d]	3.94E-03
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	1.66E-03	1.66E-03	NA[d]	NA[d]	1.66E-03
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[e]	NA[e]	1.17E-01	1.17E-01	1.17E-01
Pathway Total	—	—	—	—	**6.01E-02**	**6.01E-02**	**7.05E-01**	**7.05E-01**	**7.10E-01**

Chemical	Surface Soil[f]				Groundwater Measured Concentrations[f]		Groundwater Modeled Concentrations[f]		Total Cancer Risk[f]
	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Ingestion ILCR	Total	Ingestion HI	Total	
Benzo(*a*)anthracene	5.82E-07	9.38E-07	ND	1.52E-06	NA[b]	NA[b]	NA[b]	NA[b]	1.52E-06
Benzo(*a*)pyrene	7.98E-06	1.29E-05	1.26E-10	2.09E-05	NA[b]	NA[b]	NA[b]	NA[b]	2.09E-05
Benzo(*b*)fluoranthene	7.60E-07	1.23E-06	ND	1.99E-06	NA[b]	NA[b]	NA[b]	NA[b]	1.99E-06
Dibenzo(*a,h*)anthracene	5.38E-06	8.68E-06	8.49E-11	1.41E-05	NA[b]	NA[b]	NA[b]	NA[b]	1.41E-05
Indeno(*1,2,3-cd*)pyrene	5.43E-07	8.76E-07	8.57E-12	1.42E-06	NA[b]	NA[b]	NA[b]	NA[b]	1.42E-06
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	ND	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	7.59E-06	7.59E-06	NA[d]	NA[d]	7.59E-06
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	NA[d]	NA[d]	—
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[e]	NA[e]	ND	ND	—
Pathway Total	**1.53E-05**	**2.46E-05**	**2.19E-10**	**3.99E-05**	**7.59E-06**	**7.59E-06**	—	—	**4.74E-05**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).
[b] NA = Not applicable; this constituent is not present in this medium.
[c] Value for modeled concentration.
[d] NA = Not applicable; constituent only has a measured concentration.
[e] NA = Not applicable; constituent only has a modeled concentration.
[f] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).
ND = The toxicity data required to quantify the risk are not available.
— = No sum value could be calculated.

Table 58. Hazard Indices and Carcinogenic Risks for Future On-site Construction Worker, SWMU 27H, Building 1071

Chemical	**Subsurface Soil**[a]		**Total Hazard Index**[a]
	Oral HQ	**Dermal HQ**	
Benzo(*a*)pyrene	ND	ND	—
Pathway Total	—	—	—

Chemical	**Subsurface Soil**[b]		**Total Cancer Risk**[b]
	Oral ILCR	**Dermal ILCR**	
Benzo(*a*)pyrene	5.08E-07	4.10E-07	9.18E-07
Pathway Total	**5.08E-07**	**4.10E-07**	**9.18E-07**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 59. Hazard Indices and Carcinogenic Risks for Future On-site Juvenile Trespasser, SWMU 27H, Building 1071

Chemical	Surface Soil[a]				Surface Water Measured Concentrations[a]			Surface Water Modeled Concentrations[a]			Total Hazard Index[a]
	Ingestion HQ	Dermal HI	Inhalation HI	Total	Oral HQ	Dermal HQ	Total	Oral HQ	Dermal HQ	Total	
Benzo(*a*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	2.98E-05	1.06E-04	1.36E-04	NA[c]	NA[c]	NA[c]	1.36E-04
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	1.08E-05	3.71E-04	3.82E-04	NA[c]	NA[c]	NA[c]	3.82E-04
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[d]	NA[d]	NA[d]	7.60E-04	6.08E-03	6.84E-03	6.84E-03
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	NA[d]	NA[d]	NA[d]	3.80E-03	7.60E-02	7.98E-02	7.98E-02
Pathway Total	—	—	—	—	**4.05E-05**	**4.77E-04**	**5.18E-04**	**4.56E-03**	**8.21E-02**	**8.66E-02**	**8.71E-02**

Chemical	Surface Soil[e]				Surface Water Measured Concentrations[e]			Surface Water Modeled Concentrations[e]			Total Cancer Risk[e]
	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Oral ILCR	Dermal ILCR	Total	Oral ILCR	Dermal ILCR	Total	
Benzo(*a*)anthracene	1.88E-08	8.98E-08		1.09E-07	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.09E-07
Benzo(*a*)pyrene	2.58E-07	1.23E-06	9.29E-12	1.49E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.49E-06
Benzo(*b*)fluoranthene	2.46E-08	1.17E-07		1.42E-07	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.42E-07
Dibenzo(*a,h*)anthracene	1.74E-07	8.31E-07	6.26E-12	1.01E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.01E-06
Indeno(*1,2,3-cd*)pyrene	1.76E-08	8.39E-08	6.32E-13	1.02E-07	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.02E-07
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	2.30E-08	8.17E-08	1.05E-07	NA[c]	NA[c]	NA[c]	1.05E-07
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	ND	NA[c]	NA[c]	NA[c]	—
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[d]	NA[d]	NA[d]	ND	ND	ND	—
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	NA[d]	NA[d]	NA[d]	ND	ND	ND	—
Pathway Total	**4.94E-07**	**2.36E-06**	**1.62E-11**	**2.85E-06**	**2.30E-08**	**8.17E-08**	**1.05E-07**	—	—	—	**2.95E-06**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this constituent is not present in this medium.

[c] NA = Not applicable; constituent only has a measured concentration.

[d] NA = Not applicable; constituent only has a modeled concentration.

[e] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 60. Hazard Indices and Carcinogenic Risks for Future On-site Resident Child, SWMU 27H, Building 1071

Chemical	Surface Soil[a]				Groundwater Measured Concentrations[a]			Groundwater Modeled Concentrations[a]			Total Hazard Index[a]
	Ingestion HI	Dermal HI	Inhalation HI	Total	Ingestion HI	Dermal HI	Total	Ingestion HI	Dermal HI	Total	
Benzo(*a*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	3.56E-01	4.11E-02	3.97E-01	3.84E+00	4.43E-01	4.28E+00	4.28E+00[c]
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	2.57E-02	5.29E-04	2.62E-02	NA[d]	NA[d]	NA[d]	2.62E-02
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	1.09E-02	2.17E-03	1.30E-02	NA[d]	NA[d]	NA[d]	1.30E-02
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[e]	NA[e]	NA[e]	7.67E-01	3.54E-02	8.03E-01	8.03E-01
Pathway Total	—	—	—	—	**3.92E-01**	**4.38E-02**	**4.36E-01**	**4.60E+00**	**4.78E-01**	**5.08E+00**	**5.12E+00**

Chemical	Surface Soil[f]				Groundwater Measured Concentrations[f]			Groundwater Modeled Concentrations[f]			Total Cancer Risk[f]
	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Total	Ingestion ILCR	Dermal ILCR	Total	
Benzo(*a*)anthracene	1.82E-06	5.00E-07	ND	2.32E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.32E-06
Benzo(*a*)pyrene	2.50E-05	6.87E-06	1.24E-10	3.19E-05	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	3.19E-05
Benzo(*b*)fluoranthene	2.38E-06	6.54E-07	ND	3.04E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	3.04E-06
Dibenzo(*a,h*)anthracene	1.69E-05	4.63E-06	8.33E-11	2.15E-05	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.15E-05
Indeno(*1,2,3-cd*)pyrene	1.70E-06	4.67E-07	8.41E-12	2.17E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.17E-06
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	ND	ND	ND	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	1.19E-05	2.45E-07	1.21E-05	NA[d]	NA[d]	NA[d]	1.21E-05
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	ND	NA[d]	NA[d]	NA[d]	—
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[e]	NA[e]	NA[e]	ND	ND	ND	—
Pathway Total	**4.78E-05**	**1.31E-05**	**2.15E-10**	**6.09E-05**	**1.19E-05**	**2.45E-07**	**1.21E-05**	—	—	—	**7.31E-05**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this constituent is not present in this medium.

[c] Value for modeled concentration.

[d] NA = Not applicable; constituent only has a measured concentration.

[e] NA = Not applicable; constituent only has a modeled concentration.

[f] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 61. Hazard Indices and Carcinogenic Risks for Future On-site Resident Adult, SWMU 27H, Building 1071

	Surface Soil[a]				Groundwater Measured Concentrations[a]				Groundwater Modeled Concentrations[a]				
Chemical	Ingestion HI	Dermal HI	Inhalation HI	Total	Ingestion HI	Dermal HI	Inhalation HI	Total	Ingestion HI	Dermal HI	Inhalation HI	Total	Total Hazard Index[a]
Benzo(*a*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	1.53E-01	1.27E-02	NA[c]	1.65E-01	1.64E+00	1.37E-01	NA[c]	1.78E+00	1.78E+00[d]
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	1.10E-02	1.63E-04	ND	1.12E-02	NA[e]	NA[e]	NA[e]	NA[e]	1.12E-02
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	4.66E-03	6.70E-04	NA[c]	5.33E-03	NA[e]	NA[e]	NA[c]	NA[e]	5.33E-03
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[f]	NA[f]	NA[f]	NA[f]	3.29E-01	1.10E-02	NA[c]	3.40E-01	3.40E-01
Pathway Total	—	—	—	—	**1.68E-01**	**1.35E-02**	—	**1.82E-01**	**1.97E+00**	**1.48E-01**	—	**2.12E+00**	**2.14E+00**

	Surface Soil[g]				Groundwater Measured Concentrations[g]				Groundwater Modeled Concentrations[g]				
Chemical	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Total Cancer Risk[g]
Benzo(*a*)anthracene	9.77E-07	1.58E-06	ND	2.55E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.55E-06
Benzo(*a*)pyrene	1.34E-05	2.16E-05	1.56E-10	3.51E-05	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	3.51E-05
Benzo(*b*)fluoranthene	1.28E-06	2.06E-06	ND	3.34E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	3.34E-06
Dibenzo(*a,h*)anthracene	9.04E-06	1.46E-05	1.05E-10	2.36E-05	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.36E-05
Indeno(*1,2,3-cd*)pyrene	9.13E-07	1.47E-06	1.06E-11	2.39E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.39E-06
Chromium	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	NA[c]	ND	ND	ND	NA[c]	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	NA[b]	NA[b]	2.55E-05	3.78E-07	8.67E-07	2.67E-05	NA[e]	NA[e]	NA[e]	NA[e]	2.67E-05
Naphthalene	NA[b]	NA[b]	NA[b]	NA[b]	ND	ND	NA[c]	ND	NA[e]	NA[e]	NA[c]	NA[c]	—
Cadmium	NA[b]	NA[b]	NA[b]	NA[b]	NA[f]	NA[f]	NA[f]	NA[f]	ND	ND	NA[c]	ND	—
Pathway Total	**2.56E-05**	**4.13E-05**	**2.71E-10**	**6.70E-05**	**2.55E-05**	**3.78E-07**	**8.67E-07**	**2.67E-05**	—	—	—	—	9.37E-05

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section 1.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this constituent is not present in this medium.

[c] Not applicable; inhalation exposure is not a viable pathway for this constituent.

[d] Value for modeled concentration.

[e] NA = Not applicable; constituent only has a measured concentration.

[f] NA = Not applicable; constituent only has a modeled concentration.

[g] The equations used to calculate carcinogenic risk are presented in Appendix I, Section 1.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 62. Hazard Indices and Carcinogenic Risks for Future Off-site Installation Worker, SWMU 27H, Building 1071

Chemical	Surface Soil		Groundwater Measured Concentrations[a]		Groundwater Modeled Concentrations[a]		Total Hazard Index[a]
	Inhalation HI	Total	Ingestion HI	Total	Ingestion HI	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	5.45E-02	5.45E-02	5.87E-01	5.87E-01	5.78E-01[c]
1,1-Dichloroethene	NA[b]	NA[b]	3.94E-03	3.94E-03	NA[d]	NA[d]	3.94E-03
Naphthalene	NA[b]	NA[b]	1.66E-03	1.66E-03	NA[d]	NA[d]	1.66E-03
Cadmium	NA[b]	NA[b]	NA[e]	NA[e]	1.17E-01	1.17E-01	1.17E-01
Pathway Total	—	—	**6.01E-02**	**6.01E-02**	**7.05E-01**	**7.05E-01**	**7.10E-01**

Chemical	Surface Soil		Groundwater Measured Concentrations[f]		Groundwater Modeled Concentrations[f]		Total Cancer Risk[f]
	Inhalation ILCR	Total	Ingestion ILCR	Total	Ingestion ILCR	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	ND
Benzo(*a*)pyrene	1.26E-10	1.26E-10	NA[b]	NA[b]	NA[b]	NA[b]	1.26E-10
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	8.49E-11	8.49E-11	NA[b]	NA[b]	NA[b]	NA[b]	8.49E-11
Indeno(*1,2,3-cd*)pyrene	8.57E-12	8.57E-12	NA[b]	NA[b]	NA[b]	NA[b]	8.57E-12
Chromium	NA[b]	NA[b]	ND	ND	ND	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	7.59E-06	7.59E-06	NA[d]	NA[d]	7.59E-06
Naphthalene	NA[b]	NA[b]	ND	ND	NA[d]	NA[d]	—
Cadmium	NA[b]	NA[b]	NA[e]	NA[e]	ND	ND	—
Pathway Total	**2.19E-10**	**2.19E-10**	**7.59E-06**	**7.59E-06**	—	—	**7.59E-06**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; this constituent is not present in this medium.

[c] Value for modeled concentration.

[d] NA = Not applicable; constituent only has a measured concentration.

[e] NA = Not applicable; constituent only has a modeled concentration.

[f] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 63. Hazard Indices and Carcinogenic Risks for Future Off-site Sportsman, SWMU 27H, Building 1071

	Surface Water Measured Concentrations[a]			Fish Tissue Measured Concentrations[a]		Surface Water Modeled Concentrations[a]			Fish Tissue Modeled Concentrations[a]		
Chemical	**Oral HQ**	**Dermal HQ**	**Total**	**Oral HQ**	**Total**	**Oral HQ**	**Dermal HQ**	**Total**	**Oral HQ**	**Total**	**Total Hazard Index[a]**
1,1-Dichloroethene	3.83E-05	1.40E-04	1.78E-04	2.54E-03	2.54E-03	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.72E-03
Naphthalene	1.38E-05	4.89E-04	5.03E-04	2.82E-02	2.82E-02	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	2.87E-02
Cadmium	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	9.77E-04	8.01E-03	8.99E-03	2.31E-01	2.31E-01	2.40E-01
Chromium	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	4.88E-03	1.00E-01	1.05E-01	4.63E+00	4.63E+00	4.73E+00
Pathway Total	**5.21E-05**	**6.29E-04**	**6.81E-04**	**3.07E-02**	**3.07E-02**	**5.86E-03**	**1.08E-01**	**1.14E-01**	**4.86E+00**	**4.86E+00**	**5.01E+00**

	Surface Water Measured Concentrations[d]			Fish Tissue Measured Concentrations[d]		Surface Water Modeled Concentrations[d]			Fish Tissue Modeled Concentrations[d]		
Chemical	**Oral ILCR**	**Dermal ILCR**	**Total**	**Oral ILCR**	**Total**	**Oral ILCR**	**Dermal ILCR**	**Total**	**Oral ILCR**	**Total**	**Total Cancer Risk[d]**
1,1-Dichloroethene	8.85E-08	3.23E-07	4.12E-07	5.87E-06	5.87E-06	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	6.29E-06
Naphthalene	ND	ND	ND	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Cadmium	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	ND	ND	ND	ND	ND	—
Chromium	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	ND	ND	ND	ND	ND	—
Pathway Total	**8.85E-08**	**3.23E-07**	**4.12E-07**	**5.87E-06**	**5.87E-06**	—	—	—	—	—	**6.29E-06**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).

[b] NA = Not applicable; constituent only has a measured concentration.

[c] NA = Not applicable; constituent only has a modeled concentration.

[d] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).

ND = The toxicity data required to quantify the risk are not available.

— = No sum value could be calculated.

Table 64. Hazard Indices and Carcinogenic Risks for Future Off-site Resident Child, SWMU 27H, Building 1071

Chemical	Surface Soil		Groundwater Measured Concentrations[a]			Groundwater Modeled Concentrations[a]			Total Hazard Index[a]
	Inhalation HI	Total	Ingestion HI	Dermal HI	Total	Ingestion HI	Dermal HI	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	3.56E-01	4.11E-02	3.97E-01	3.84E+00	4.43E-01	4.28E+00	4.28E+00[c]
1,1-Dichloroethene	NA[b]	NA[b]	2.57E-02	5.29E-04	2.62E-02	NA[d]	NA[d]	NA[d]	2.62E-02
Naphthalene	NA[b]	NA[b]	1.09E-02	2.17E-03	1.30E-02	NA[d]	NA[d]	NA[d]	1.30E-02
Cadmium	NA[b]	NA[b]	NA[e]	NA[e]	NA[e]	7.67E-01	3.54E-02	8.03E-01	8.03E-01
Pathway Total	—	—	**3.92E-01**	**4.38E-02**	**4.36E-01**	**4.60E+00**	**4.78E-01**	**5.08E+00**	**5.12E+00**

Chemical	Surface Soil		Groundwater Measured Concentrations[f]			Groundwater Modeled Concentrations[f]			Total Cancer Risk[f]
	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Total	Ingestion ILCR	Dermal ILCR	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	
Benzo(*a*)pyrene	1.24E-10	1.24E-10	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.24E-10
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	
Dibenzo(*a,h*)anthracene	8.33E-11	8.33E-11	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	8.33E-11
Indeno(*1,2,3-cd*)pyrene	8.41E-12	8.41E-12	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	8.41E-12
Chromium	NA[b]	NA[b]	ND	ND	ND	ND	ND	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	1.19E-05	2.45E-07	1.21E-05	NA[d]	NA[d]	NA[d]	1.37E-05
Naphthalene	NA[b]	NA[b]	ND	ND	ND	NA[d]	NA[d]	NA[d]	—
Cadmium	NA[b]	NA[b]	NA[e]	NA[e]	NA[e]	ND	ND	ND	—
Pathway Total	**2.15E-10**	**2.15E-10**	**1.19E-05**	**2.45E-07**	**1.21E-05**	—	—	—	**1.37E-05**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section I.4.2 of the revised final Phase II RFI Report (SAIC 2000a).
[b] NA = Not applicable; this constituent is not present in this medium.
[c] Value for modeled concentration.
[d] NA = Not applicable; constituent only has a measured concentration.
[e] NA = Not applicable; constituent only has a modeled concentration.
[f] The equations used to calculate carcinogenic risk are presented in Appendix I, Section I.4.1 of the revised final Phase II RFI Report (SAIC 2000a).
ND = The toxicity data required to quantify the risk are not available.
— = No sum value could be calculated.

Table 65. Hazard Indices and Carcinogenic Risks for Future Off-site Resident Adult, SWMU 27H, Building 1071

Chemical	Surface Soil		Groundwater Measured Concentrations[a]				Groundwater Modeled Concentrations[a]				Total Hazard Index[a]
	Inhalation HI	Total	Ingestion HI	Dermal HI	Inhalation HI	Total	Ingestion HI	Dermal HI	Inhalation HI	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*a*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Dibenzo(*a,h*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Indeno(*1,2,3-cd*)pyrene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	—
Chromium	NA[b]	NA[b]	1.53E-01	1.27E-02	NA[c]	1.65E-01	1.64E+00	1.37E-01	NA[c]	1.78E+00	1.78E+00[d]
1,1-Dichloroethene	NA[b]	NA[b]	1.10E-02	1.63E-04	ND	1.12E-02	NA[e]	NA[e]	NA[c]	NA[e]	1.12E-02
Naphthalene	NA[b]	NA[b]	4.66E-03	6.70E-04	NA[c]	5.33E-03	NA[e]	NA[e]	NA[c]	NA[e]	5.33E-03
Cadmium	NA[b]	NA[b]	NA[f]	NA[f]	NA[f]	NA[f]	3.29E-01	1.10E-02	NA[c]	3.40E-01	3.40E-01
Pathway Total			**1.68E-01**	**1.35E-02**	—	**1.82E-01**	**1.97E+00**	**1.48E-01**	—	**2.12E+00**	**2.14E+00**

Chemical	Surface Soil		Groundwater Measured Concentrations[f]				Groundwater Modeled Concentrations[f]				Total Cancer Risk[g]
	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	Ingestion ILCR	Dermal ILCR	Inhalation ILCR	Total	
Benzo(*a*)anthracene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	
Benzo(*a*)pyrene	1.56E-10	1.56E-10	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.56E-10
Benzo(*b*)fluoranthene	ND	ND	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	
Dibenzo(*a,h*)anthracene	1.05E-10	1.05E-10	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.05E-10
Indeno(*1,2,3-cd*)pyrene	1.06E-11	1.06E-11	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	1.06E-11
Chromium	NA[b]	NA[b]	ND	ND	NA[c]	ND	ND	ND	NA[c]	ND	—
1,1-Dichloroethene	NA[b]	NA[b]	2.55E-05	3.78E-07	8.67E-07	2.67E-05	NA[e]	NA[e]	NA[c]	NA[e]	2.67E-05
Naphthalene	NA[b]	NA[b]	ND	ND	NA[c]	ND	NA[e]	NA[e]	NA[c]	NA[e]	—
Cadmium	NA[b]	NA[b]	NA[f]	NA[f]	NA[f]	NA[f]	ND	ND	NA[c]	ND	—
Pathway Total	**2.71E-10**	**2.71E-10**	**2.55E-05**	**3.78E-07**	**8.67E-07**	**2.67E-05**	—	—	—	—	**2.67E-05**

[a] The equations used to calculate noncarcinogenic risk are presented in Appendix I, Section 1.4.2 of the revised final Phase II RFI Report (SAIC 2000a).
[b] NA = Not applicable; this constituent is not present in this medium.
[c] Not applicable; inhalation exposure is not a viable pathway for this constituent.
[d] Value for modeled concentration.
[e] NA = Not applicable; constituent only has a measured concentration.
[f] NA = Not applicable; constituent only has a modeled concentration.
[g] The equations used to calculate carcinogenic risk are presented in Appendix I, Section 1.4.1 of the revised final Phase II RFI Report (SAIC 2000a).
ND = The toxicity data required to quantify the risk are not available.
— = No sum value could be calculated.

Table 66. Remedial Levels for Groundwater, SWMU 27H, Building 1071

COC	Maximum Detected Concentration (µg/L)	Maximum Contaminant Level (µg/L)
1,1-Dichlorethene	8.6	7
Chromium	31	100

Table 67. Remedial Levels for Surface Soil, SWMU 27H, Building 1071

COC	Maximum Detected Concentration (mg/kg)	Risk-based Remedial Levels (mg/kg)	
		ILCR	
		1×10^{-6}	1×10^{-5}
Benzo(*a*)anthracene	2.87	0.89	**8.93**
Benzo(*a*)pyrene	4.06	0.09	**0.89**
Benzo(*b*)fluoranthene	3.64	0.89	**8.93**
Dibenzo(*a,h*)anthracene	2.77	0.09	**0.89**
Indeno(*1,2,3-cd*)pyrene	2.46	0.89	**8.93**

Bold indicates values are recommended remedial levels.

Table 68. Target Groundwater Concentrations for Contaminant Migration Constituents of Concern, SWMU 27H, Building 1071

CMCOCs	Point of Exposure	Units	Estimated Groundwater Concentration (µg/L)	Maximum Contaminant Level (µg/L)	Target Groundwater Concentration (µg/L)		
					Hazard Index		
					0.1	0.5	1
Cadmium	Surface water	µg/L	6	**5**	2.5	12.5	25.0
Cadmium	Groundwater	µg/L	6	**5**	0.7	3.7	7.5
Chromium	Surface water	µg/L	180	100	3.8	19.0	**38.0**[a]
Chromium	Groundwater	µg/L	180	100	4.2	21.0	42.1

[a] Lowest concentration (most conservative) between surface water and groundwater was selected as target groundwater concentration.

Bold indicates values are recommended target groundwater values.

Table 69. Remedial Levels for Contaminant Migration Constituents of Concern, SWMU 27H, Building 1071

CMCOCs	Point of Exposure	Units	Maximum Soil Concentration	Risk-based Remedial Levels			Remedial Level Based on MCL	Subsurface Soil Background
				Hazard Index				
				0.1	0.5	1		
Cadmium	Surface water	mg/kg	0.76	0.32	1.58	3.16	**0.63**	0.23
Cadmium	Groundwater	mg/kg	0.76	0.09	0.47	0.95	**0.63**	0.23
Chromium	Surface water	mg/kg	7.40	0.16	0.78	1.56	4.11	**11.60**
Chromium	Groundwater	mg/kg	7.40	0.17	0.86	1.73	4.11	**11.60**

Bold indicates values are recommended remedial levels.

Table 70. Field Parameter Measurements During the Supplemental Groundwater Sampling (October/November 2000), SWMU 27H, Building 1071

		Field Reading at Monitoring Well				
Station	**Date**	**pH (su)**	**Conductivity (mS/cm)**	**Temperature (°C)**	**DO (mg/L)**	**Redox (mV)**
27H-MW-1	11/01/00	4.74	123.7	25.95	0.68	199
27H-MW-2	10/31/00	4.21	159.1	27.95	[a]	[a]
27H-MW-3	10/31/00	4.63	101.5	27.81	[a]	[a]
27H-MW-4	10/31/00	4.87	0.18	25.00	[a]	[a]
27H-MW-5	10/31/00	4.58	35.9	24.92	[a]	[a]
27H-MW-6	11/01/00	5.69	223.8	27.09	3.56	124
27H-MW-7	10/31/00	3.97	271.1	26.24	[a]	[a]
27H-MW-8	10/31/00	4.32	0.15	23.46	[a]	[a]

[a] Measurement was not recorded because the DO and redox probes on purge saver #36469 were inoperable.

DO = Dissolved oxygen.

Redox = Oxidation-reduction potential.

Table 71. Water Level Measurements During the Supplemental Groundwater Sampling (October/November 2000), SWMU 27H, Building 1071

Station	**Date**	**Screened Interval (feet bgs)**	**Elevation of Measuring Point (feet amsl)**	**Depth to Water (feet below MP)**	**Elevation of Potentiometric Surface (feet amsl)**
27H-MW-1	10/30/00	3.65 to 13.65	83.70	7.21	76.49
27H-MW-2	10/30/00	34.75 to 44.75	83.73	8.34	75.39
27H-MW-3	10/30/00	3.75 to 13.75	83.34	7.16	76.18
27H-MW-4	10/30/00	3.15 to 13.15	83.59	7.49	76.10
27H-MW-5	10/30/00	34.75 to 44.75	83.68	8.56	75.12
27H-MW-6	10/30/00	4.20 to 14.20	83.47	8.11	75.36
27H-MW-7	10/30/00	33.90 to 43.90	83.41	8.12	75.29
27H-MW-8	10/30/00	33.70 to 43.70	81.52	6.16	75.36

amsl = Above mean sea level.

bgs = Below ground surface.

MP = Measuring point (top of casing).

Table 72. Summary of Analytical Results in Groundwater (October/November 2000), SWMU 27H, Building 1071

Station	**Remedial Level**	**27H-MW-1**	**27H-MW-2**	**27H-MW-3**	**27H-MW-4**
Sample ID		**7N4172**	**7N4272**	**7N4372**	**7N4472**
Date		**11/01/00**	**10/31/00**	**10/31/00**	**10/31/00**
		Volatile Organic Compound (µg/L)			
1,1-Dichloroethene	7	<1	<1.2	<1	<0.2
Station	**Remedial Level**	**27H-MW-5**	**27H-MW-6**	**27H-MW-7**	**27H-MW-8**
Sample ID		**7N4572**	**7N4672**	**7N4772**	**7N4872**
Date		**10/31/00**	**11/01/00**	**11/01/00**	**10/31/00**
		Volatile Organic Compound (µg/L)			
1,1-Dichloroethene	7	<1	<1	<1	<1

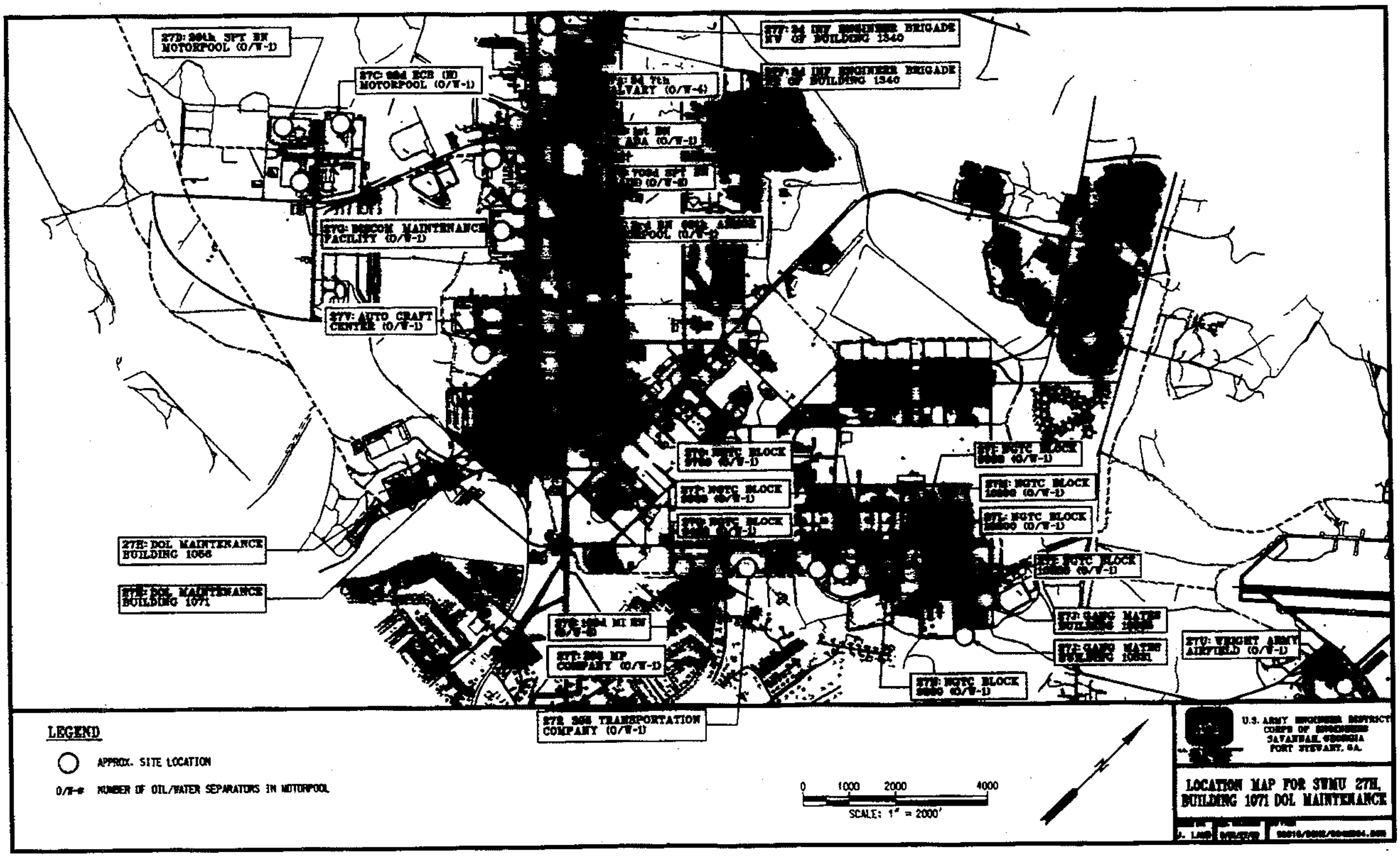


Figure 1. Location Map for SWMU 27H, Building 1071

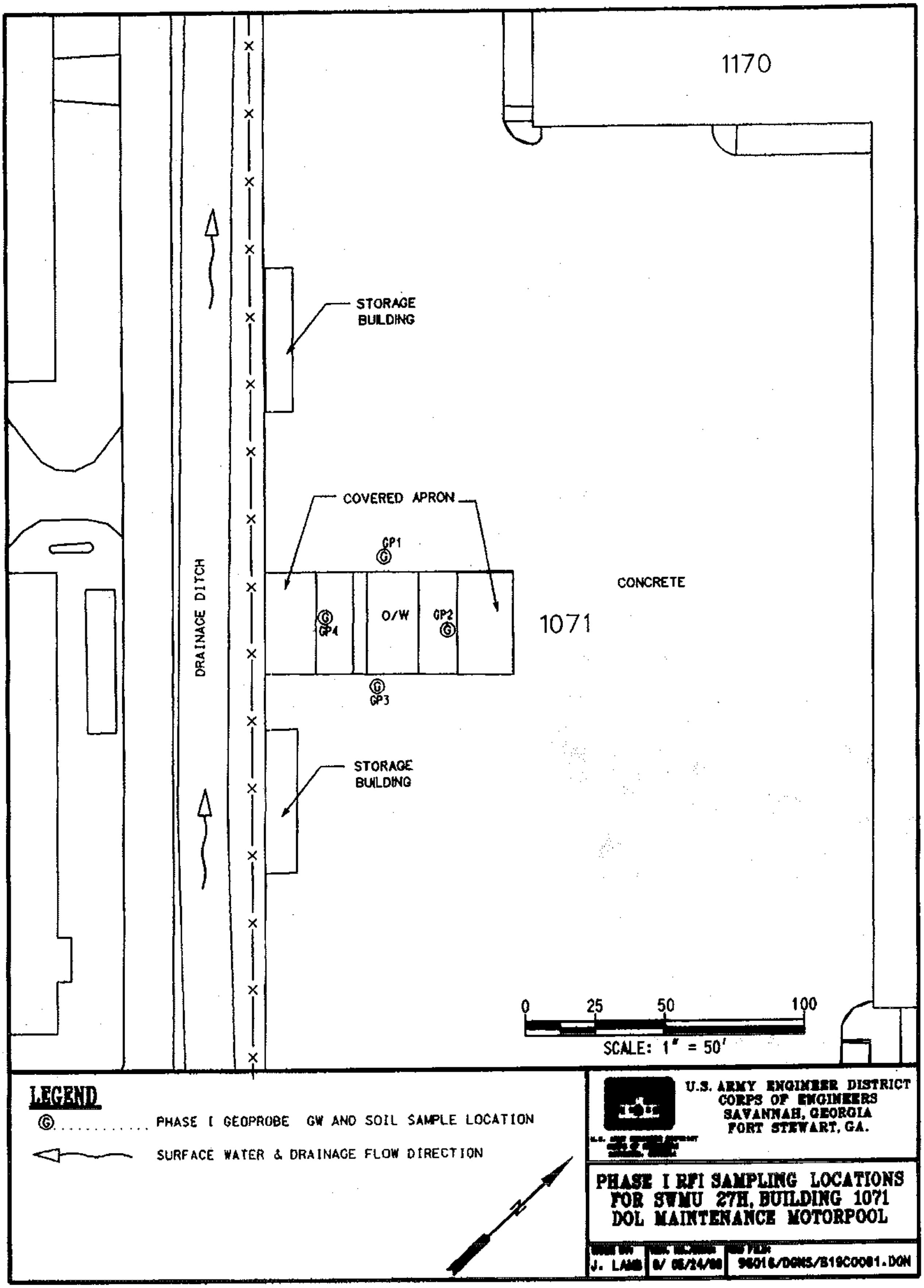


Figure 2. Phase I RFI Sampling Locations, SWMU 27H, Building 1071

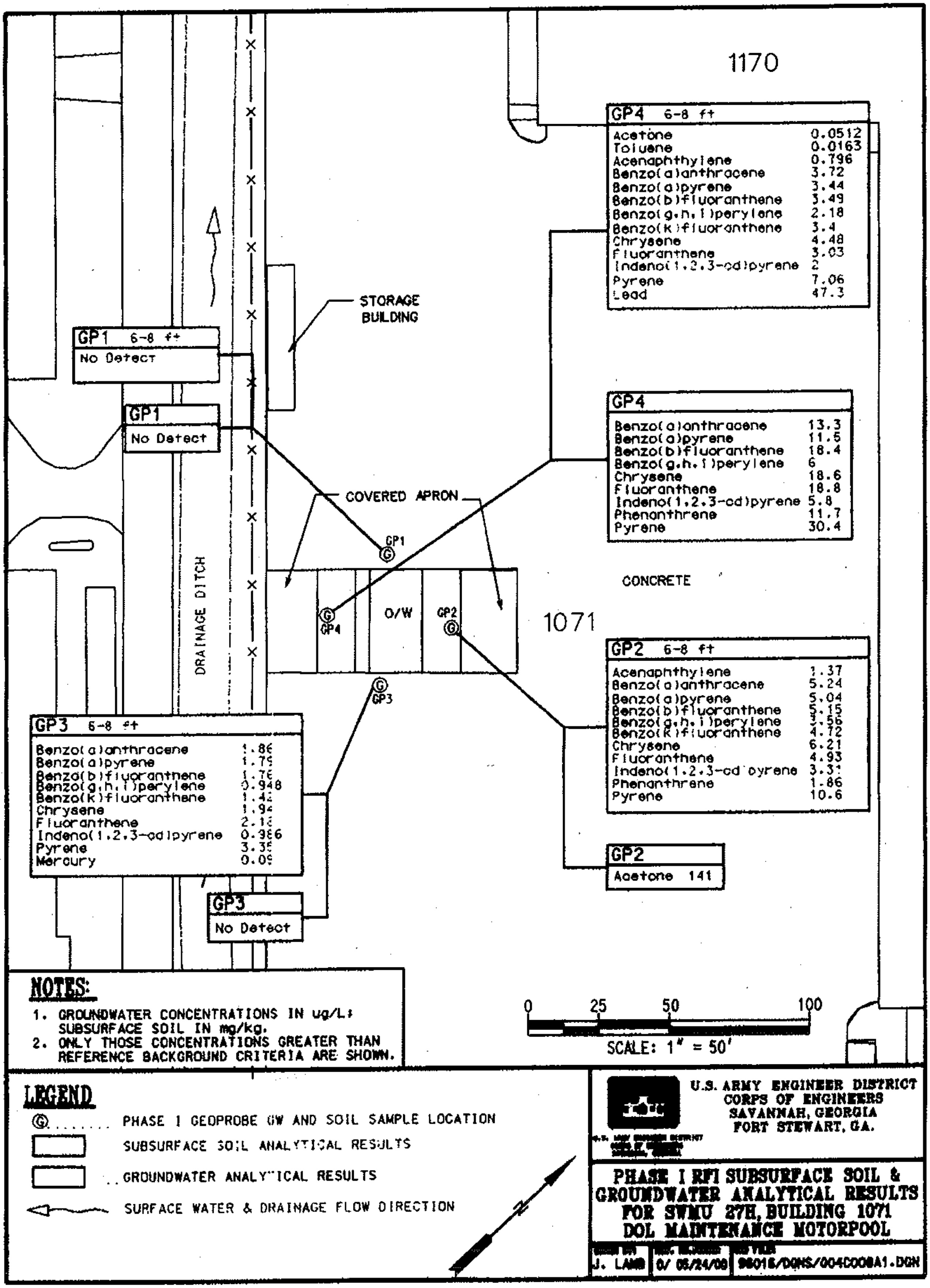


Figure 3. Summary of Phase I RFI Analytical Results in Subsurface Soil and Groundwater, SWMU 27H, Building 1071

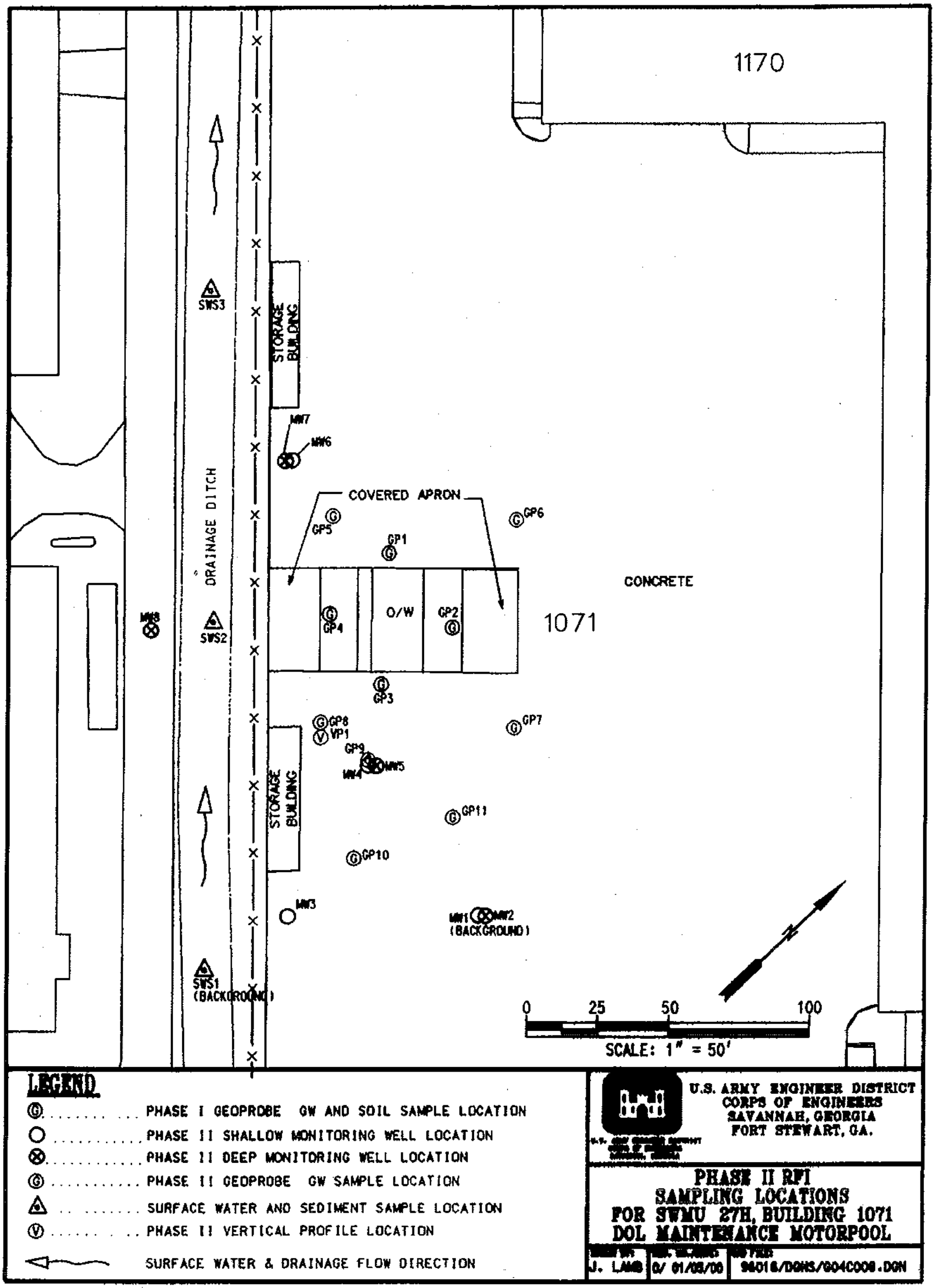
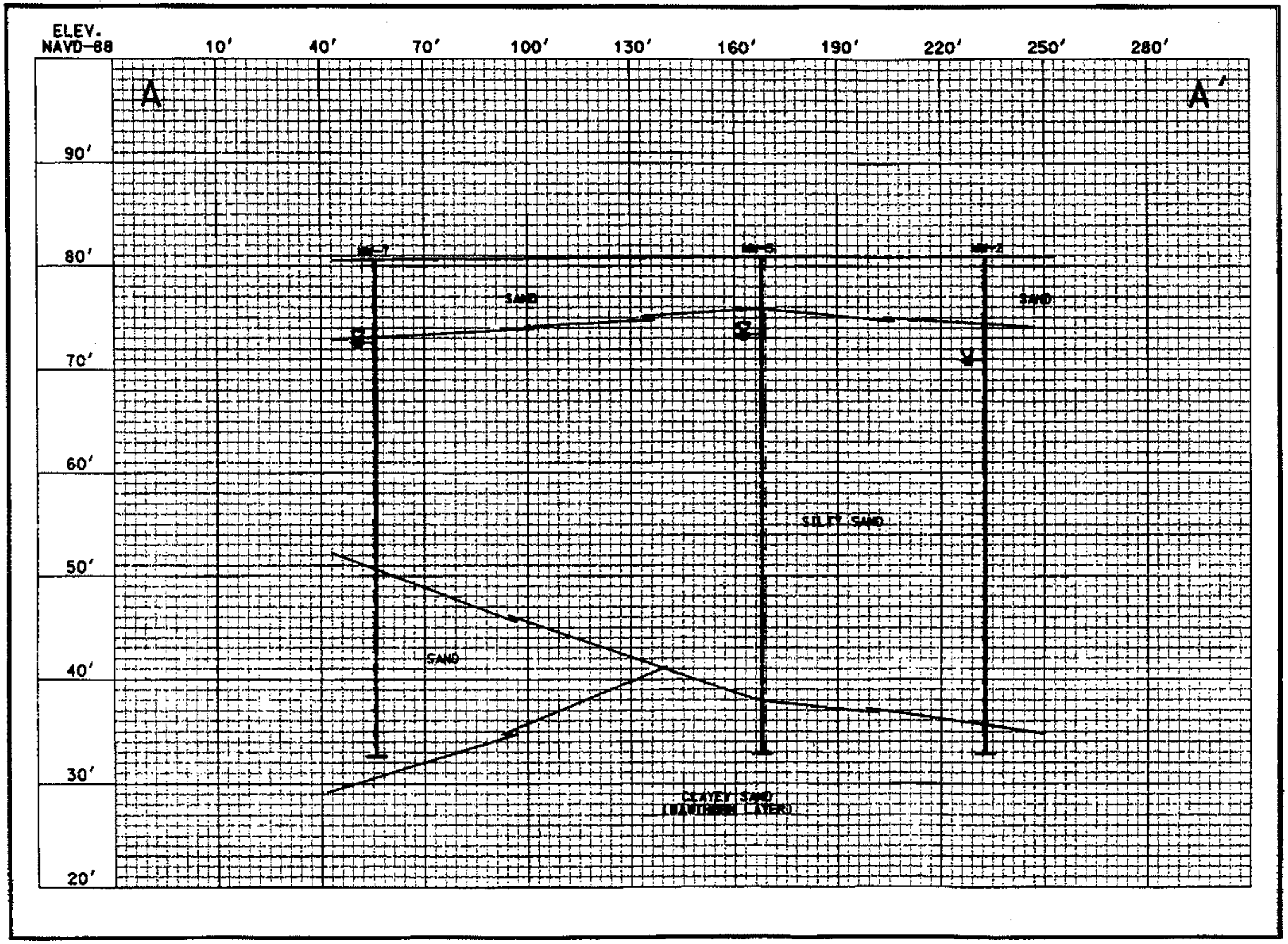
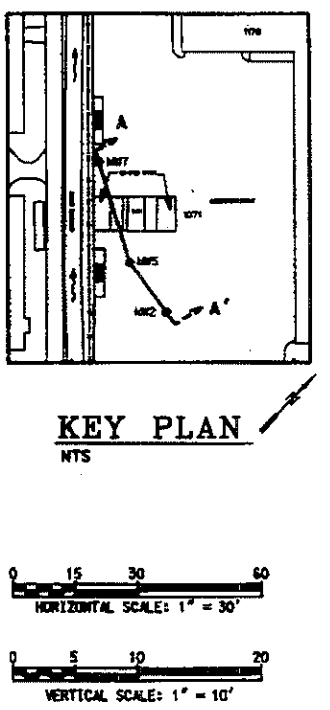


Figure 4. Phase II RFI Sampling Locations, SWMU 27H, Building 1071



LEGEND



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CROSS SECTION A-A'
FOR SWMU 27H, BUILDING 1071
DOL MAINTENANCE MOTORPOOL

J. LAND

Figure 5. Phase II RFI Cross Section A-A', SWMU 27H, Building 1071

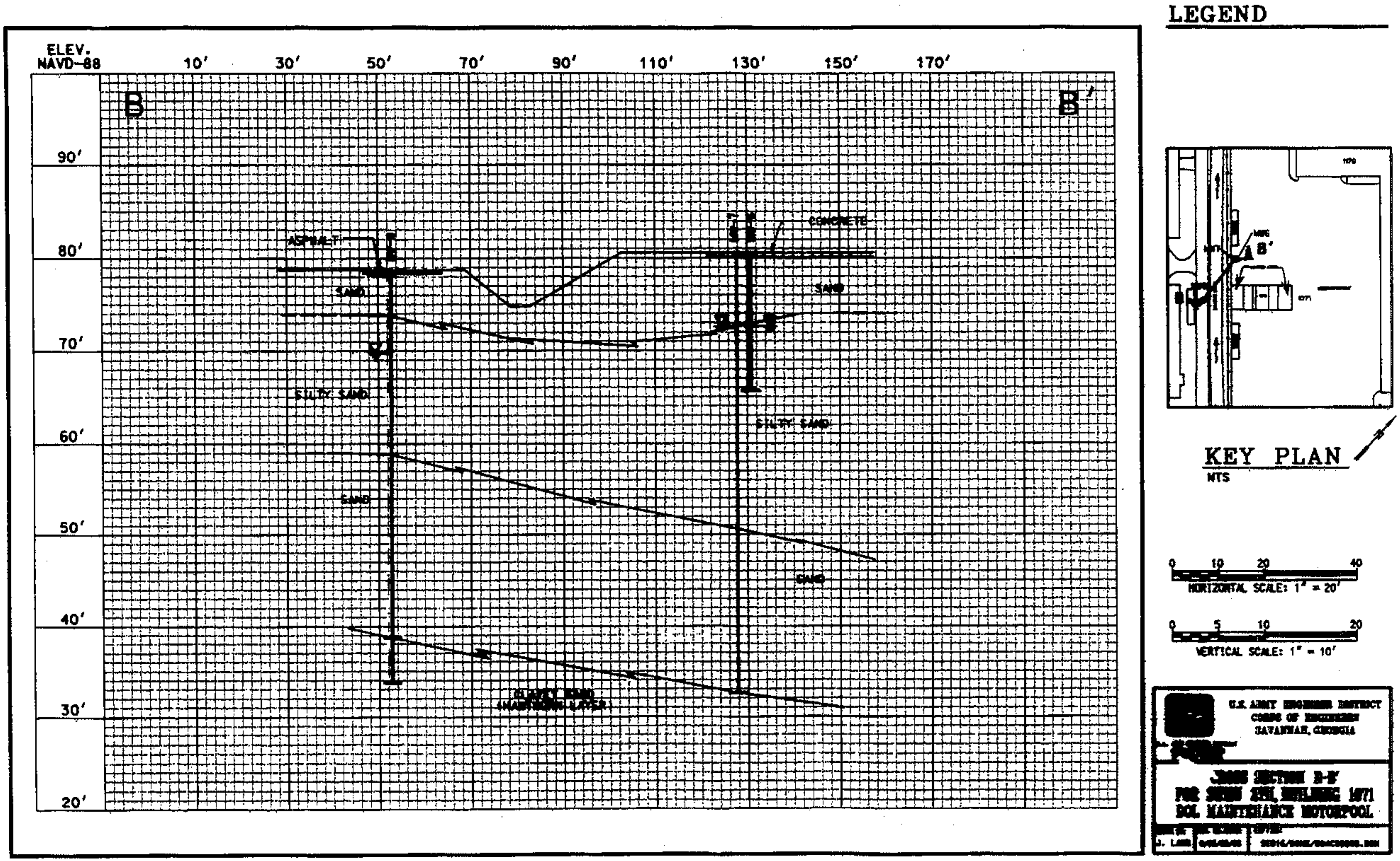


Figure 6. Phase II RFI Cross Section B-B', SWMU 27H, Building 1071

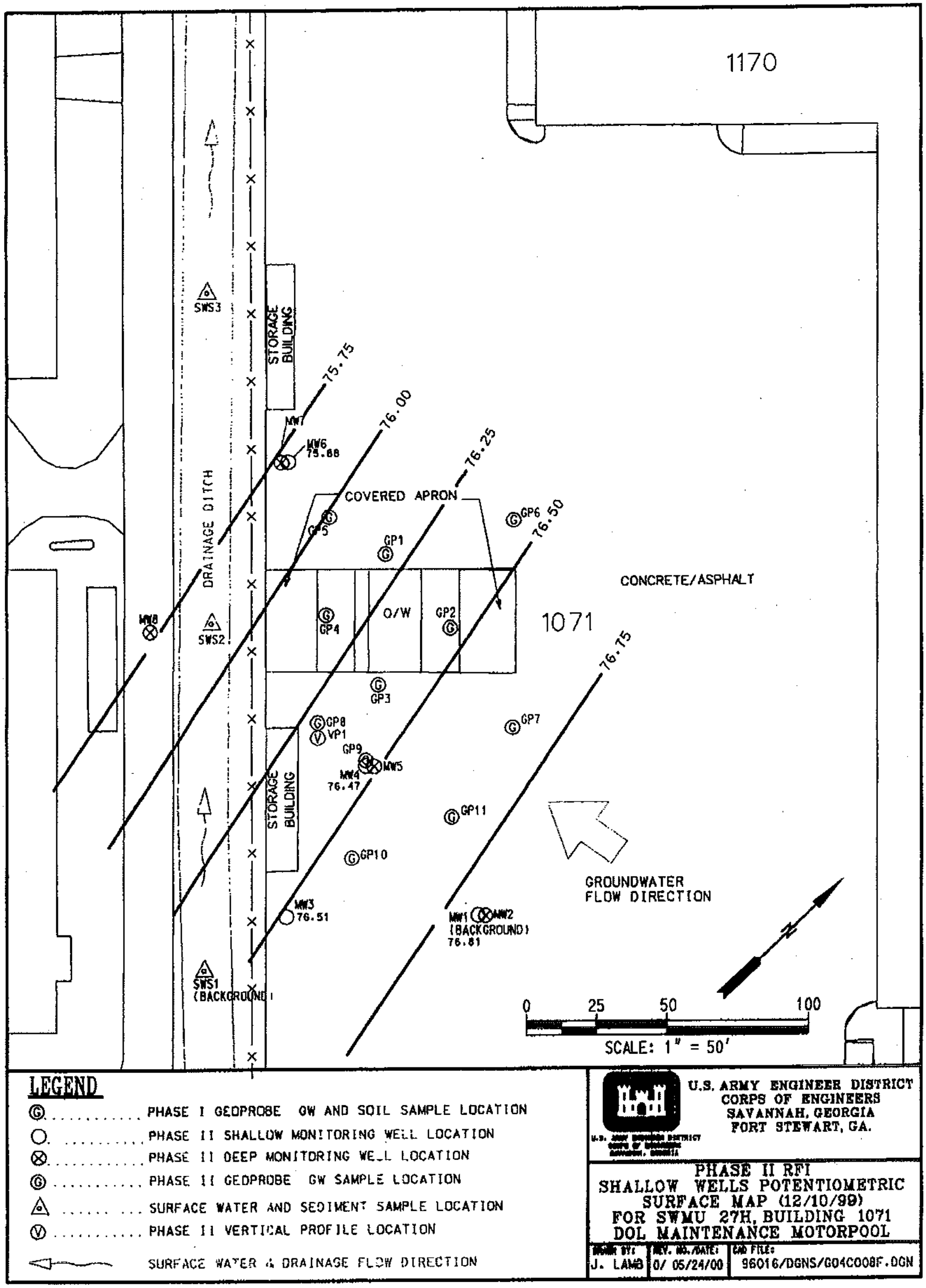


Figure 7. Phase II RFI Shallow Groundwater Potentiometric Surface Map, SWMU 27H, Building 1071

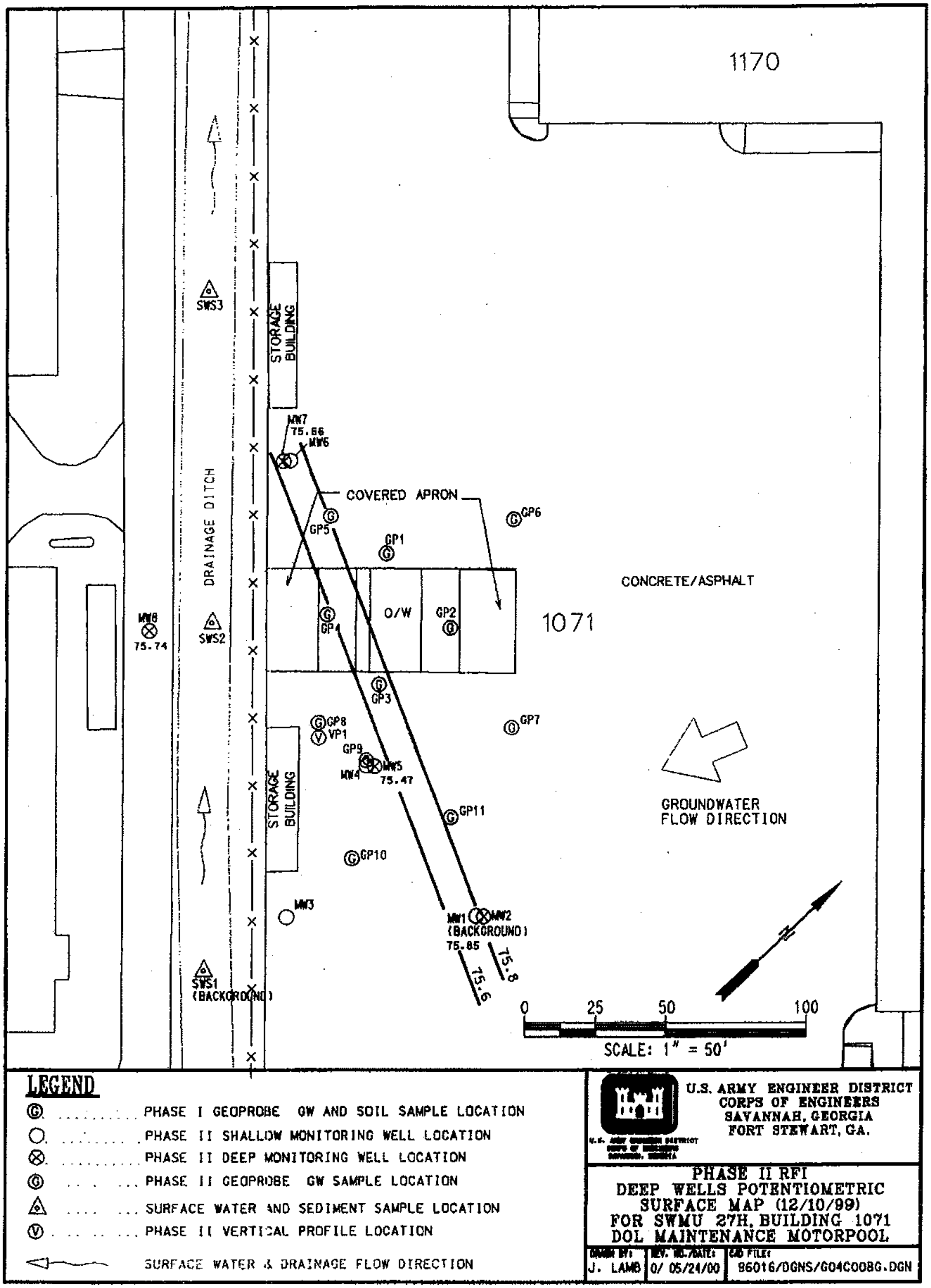
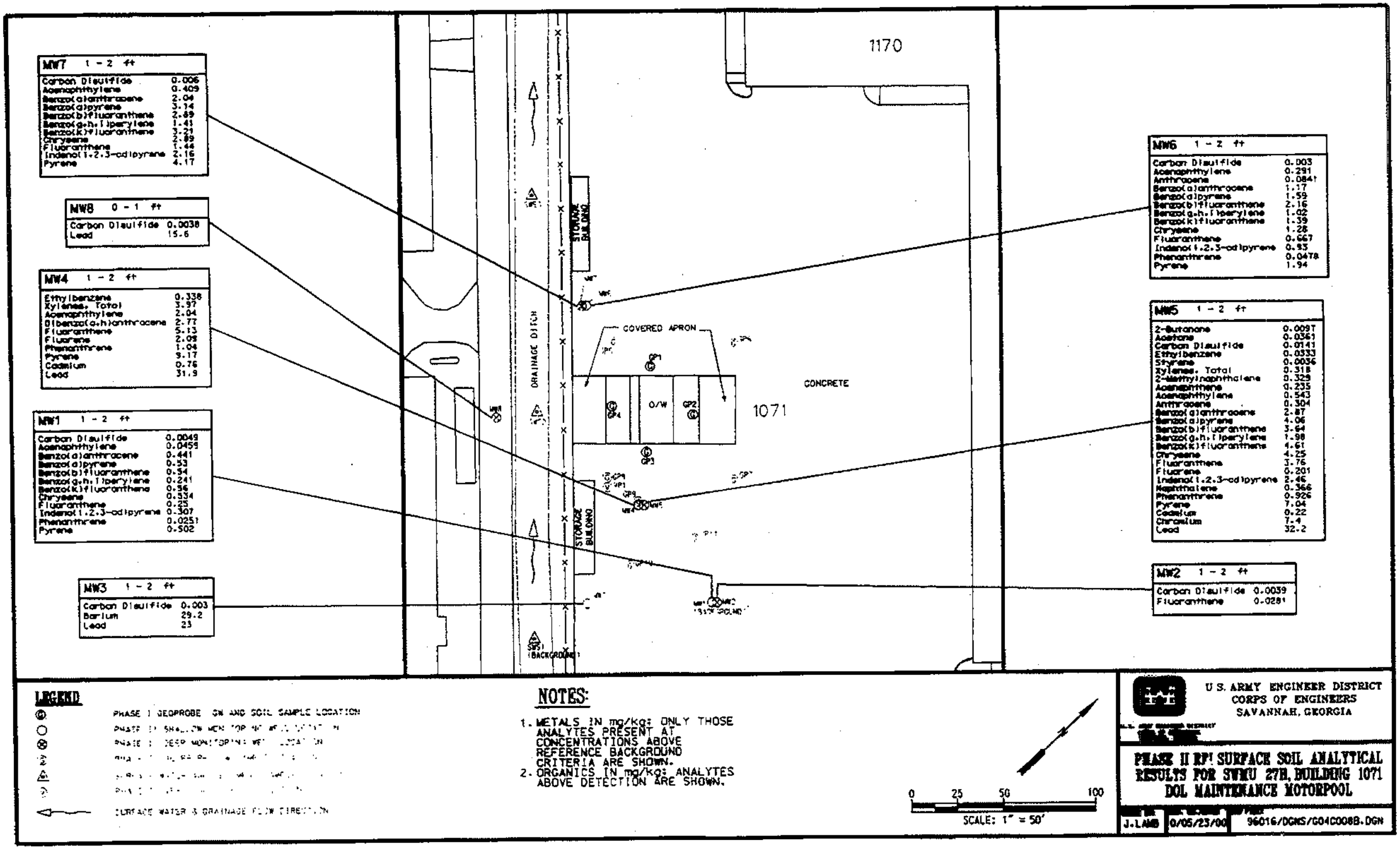


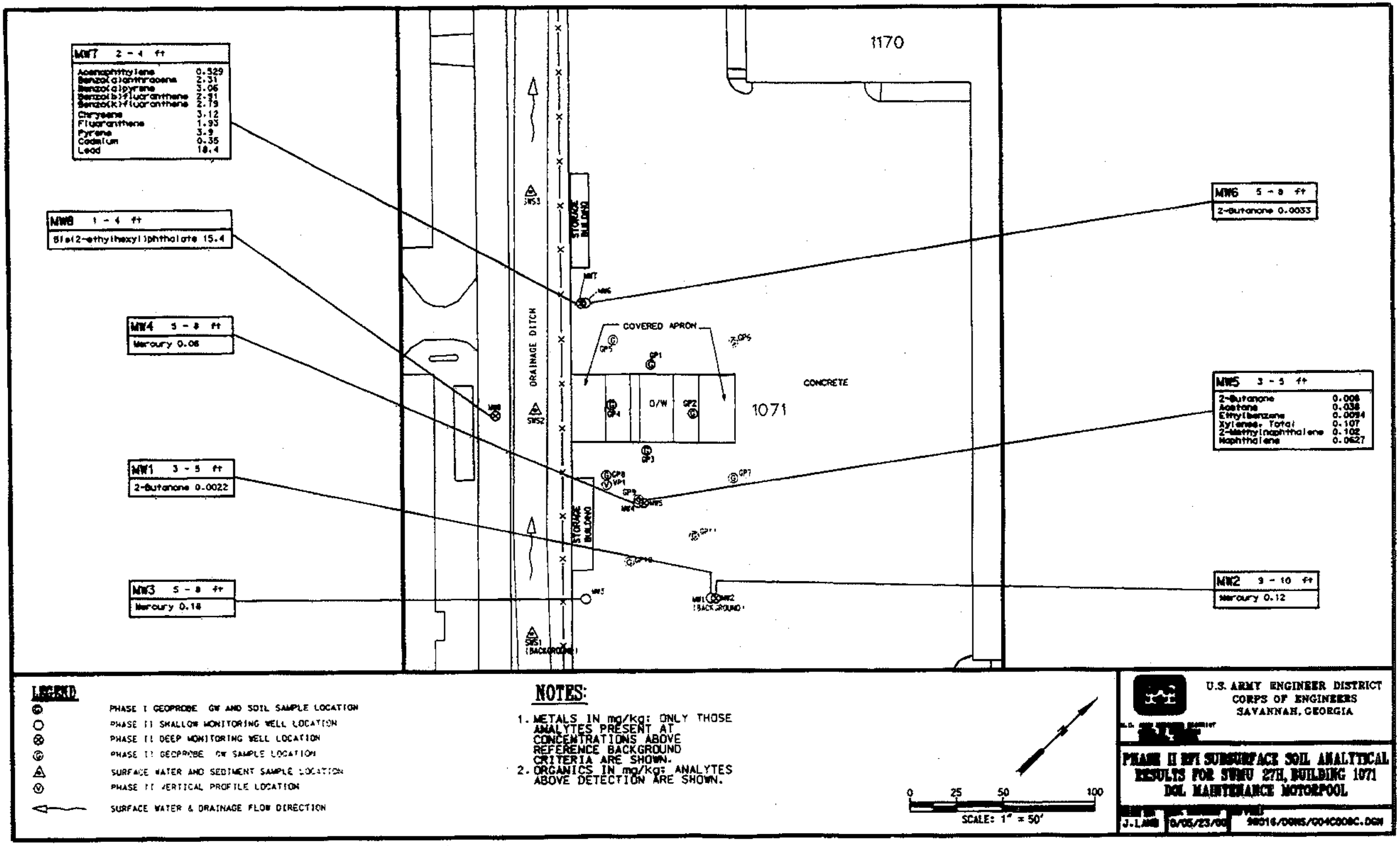
Figure 8. Phase II RFI Deep Groundwater Potentiometric Surface Map, SWMU 27H, Building 1071



NOTES:

1. METALS IN mg/kg: ONLY THOSE ANALYTES PRESENT AT CONCENTRATIONS ABOVE REFERENCE BACKGROUND CRITERIA ARE SHOWN.
2. ORGANICS IN mg/kg: ANALYTES ABOVE DETECTION ARE SHOWN.

Figure 9. Summary of Phase II RFI Analytical Results in Surface Soil, SWMU 27H, Building 1071



LEGEND

⊙	PHASE I GEOPROBE GW AND SOIL SAMPLE LOCATION
○	PHASE II SHALLOW MONITORING WELL LOCATION
⊗	PHASE II DEEP MONITORING WELL LOCATION
Ⓖ	PHASE II GEOPROBE GW SAMPLE LOCATION
△	SURFACE WATER AND SEDIMENT SAMPLE LOCATION
Ⓥ	PHASE II VERTICAL PROFILE LOCATION
◁~~	SURFACE WATER & DRAINAGE FLOW DIRECTION

NOTES:

1. METALS IN mg/kg; ONLY THOSE ANALYTES PRESENT AT CONCENTRATIONS ABOVE REFERENCE BACKGROUND CRITERIA ARE SHOWN.
2. ORGANICS IN mg/kg; ANALYTES ABOVE DETECTION ARE SHOWN.

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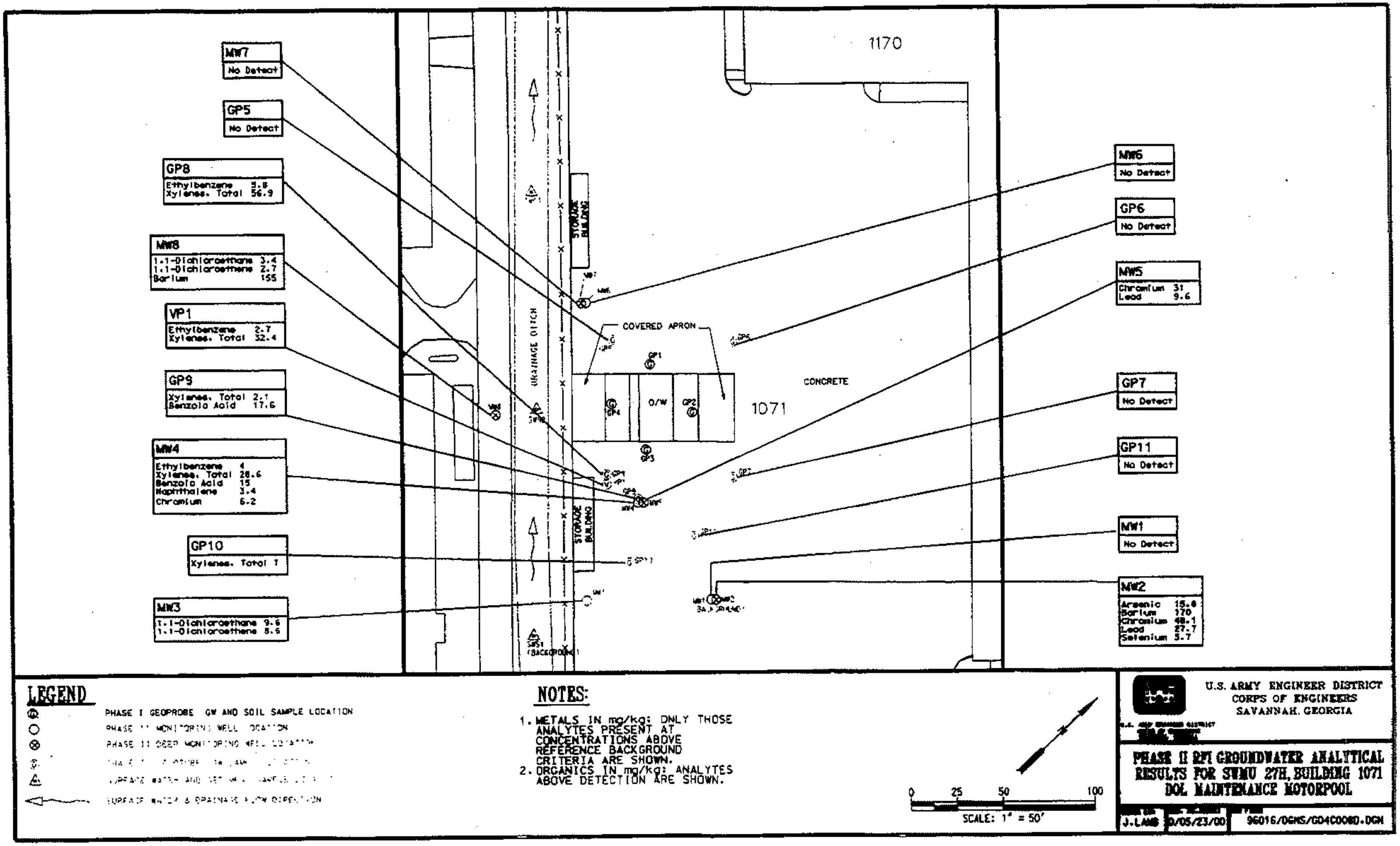
PHASE II RFI SUBSURFACE SOIL ANALYTICAL RESULTS FOR SWMU 27H, BUILDING 1071 DOL MAINTENANCE MOTORPOOL

J.LANG | 0/05/23/00 | 98016/DGNS/G04C008C.DGN

Figure 10. Summary of Phase II RFI Analytical Results in Subsurface Soil, SWMU 27H, Building 1071



NOTES:

1. METALS IN mg/kg; ONLY THOSE ANALYTES PRESENT AT CONCENTRATIONS ABOVE REFERENCE BACKGROUND CRITERIA ARE SHOWN.
2. ORGANICS IN mg/kg; ANALYTES ABOVE DETECTION ARE SHOWN.

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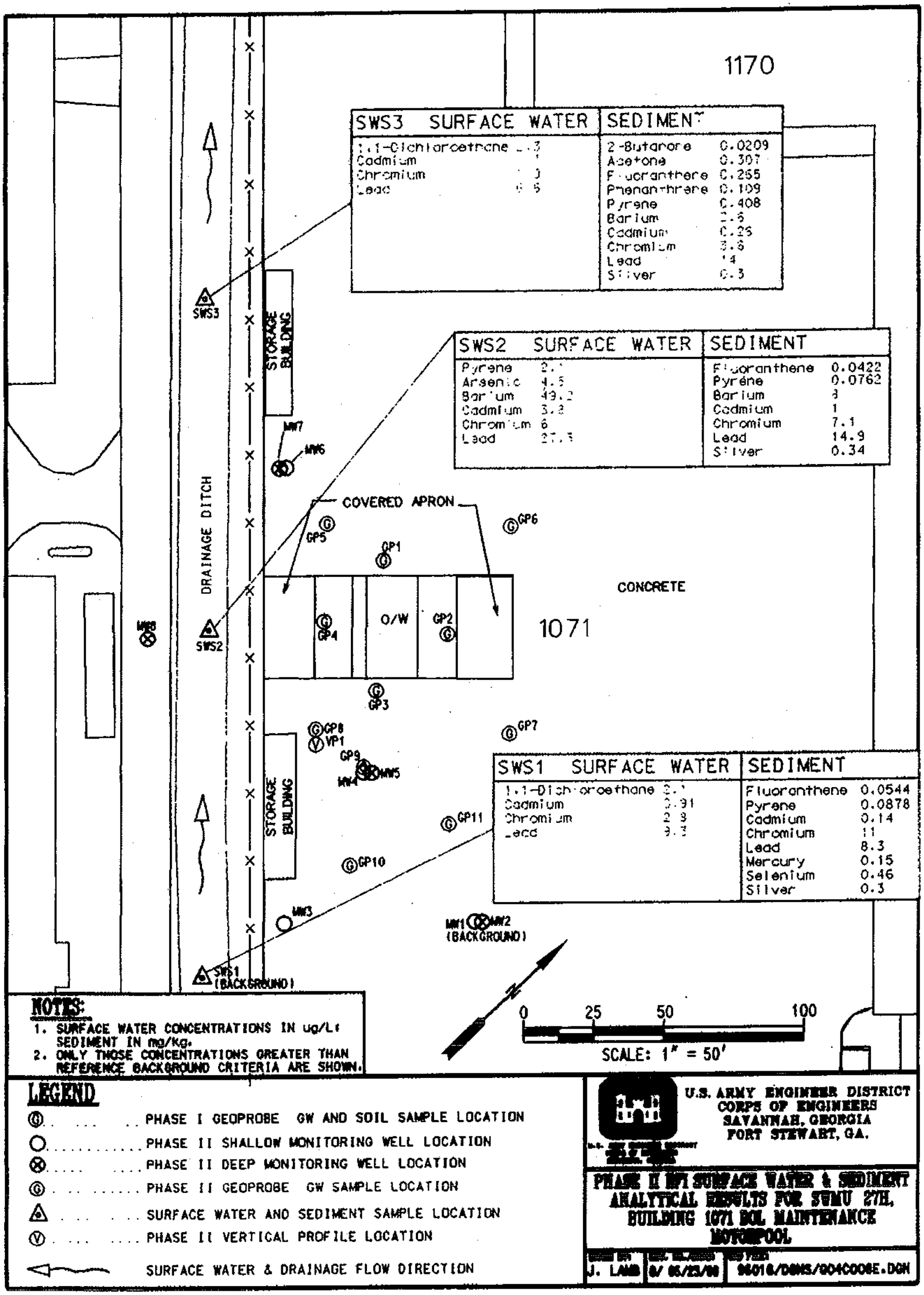
PHASE II RFI GROUNDWATER ANALYTICAL
RESULTS FOR SWMU 27H, BUILDING 1071
DOL MAINTENANCE MOTORPOOL

J.LAMB
0/05/23/00
96016/DGNS/GD4C00BD.DGN

Figure 11. Summary of Phase II RFI Analytical Results is Groundwater. SWMU 27H. Building 1071



SWS3 SURFACE WATER	
1,1-Dichloroethane	[illegible]
Cadmium	[illegible]
Chromium	[illegible]
Lead	[illegible]

SWS3 SEDIMENT	
2-Butanone	0.0209
Acetone	0.307
Fluoranthene	0.255
Phenanthrene	0.109
Pyrene	0.408
Barium	2.6
Cadmium	0.25
Chromium	3.6
Lead	14
Silver	0.3

SWS2 SURFACE WATER	
Pyrene	2.[illegible]
Arsenic	4.5
Barium	49.2
Cadmium	3.8
Chromium	6
Lead	27.5

SWS2 SEDIMENT	
Fluoranthene	0.0422
Pyrene	0.0762
Barium	8
Cadmium	1
Chromium	7.1
Lead	14.9
Silver	0.34

SWS1 SURFACE WATER	
1,1-Dichloroethane	[illegible]
Cadmium	0.91
Chromium	2.8
Lead	9.3

SWS1 SEDIMENT	
Fluoranthene	0.0544
Pyrene	0.0878
Cadmium	0.14
Chromium	11
Lead	8.3
Mercury	0.15
Selenium	0.46
Silver	0.3

NOTES:
1. SURFACE WATER CONCENTRATIONS IN ug/L; SEDIMENT IN mg/kg.
2. ONLY THOSE CONCENTRATIONS GREATER THAN REFERENCE BACKGROUND CRITERIA ARE SHOWN.

LEGEND

Ⓖ	PHASE I GEOPROBE GW AND SOIL SAMPLE LOCATION
○	PHASE II SHALLOW MONITORING WELL LOCATION
⊗	PHASE II DEEP MONITORING WELL LOCATION
Ⓖ	PHASE II GEOPROBE GW SAMPLE LOCATION
△	SURFACE WATER AND SEDIMENT SAMPLE LOCATION
Ⓥ	PHASE II VERTICAL PROFILE LOCATION
◁	SURFACE WATER & DRAINAGE FLOW DIRECTION

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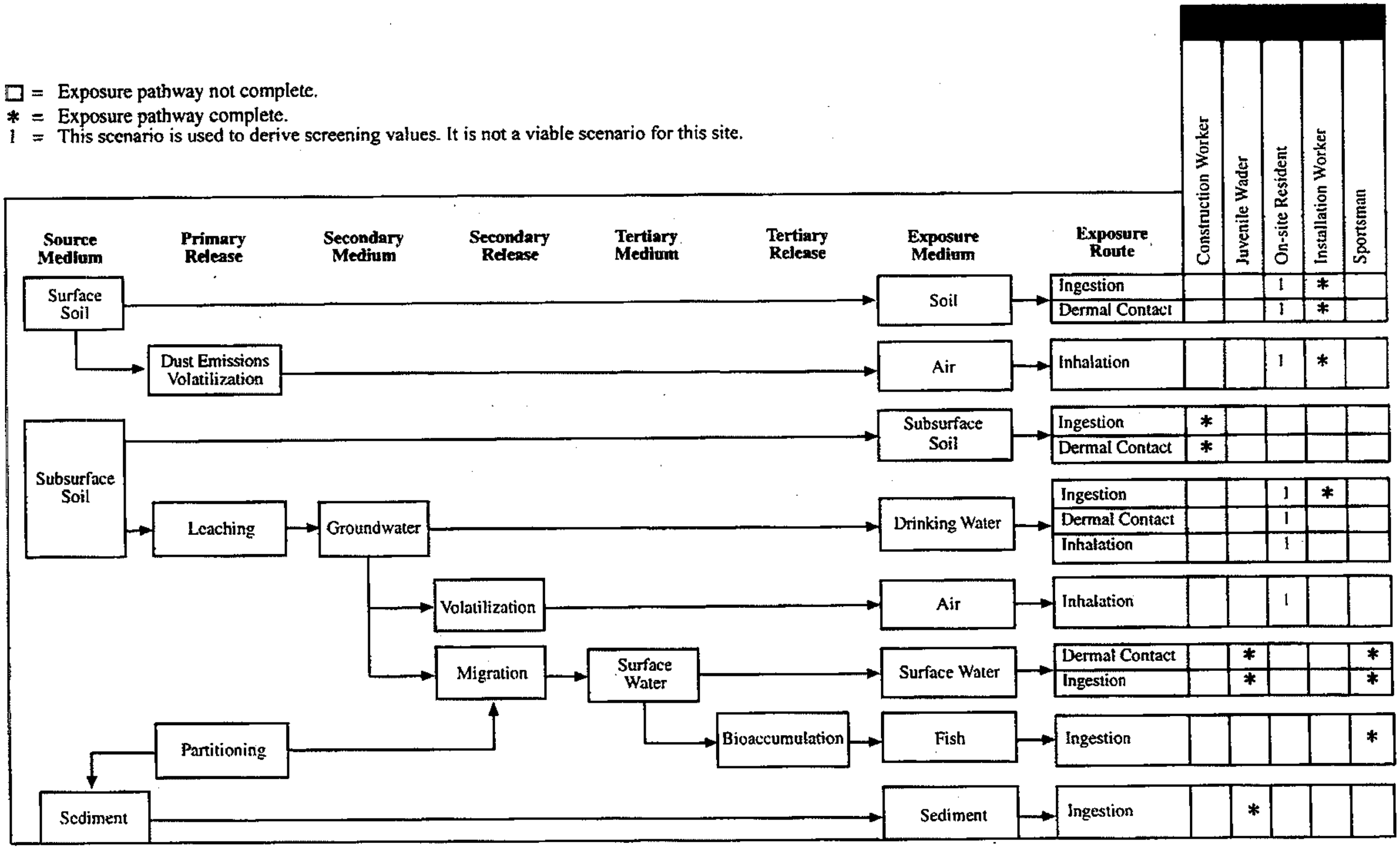
FORT STEWART, GA.

PHASE II RFI SURFACE WATER & SEDIMENT ANALYTICAL RESULTS FOR SWMU 27H, BUILDING 1071 DOL MAINTENANCE MOTORPOOL

J. LAMB | 6/ 05/23/00 | 96016/DGNS/004C006E.DGN

Figure 12. Summary of Phase II RFI Analytical Results in Surface Water and Sediment, SWMU 27H, Building 1071

☐ = Exposure pathway not complete.
* = Exposure pathway complete.
! = This scenario is used to derive screening values. It is not a viable scenario for this site.



Exposure Medium	Exposure Route	Construction Worker	Juvenile Wader	On-site Resident	Installation Worker	Sportsman
Soil	Ingestion			!	*	
	Dermal Contact			!	*	
Air	Inhalation			!	*	
Subsurface Soil	Ingestion	*				
	Dermal Contact	*				
Drinking Water	Ingestion			!	*	
	Dermal Contact			!		
	Inhalation			!		
Air	Inhalation			!		
Surface Water	Dermal Contact		*			*
	Ingestion		*			*
Fish	Ingestion					*
Sediment	Ingestion		*			

Figure 13. Phase II RFI Potential Migration and Exposure Pathways, SWMU 27H, Building 1071

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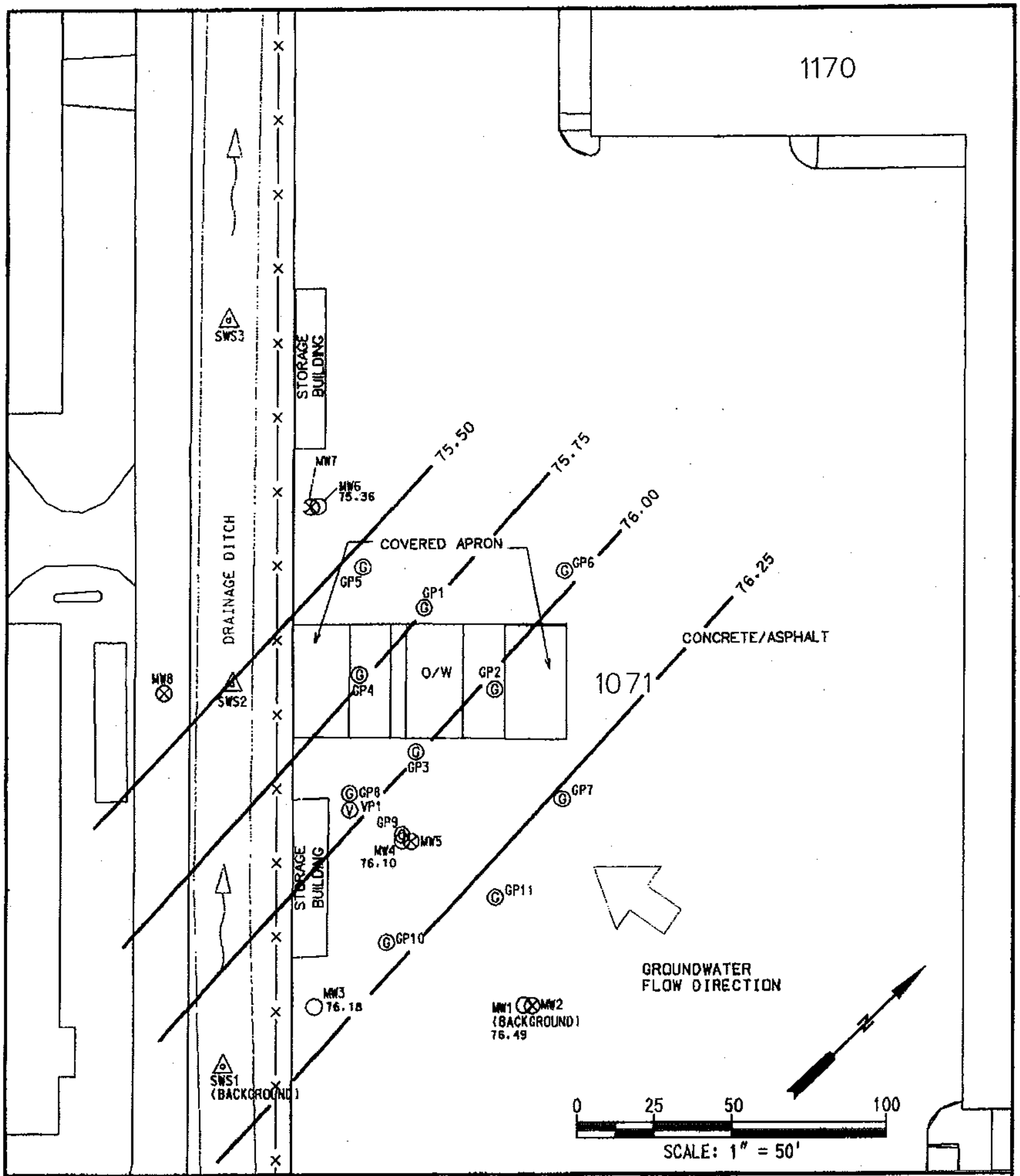

LEGEND

Ⓖ..........	PHASE I GEOPROBE GW AND SOIL SAMPLE LOCATION
○...........	PHASE II SHALLOW MONITORING WELL LOCATION
⊗....	PHASE II DEEP MONITORING WELL LOCATION
Ⓖ..........	PHASE II GEOPROBE GW SAMPLE LOCATION
△	SURFACE WATER AND SEDIMENT SAMPLE LOCATION
Ⓥ..........	PHASE II VERTICAL PROFILE LOCATION
◁——	SURFACE WATER & DRAINAGE FLOW DIRECTION

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SUPPLEMENTAL CHARACTERIZATION
SHALLOW WELLS POTENTIOMETRIC
SURFACE MAP (10/30/00) FOR SWMU 27H
BUILDING 1071 DOL MAINTENANCE MOTORPOOL

DRAWN BY:	REV. NO./DATE:	CAD FILE:
J. LAMB	0/ 03/09/01	98016/DGNS/G04C00BFA.DGN

Figure 14. Supplemental Shallow Groundwater Potentiometric Surface Map, SWMU 27H, Building 1071

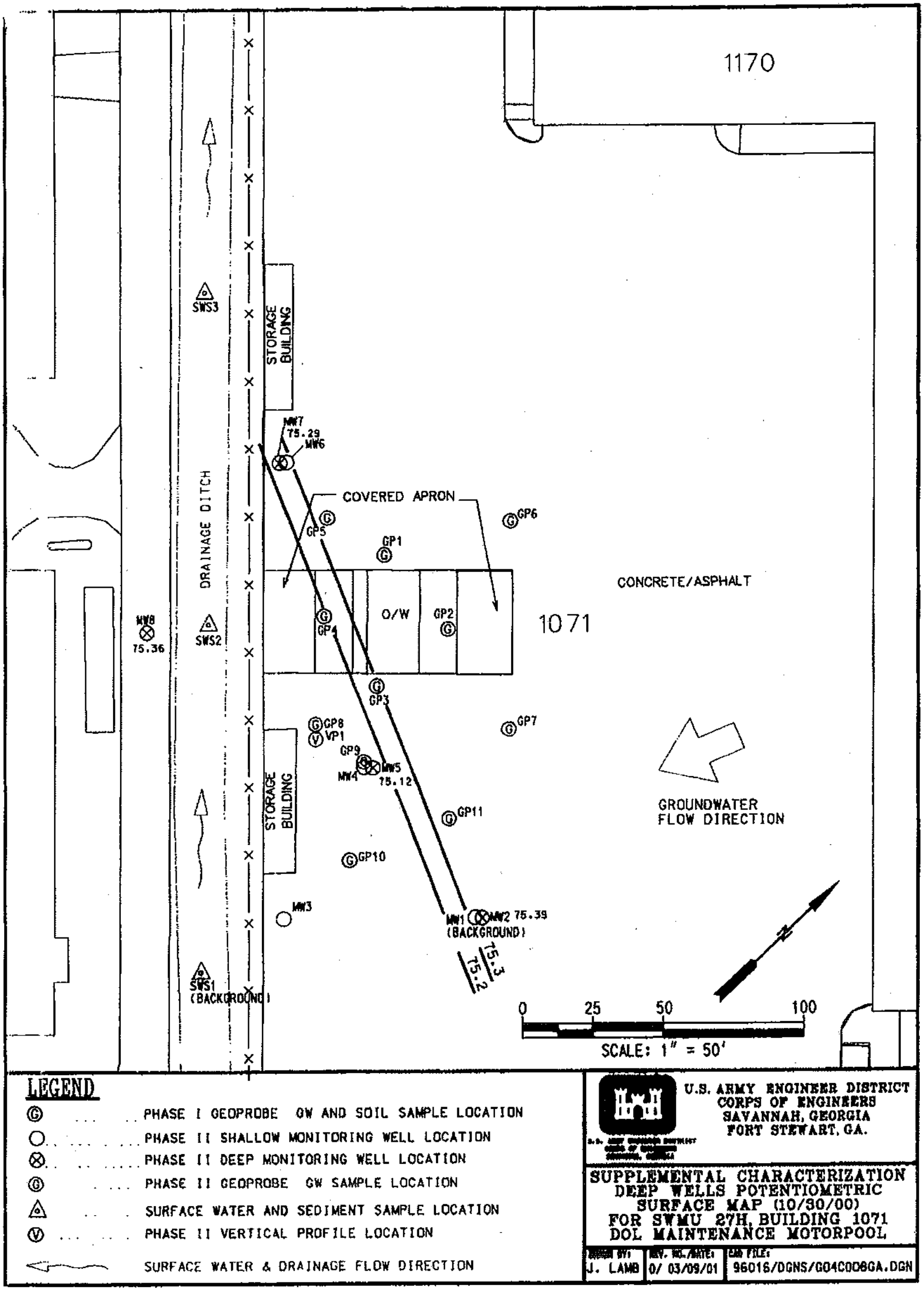

Figure 15. Supplemental Deep Groundwater Potentiometric Surface Map SWMU 27H, Building 1071.

ATTACHMENT A
TO SWMU 27H, BUILDING 1071
TO THE
REVISED FINAL PHASE II RCRA FACILITY INVESTIGATION REPORT
FOR
16 SOLID WASTE MANAGEMENT UNITS
AT
FORT STEWART, GEORGIA

FATE AND TRANSPORT ANALYSIS

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Fate and transport modeling was performed for the preliminary contaminant migration contaminants of potential concern (CMCOPCs) in soil and human health contaminants of potential concern (HHCOPCs) and ecological contaminants of potential concern (ECOPCs) in groundwater. The main purpose of the modeling was to estimate future groundwater concentrations from the leachate beneath Solid Waste Management Unit (SWMU) 27H, Building 1071 and also to predict future surface water concentrations at the receptor locations. A man-made drainage ditch is located adjacent to the site. The drainage ditch ultimately discharges into Mill Creek. Because of the proximity of this shallow ditch to the site, it was assumed that the concentrations of the contaminants of potential concern (CMCOPCs, HHCOPCs, and ECOPCs) in shallow groundwater were the same as the surface water concentrations in the drainage ditch.

The maximum groundwater concentrations of the HHCOPCs detected in deep groundwater were modeled to a tributary of Mill Creek located approximately 1,500 feet away from the site. The modeling procedures used to estimate groundwater and surface water concentrations are discussed below.

Migration to Groundwater Beneath the Source

The groundwater concentrations resulting from the leaching of the preliminary CMCOPCs—benzo(*a*)anthracene, benzo(*b*)fluoranthene, dibenzo(*a,h*)anthracene, cadmium, chromium, and mercury—from the soil above the water table were estimated using the Seasonal Soil Compartment (SESOIL) Model [see Section 6.4.2 and Appendix K of the revised final Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for 16 SWMUs (SAIC 2000a)]. Chemical and climatic parameters used in SESOIL modeling are presented in Table 6-2 and Appendix K, Table K-1 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a), respectively. The hydrogeological parameters and application data used in SESOIL are presented in Tables A-1 and A-2, respectively. SESOIL modeling results are presented in Table A-3 and Figures A-1 and A-2. The predicted groundwater concentrations are calculated by dividing the SESOIL leachate concentration by a dilution factor (DF) of 2.17. The DF was developed using the hydraulic analysis method (EPA 1996), which involves calculating the rate of flow through the aquifer system and the rate of rainwater percolation into the aquifer. The parameters used in the development of the DF are presented in Table A-1. The thickness of the zone of mixing in the groundwater aquifer was calculated to be 17.1 feet, using the formula for depth of mixing presented in the U.S. Environmental Protection Agency's soil screening guidance (EPA 1996). The modeling results indicated that benzo(*a*)anthracene, benzo(*b*)fluoranthene, and dibenzo(*a,h*)anthracene will naturally attenuate before reaching the water table. Modeling results also indicated that the predicted groundwater concentration of mercury will not exceed its maximum contaminant level (MCL). Groundwater concentrations of cadmium and chromium were predicted to be 0.006 mg/L (MCL 0.005 mg/L) and 0.18 mg/L (MCL 0.1 mg/L), respectively.

Migration of Groundwater to Surface Water

The exposure concentrations of HHCOPCs detected in the shallow groundwater (1,1-dichloroethene and naphthalene) and the modeled groundwater concentrations of CMCOPCs in soil (cadmium and chromium) were conservatively assumed to be same as the surface water exposure concentrations in the shallow drainage ditch next to the site.

The concentrations of the deep groundwater HHCOPCs (chromium and 1,1-dichloroethene) were modeled to estimate their potential concentrations at the tributary of Mill Creek, located approximately 1,500 feet from the site. One-dimensional Analytical Solute Transport (ODAST) and Analytical Transient 1-, 2-, 3-Dimensional AT123D models [see Chapter 6.0 and Appendix K of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a)] were used to predict the surface water concentrations of inorganic (barium, chromium, and lead) and organic (1,1-dichloroethene) contaminants of potential concern (COPCs), respectively, due to migration of deep groundwater.

The ODAST modeling parameters are presented in Table A-4. ODAST modeling of metals assumed a constant concentration at the source for a period of 70 years and was simulated for a period of 1,000 years. The ODAST modeling results (Table A-5) indicate that barium, chromium, and lead in deep groundwater will not migrate to the tributary of Mill Creek through the deep groundwater pathway.

The AT123D modeling parameters are presented in Table A-6. The biodegradation rate of 1,1-dichloroethene used in the modeling is presented in Table 6-2 of the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000a). The AT123D model of 1,1-dichloroethene was calibrated to the maximum observed deep groundwater concentration (0.0027 mg/L). AT123D modeling assumed a steady-state constant concentration of 1,1-dichloroethene at the source. The AT123D modeling results (Table A-7) indicate that 1,1-dichloroethene will not reach the receptor location through the deep groundwater pathway; therefore, the predicted surface water exposure concentration due to migration of the deep groundwater HHCOPC—1,1-dichloroethene—is zero. The AT123D model output file for 1,1-dichloroethene is presented at the back of this attachment.

Based on the modeling results discussed above, the risks from barium, chromium, lead, and 1,1-dichloroethene in deep groundwater migrating to the surface water were not assessed further in the risk assessment.

REFERENCES

EPA (U.S. Environmental Protection Agency) 1996. *Soil Screening Guidance: Technical Background Document*, EPA/540/R-95/128, Office of Solid Waste and Emergency Response, May.

Mills, W. B., D. B. Porcella, M. J. Ungs, S. A. Gherini, K. V. Summers, G. L. Rupp, and G. L. Bowie 1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants: Parts 1, 2, and 3*, EPA/600/6-85/002, EPA Environmental Research Laboratory, Office of Research and Development, Athens, Georgia.

SAIC (Science Applications International Corporation) 2000. *Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia* (Revised Final), April.

Table A-1. Hydrogeological Parameters Used for SESOIL Modeling, SWMU 27H, Building 1071

Parameter Type	Parameter Value	Source
Soil type	Silty sand	SWMU 27H, Building 1071 specific
Bulk density (gm/cm^3)	1.57	Laboratory analysis
Percolation rate (cm/year)	9	From HELP model
Intrinsic permeability (cm^2)	2.70E-10	Calibrated
Disconnectedness index	9	Calibrated
Porosity (%)	41	Laboratory analysis
Depth to water table (feet)	8	Site specific
Organic carbon content (%)	2.89	Laboratory analysis
Frendlich equation exponent	1	SESOIL default value
DAF	2.17	Calculated
Area of source (m^2)	9.61E+02	Estimated from soil contamination area

DAF = Dilution attenuation factor.
HELP = Hydrologic Evaluation of Landfill Performance.

Table A-2. SESOIL Application Data, SWMU 27H, Building 1071

COPCs	No. of Layers	Layer No.	Thickness of Layer (feet)	No. of Sublayers	Sublayer No.	Concentration (µg/g)
Benzo(*a*)anthracene	4	1	2	1	1	0.287
		2	3	3	1	2.31
					2	2.31
					3	0
		3	3	3	1	3.72
					2	5.24
					3	5.24
		4	0.25	1	1	0
Benzo(*b*)fluoranthene	4	1	2	1	1	3.64
		2	3	3	1	2.91
					2	2.91
					3	0
		3	3	3	1	3.49
					2	5.15
					3	5.15
		4	0.25	1	1	0
Dibenzo(*a,h*)anthracene	4	1	2	1	1	2.77
		2	3	3	1	0
					2	0
					3	0
		3	3	3	1	0
					2	0
					3	0
		4	0.25	1	1	0
Cadmium	4	1	2	1	1	0.76
		2	3	3	1	0.35
					2	0.35
					3	0
		3	3	3	1	0.22
					2	0.22
					3	0.22
		4	0.25	1	1	0

Table A-2. SESOIL Application Data, SWMU 27H, Building 1071 (continued)

COPCs	No. of Layers	Layer No.	Thickness of Layer (feet)	No. of Sublayers	Sublayer No.	Concentration (µg/g)
Chromium	4	1	2	1	1	7.4
		2	3	3	1	0
					2	0
					3	0
		3	3	3	1	0
					2	0
					3	0
		4	0.25	1	1	0
Mercury	4	1	2	1	1	0
		2	3	3	1	0
					2	0
					3	0
		3	3	3	1	0.18
					2	0.18
					3	0.18
		4	0.25	1	1	0

Table A-3. Summary of Leachate Modeling Results, SWMU 27H, Building 1071

Preliminary CMCOPCs[a]	Maximum Concentration (mg/kg)	Predicted $C_{leachate,max}$ beneath the Source (mg/L)	Predicted T_{max} (years)	Predicted $C_{gw,max}$ at the Source[b] (mg/L)	Maximum Observed Groundwater Concentration (mg/L)	Groundwater Target Concentration(mg/L)	Source[c]	CMCOPC?
Organics								
Benzo(*a*)anthracene	5.24	0.000	NA	0.000	ND	NA		No
Benzo(*b*)fluoranthene	5.15	0.000	NA	0.000	ND	NA		No
Dibenzo(*a,h*)anthracene	2.77	0.000	NA	0.000	ND	NA		No
Inorganics								
Cadmium	0.76	0.013	756	0.006	ND	0.005	M	Yes
Chromium	7.4	0.39	247	0.180	0.031	0.1	M	Yes
Mercury	0.18	0.0025	106	0.001	ND	0.002	M	No

[a] These constituents were selected for SESOIL modeling from this site.

[b] The predicted maximum concentration in groundwater ($C_{gw,max}$) at the source was calculated by applying a dilution factor to the predicted maximum leachate concentration ($C_{leachate,max}$).

[c] M = Maximum contaminant level.

NA = Not applicable.

ND = Not detected.

Table A-4. Parameters Used for ODAST Modeling, SWMU 27H, Building 1071

Parameter Type	Parameter Value	Source
Bulk density (gm/cm^3)	1.57	Laboratory analysis
Effective porosity (%)	20	Mills et al. (1985) for sandy silt
Hydraulic conductivity (cm/s)	3.50E-04	Site specific
Hydraulic gradient	0.017	Site-specific gradient for deep groundwater
Groundwater velocity (feet/day)	0.085	Calculated
Dispersion coefficient (feet^2/day)	12.75	Calculated assuming dispersivity = 0.1 × distance to receptor
Distance to receptor (feet)	1,500	Approximate distance to a tributary to Mill Creek
Distribution coefficient for barium (L/kg)	11	Corresponding to pH = 4.9 (EPA 1996)
Distribution coefficient for chromium (L/kg)	31	Corresponding to pH = 4.9 (EPA 1996)
Distribution coefficient for lead (L/kg)	100	Lowest value presented in Table 6.1 of SAIC 2000a

Table A-5. ODAST Modeling Results, SWMU 27H, Building 1071

COPC	Source Concentration (mg/L)	Dilution Factor[a]	Receptor	Receptor Point Groundwater Concentration (mg/L)
Barium[b]	0.155	Infinite	Tributary to Mill Creek (1,500 feet)	0
Chromium[c]	0.031	Infinite	Tributary to Mill Creek (1,500 feet)	0
Lead[b]	0.096	Infinite	Tributary to Mill Creek (1,500 feet)	0

[a] Dilution factor represents (maximum concentration at the source) ÷ (maximum predicted concentration at the receptor in 1,000 year simulation).

[b] ECOPCs in deep groundwater.

[c] HHCOPC in deep groundwater.

Table A-6. Key Hydrogeological Parameters Used for AT123D Modeling, SWMU 27H, Building 1071

Parameter Type	Parameter Value	Source
Bulk density (gm/cm^3)	1,507	Laboratory analysis
Effective porosity (%)	20	Mills et al. (1985) for sandy silt type
Hydraulic conductivity (m/hour)	1.26E-02	Site specific
Hydraulic gradient	0.017	Site-specific gradient for deep groundwater
Dispersivity (m)	46	Calculated assuming dispersivity = 0.1 × distance to receptor
Density of water (kg/m^3)	1,000	Assumed
Fraction of organic carbon (unitless)	0.0244	Laboratory analysis for the 9-foot to 10-foot interval
Distance to receptor (feet)	1,500	Approximate distance to the Canoochee Creek
Source area length (m)	42	Conservative estimate
Source are width (m)	23	Conservative estimate

Table A-7. AT123D Modeling Results, SWMU 27H, Building 1071

COPC[a]	Source Concentration[b] (mg/L)	Dilution Factor[b]	Receptor	Receptor Point Groundwater Concentration (mg/L)
1,1-Dichloroethene	0.0027	Infinite	Tributary to Mill Creek (1,500 feet)	0.00E+00

[a] HHCOPC in deep groundwater.

[b] Maximum observed groundwater concentrations in deep wells.

[c] Dilution factor represents (maximum concentration at the source) ÷ (maximum predicted concentration at the receptor).

Figure A-1. Predicted Concentration of Cadmium in Groundwater Based on Leachate Modeling Using SESOIL, SWMU 27H, Building 1071

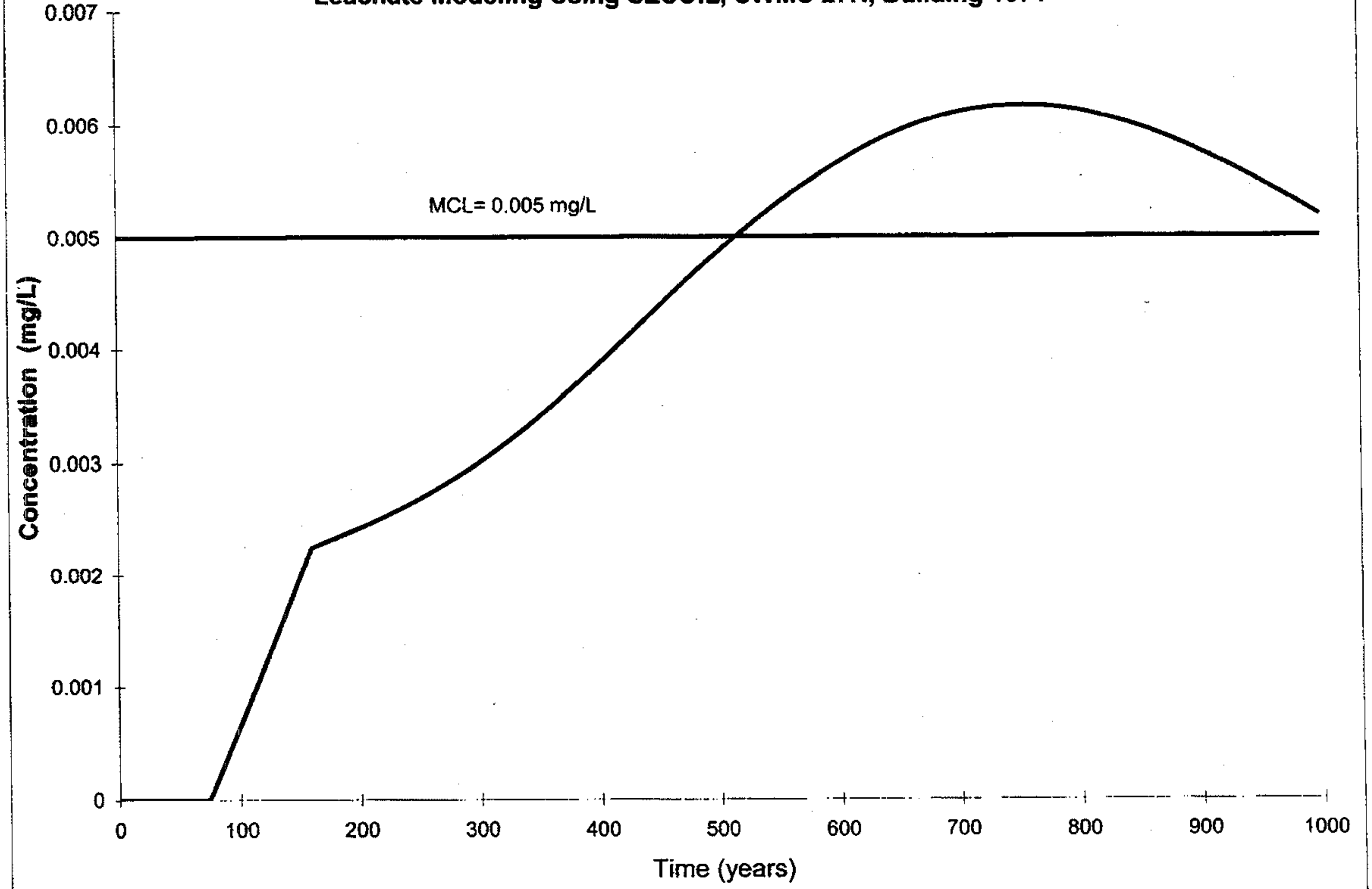
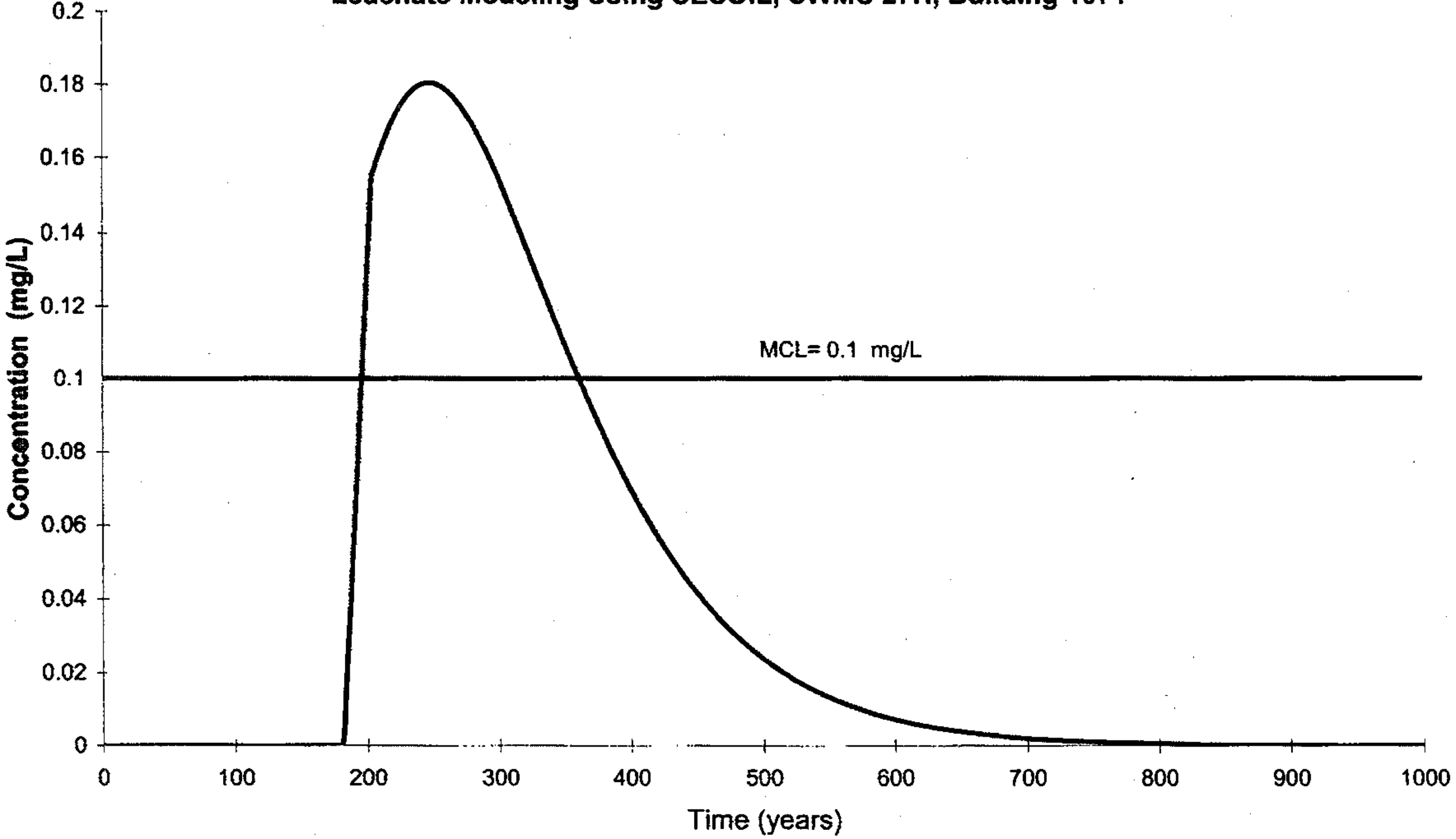


Figure A-2. Predicted Concentration of Chromium in Groundwater Based on Leachate Modeling Using SESOIL, SWMU 27H, Building 1071



AT123D OUTPUT FILE FOR SWMU 27H, BUILDING 1071

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SWMU 27H, Building 1071 1,1-Dichloroethene

```
NO. OF POINTS IN X-DIRECTION ..................... 12
NO. OF POINTS IN Y-DIRECTION .....................  1
NO. OF POINTS IN Z-DIRECTION .....................  1
NO. OF ROOTS: NO. OF SERIES TERMS ................ 400
NO. OF BEGINNING TIME STEP ....................... 900
NO. OF ENDING TIME STEP ......................... 1198
NO. OF TIME INTERVALS FOR PRINTED OUT SOLUTION .... 16
INSTANTANEOUS SOURCE CONTROL = 0 FOR INSTANT SOURCE  1
SOURCE CONDITION CONTROL = 0 FOR STEADY SOURCE ....  0
INTERMITTENT OUTPUT CONTROL = 0 NO SUCH OUTPUT ....  1
CASE CONTROL =1 THERMAL, = 2 FOR CHEMICAL, = 3 RAD   2


AQUIFER DEPTH, = 0.0 FOR INFINITE DEEP (METERS) ... 0.1524E+02
AQUIFER WIDTH, = 0.0 FOR INFINITE WIDE (METERS) ... 0.0000E+00
BEGIN POINT OF X-SOURCE LOCATION (METERS) ......... -0.4200E+02
END POINT OF X-SOURCE LOCATION (METERS) ........... 0.0000E+00
BEGIN POINT OF Y-SOURCE LOCATION (METERS) ......... -0.1150E+02
END POINT OF Y-SOURCE LOCATION (METERS) ........... 0.1150E+02
BEGIN POINT OF Z-SOURCE LOCATION (METERS) ......... -0.1000E+01
END POINT OF Z-SOURCE LOCATION (METERS) ........... 0.0000E+00


POROSITY ........................................ 0.2000E+00
HYDRAULIC CONDUCTIVITY (METER/HOUR) ............... 0.1260E-01
HYDRAULIC GRADIENT ............................ 0.1700E-01
LONGITUDINAL DISPERSIVITY (METER) ................ 0.4600E+02
LATERAL DISPERSIVITY (METER) ..................... 0.4600E+01
VERTICAL DISPERSIVITY (METER) .................... 0.1000E+01
DISTRIBUTION COEFFICIENT, KD (M**3/KG) ........... 0.1890E-02
HEAT EXCHANGE COEFFICIENT (KCAL/HR-M**2-DEGREE C).. 0.0000E+00


MOLECULAR DIFFUSION MULTIPLY BY POROSITY (M**2/HR)  0.4280E-05
DECAY CONSTANT (PER HOUR) ........................ 0.1000E-04
BULK DENSITY OF THE SOIL (KG/M**3) ............... 0.1570E+04
ACCURACY TOLERANCE FOR REACHING STEADY STATE ...... 0.1000E-02
DENSITY OF WATER (KG/M**3) ....................... 0.1000E+04
TIME INTERVAL SIZE FOR THE DESIRED SOLUTION (HR) .. 0.7300E+03
DISCHARGE TIME (HR) .............................. 0.8760E+06
WASTE RELEASE RATE (KCAL/HR), (KG/HR), OR (CI/HR) . 0.5340E-06


RETARDATION FACTOR ............................... 0.1584E+02
RETARDED DARCY VELOCITY (M/HR) ................... 0.6763E-04
RETARDED LONGITUDINAL DISPERSION COEF. (M**2/HR) .. 0.3112E-02
RETARDED LATERAL DISPERSION COEFFICIENT (M**2/HR) . 0.3124E-03
RETARDED VERTICAL DISPERSION COEFFICIENT (M**2/HR). 0.6898E-04
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.0000E+00 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y     0.            10.           20.           50.           75.           90.
0.    0.000E+00     0.000E+00     0.000E+00     0.000E+00     0.000E+00     0.000E+00
CONTINUE X
Y     100.          120.          150.          200.          400.          457.
0.    0.000E+00     0.000E+00     0.000E+00     0.000E+00     0.000E+00     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6563E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y     0.            10.           20.           50.           75.           90.
0.    0.270E-02     0.124E-02     0.624E-03     0.965E-04     0.227E-04     0.979E-05
CONTINUE X
Y     100.          120.          150.          200.          400.          457.
0.    0.562E-05     0.187E-05     0.356E-06     0.203E-07     0.000E+00     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6680E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y     0.            10.           20.           50.           75.           90.
0.    0.270E-02     0.124E-02     0.624E-03     0.965E-04     0.228E-04     0.981E-05
CONTINUE X
Y     100.          120.          150.          200.          400.          457.
0.    0.564E-05     0.188E-05     0.360E-06     0.210E-07     0.000E+00     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6796E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y     0.            10.           20.           50.           75.           90.
0.    0.270E-02     0.124E-02     0.624E-03     0.965E-04     0.228E-04     0.982E-05
CONTINUE X
Y     100.          120.          150.          200.          400.          457.
0.    0.565E-05     0.188E-05     0.364E-06     0.216E-07     0.000E+00     0.000E+00
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.6913E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.124E-02    0.624E-03    0.965E-04    0.228E-04    0.983E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.566E-05    0.189E-05    0.367E-06    0.222E-07    0.762E-15    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7030E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.124E-02    0.624E-03    0.966E-04    0.228E-04    0.985E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.567E-05    0.190E-05    0.370E-06    0.228E-07    0.273E-14    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7147E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.985E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.567E-05    0.190E-05    0.373E-06    0.233E-07    0.490E-14    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7264E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.986E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.568E-05    0.191E-05    0.375E-06    0.238E-07    0.794E-14    0.000E+00
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7380E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.987E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.569E-05    0.191E-05    0.378E-06    0.243E-07    0.119E-13    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7497E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.988E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.569E-05    0.192E-05    0.380E-06    0.247E-07    0.167E-13    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7614E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.988E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.570E-05    0.192E-05    0.382E-06    0.252E-07    0.223E-13    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7731E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.228E-04    0.989E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.570E-05    0.192E-05    0.383E-06    0.255E-07    0.288E-13    0.000E+00
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7848E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.            10.           20.           50.           75.           90.
0.   0.270E-02     0.125E-02     0.624E-03     0.966E-04     0.229E-04     0.989E-05
CONTINUE X
Y    100.          120.          150.          200.          400.          457.
0.   0.571E-05     0.193E-05     0.385E-06     0.259E-07     0.364E-13     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.7964E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.            10.           20.           50.           75.           90.
0.   0.270E-02     0.125E-02     0.624E-03     0.966E-04     0.229E-04     0.990E-05
CONTINUE X
Y    100.          120.          150.          200.          400.          457.
0.   0.571E-05     0.193E-05     0.386E-06     0.263E-07     0.452E-13     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8081E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.            10.           20.           50.           75.           90.
0.   0.270E-02     0.125E-02     0.624E-03     0.966E-04     0.229E-04     0.990E-05
CONTINUE X
Y    100.          120.          150.          200.          400.          457.
0.   0.571E-05     0.193E-05     0.388E-06     0.266E-07     0.550E-13     0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8198E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.            10.           20.           50.           75.           90.
0.   0.270E-02     0.125E-02     0.624E-03     0.966E-04     0.229E-04     0.990E-05
CONTINUE X
Y    100.          120.          150.          200.          400.          457.
0.   0.572E-05     0.193E-05     0.389E-06     0.269E-07     0.660E-13     0.000E+00
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DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8315E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.229E-04    0.991E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.572E-05    0.193E-05    0.390E-06    0.272E-07    0.778E-13    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8432E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.229E-04    0.991E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.572E-05    0.194E-05    0.391E-06    0.274E-07    0.908E-13    0.000E+00


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8548E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.229E-04    0.991E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.572E-05    0.194E-05    0.392E-06    0.276E-07    0.105E-12    0.000E+00
STEADY STATE SOLUTION HAS NOT BEEN REACHED BEFORE FINAL SIMULATING TIME


DISTRIBUTION OF DISSOLVED CHEMICALS IN PPM AT  0.8665E+06 HRS
(ADSORBED CHEMICAL CONC. =   0.1890E+01 * DISSOLVED CHEMICAL CONC.)

Z = 0.00
X
Y    0.           10.          20.          50.          75.          90.
0.   0.270E-02    0.125E-02    0.624E-03    0.966E-04    0.229E-04    0.991E-05
CONTINUE X
Y    100.         120.         150.         200.         400.         457.
0.   0.572E-05    0.194E-05    0.392E-06    0.279E-07    0.120E-12    0.000E+00
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ATTACHMENT B
TO SWMU 27H, BUILDING 1071
TO THE
REVISED FINAL PHASE II RCRA FACILITY INVESTIGATION REPORT
FOR
16 SOLID WASTE MANAGEMENT UNITS
AT
FORT STEWART, GEORGIA

TOXICITY PROFILES FOR CONTAMINANTS OF POTENTIAL CONCERN

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This appendix contains the toxicity profiles for human health contaminants of potential concern (HHCOPCs). The toxicity profiles provide pertinent information concerning the uptake, mechanisms of toxicity, and toxicity values for the HHCOPCs. In addition to the toxicity profiles, a toxicity summary (Table B-1) is given for all of the site-related contaminants. The toxicity summary consists of the essential data used to derive toxicity values [reference doses (RfDs) and cancer slope factors] obtained from U.S. Environmental Protection Agency (EPA) toxicity databases [Integrated Risk Information System (IRIS; EPA 2000) and Health Effects Assessment Summary Tables (HEAST; EPA 1997)].

Benzo(*a*)anthracene. Benzo(*a*)anthracene is a polycyclic aromatic hydrocarbon (PAH) with four aromatic rings, two of which share carbons with only one other ring. No commercial production or use of this compound is known. Benzo(*a*)anthracene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It is found in various kinds of smoke and flue gases; tobacco smoke; automobile exhaust; roasted coffee; and charcoal-broiled, barbecued, or smoked meats. It is also found in creosote, coal tar, petroleum asphalt, and a variety of foods including vegetable oils and baker's yeast (Francis 1992).

No absorption data for benzo(*a*)anthracene are available; however, analogy to structurally related PAHs, primarily benzo(*a*)pyrene, suggests that it would be absorbed from the gastrointestinal tract, lungs, and skin (Francis 1992).

Benzo(*a*)anthracene is considered to be a carcinogenic PAH, but little is know about the systemic toxicity of this chemical. The toxic effects of benzo(*a*)anthracene and similar PAHs are primarily directed toward tissues that contain proliferating cells such as the hematopoietic system, lymphoid system, and reproductive tissues (Francis 1992). Neither an oral RfD nor an inhalation reference concentration (RfC) has been derived for benzo(*a*)anthracene in either IRIS or HEAST (EPA 2000; EPA 1997). Benzo(*a*)anthracene is classified by EPA in weight-of-evidence Group B2, probable human carcinogen (EPA 2000).

See also the toxicity profile for PAHs.

Benzo(*b*)fluoranthene. Benzo(*b*)fluoranthene, a crystalline solid, is a PAH with one five-membered ring and four six-membered rings. No commercial production or use of this compound is known. Benzo(*b*)fluoranthene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in cigarette smoke, urban air, gasoline engine exhaust, emissions from burning coal and from oil-fired heating, broiled and smoked food, oils, and margarine (Faust 1994a).

No absorption data are available for benzo(*b*)fluoranthene; however, by analogy to structurally related PAHs, primarily benzo(*a*)pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin. Major metabolites of benzo(*b*)fluoranthene formed *in vitro* in the livers of rats include dihydrodiols and monohydroxy derivatives and monohydroxy derivatives in mouse epidermis (Faust 1994a).

Benzo(*b*)fluoranthene is considered to be a carcinogenic PAH, but little is know about the systemic toxicity of this chemical. Neither an oral RfD nor an inhalation RfC has been derived for benzo(*b*)fluoranthene in either IRIS or HEAST (EPA 2000; EPA 1997). Benzo(*b*)fluoranthene is classified by EPA in weight-of-evidence Group B2, probable human carcinogen (EPA 2000).

See also the toxicity profile for PAHs.

Benzo(*a*)pyrene. Benzo(*a*)pyrene is a PAH that can be derived from coal tar. It occurs ubiquitously in products of incomplete combustion of fossil fuels and has been identified in ambient air, surface water, drinking water, wastewater, and charbroiled foods. Benzo(*a*)pyrene is primarily released to the air and removed from the atmosphere by photochemical oxidation and dry deposition to land or water. Biodegradation is the most important transformation process in soil or sediment (Faust 1994b).

Benzo(*a*)pyrene is readily absorbed after inhalation, ingestion, and dermal contact. After inhalation exposure, benzo(*a*)pyrene is rapidly distributed to several tissues in rats. The metabolism of the compound is complex and includes the formation of a proposed ultimate carcinogen, benzo(*a*)pyrene 7,8 diol-9,10-epoxide. The major route of excretion is hepatobiliary, followed by elimination in the feces (Faust 1994b).

Numerous epidemiologic studies have shown a clear association between exposure to various mixtures of PAHs containing benzo(*a*)pyrene (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and increased risk of lung cancer and other tumors. However, each of the mixtures also contained other potentially carcinogenic PAHs; therefore, distinguishing the contribution of benzo(*a*)pyrene to the carcinogenicity of these mixtures is not possible. An extensive database is available for the carcinogenicity of benzo(*a*)pyrene in experimental animals. Dietary administration of the compound has produced papillomas and carcinomas of the forestomach in mice, and treatment by gavage has produced mammary tumors in rats and pulmonary adenomas in mice. Exposure by inhalation and intratracheal instillation has resulted in benign and malignant tumors of the respiratory and upper digestive tracts of hamsters. Numerous topical application studies have shown that benzo(*a*)pyrene induces skin tumors in several species, although mice appear to be the most sensitive species. Benzo(*a*)pyrene is a complete carcinogen and also an initiator of skin tumors. It has been reported to induce tumors in animals when administered by other routes, such as intravenous, intraperitoneal, subcutaneous, intrapulmonary, and transplacental routes (Faust 1994b).

No oral RfD or inhalation RfC has been calculated for this chemical (EPA 1997; EPA 2000). Benzo(*a*)pyrene is classified as a Group B2 carcinogen, probable human carcinogen, with an oral slope factor of 7.30/(mg/kg-day) (EPA 2000).

See also the toxicity profile for PAHs.

Cadmium. Cadmium is a naturally occurring element found worldwide in soil and rocks. The primary sources of environmental cadmium contamination are smelters and the burning of fossil fuels in power plants.

Cadmium is absorbed more efficiently through the lungs than by the gastrointestinal tract. Acute oral exposures to cadmium can cause vomiting, diarrhea, and abdominal pain, while longer-term oral exposure to cadmium affects the kidneys and possibly the skeletal system (Young 1991). Inhalation exposure to cadmium may cause headache, chest pains, muscular weakness, pulmonary edema, and death (Young 1991), while longer-term inhalation exposure also results in kidney damage (ATSDR 1989a; EPA 1980; EPA 1984a).

Limited evidence shows possible adverse spermatogenic effects of cadmium in occupationally exposed workers (Barlow and Sullivan 1982). The results of genotoxicity and mutagenicity tests with cadmium are inconclusive. Some assays show positive results (certain mammalian cell culture assay systems), while other assays report negative findings (mouse bone marrow and mouse micronucleus assays) (ATSDR 1989a).

EPA's IRIS database (EPA 2000) lists oral RfDs of 0.0005 mg/kg/day and 0.001 mg/kg/day for cadmium in water and in food, respectively. These RfDs were based on respective human no observed adverse effect levels (NOAELs) of 0.005 mg/kg/day and 0.01 mg/kg/day in water and food, respectively, and an uncertainty factor of 10 to account for human variability. The NOAELs were calculated with a toxicokinetic model using a human renal cortex concentration of 200 μg cadmium per gram wet weight, the highest human renal cadmium concentration not associated with significant proteinuria in EPA's *Drinking Water Criteria Document on Cadmium* (EPA 1985). The model assumed that 0.01 percent of the cadmium body burden is eliminated daily and that 5 percent and 2.5 percent of ingested cadmium are absorbed from water and food, respectively. A new RfD has been proposed in EPA's recent *Toxicological Review: Cadmium and Compounds* (EPA 1999), which is undergoing external review. The proposed RfD of 0.0007 mg/kg/day is an estimate of a daily oral intake (in excess of estimated dietary cadmium intake) that would be associated with a 10-percent occurrence of minimal proteinuria/enzymuria in an exposed population at the age of 70. The estimate is based on a toxicokinetic model and data for renal dysfunction in cross-sectional studies of human populations exposed to excess cadmium.

An RfC assessment is not available in IRIS or HEAST, but an inhalation RfC has been proposed in EPA's recent *Toxicological Review: Cadmium and Compounds* (EPA 1999), which is undergoing external review. The proposed RfC of 0.00065 mg/m^3 is an estimate of an air concentration producing an inhaled intake (in excess of estimated dietary cadmium intake) that would be associated with a 10-percent occurrence of minimal proteinuria/enzymuria in an exposed population at the age of 70. The estimate is based on a toxicokinetic model and data for renal dysfunction in cross-sectional studies of human populations exposed to excess cadmium (EPA 1999).

EPA has placed cadmium in weight-of-evidence class B1, probable human carcinogen (EPA 2000). An inhalation unit risk of $1.8 \times 10^{-3}/(\mu g/m^3)$ was derived based on excess deaths from lung, trachea, and bronchus cancers in male workers exposed to airborne cadmium in the workplace (EPA 2000).

Chromium. Chromium is a metal that occurs in nature primarily as the mineral chromite. Although chromium exists in several valence states, the trivalent (III) and hexavalent (VI) valence states are the only two of any biological significance (Amdur, Doull, and Klassan 1991). Trivalent chromium is considered an essential element in man and animals.

Acute animal studies indicate that chromium (III) compounds are consistently less toxic than chromium (VI) ones (Friberg, Nordberg, and Vouk 1986), but neither oxidation state is very toxic by the oral route (Daugherty 1992). No adverse effects were observed in long-term drinking water studies in rats.

Chromium compounds (particularly hexavalent compounds) are very strong skin irritants and sensitizers in humans, producing dermatitis, dermatosis, eczema, erythema, and skin ulceration. Exposure to chromium has caused respiratory effects such as nasal irritation, nasal ulcers, nasal perforation, asthmatic attacks, pneumoconiosis, bronchitis, and chronic lung congestion in humans under various occupational conditions (Daugherty 1992). Both hexavalent and trivalent chromium compounds are known to be nephrotoxic, with some reports indicating that they may also be hepatotoxic and neurotoxic (EPA 1984b).

Chromium compounds, both trivalent and hexavalent, have induced developmental effects in hamsters and mice (but only at maternally toxic doses) and testicular effects in rabbits after intraperitoneal, intravenous, or subcutaneous injections (EPA 1984b). Bacterial test systems have consistently demonstrated that chromium (VI) compounds are directly mutagenic, while chromium (III) compounds are not (EPA 1984b). An increased frequency of chromosome aberrations in lymphocytes from workers exposed to chromates during production of such compounds has been reported (EPA 1984b), and several occupational epidemiology studies have shown that occupational exposure to chromium is associated with an increase in lung cancer deaths for workers. Evidence also suggests increased risk of developing nasal, pharyngeal, and gastrointestinal cancers (IARC 1980; Daugherty 1992).

An oral RfD value of 0.003 mg/kg-day has been calculated for chromium (VI) (EPA 2000). The RfD is based on a chronic drinking water study with rats. No adverse effects were noted in the study (EPA 2000). The inhalation RfC for chromium (VI) is 8E-6 $\mu g/m^3$ based on nasal septum atrophy in exposed occupational populations (EPA 2000). EPA has placed chromium (VI) in weight-of-evidence group A, known human carcinogen, for its carcinogenicity via inhalation. The air unit risk is $0.012/(\mu g/m^3)$ (EPA 2000).

Dibenzo(*a,h*)anthracene. Dibenzo(*a,h*)anthracene is a PAH with five six-membered rings. No commercial production or use of this compound is known. Dibenzo(*a,h*)anthracene is found in fossil fuels and occurs ubiquitously in products of incomplete combustion. It has been detected in cigarette smoke, urban air, gasoline engine exhaust, emissions from burning coal and from oil-fired heating, broiled and smoked food, oils, and margarine (Faust 1995).

No absorption data are available for dibenzo(*a,h*)anthracene; however, by analogy to structurally related PAHs, primarily benzo(*a*)pyrene, it would be expected to be absorbed from the gastrointestinal tract, lungs, and skin (Faust 1995).

There are limited data on the toxicity of this PAH in humans. Toxicity studies with laboratory animals have shown depressed immune responses, kidney lesions, and increased development of arterioslerotic plaques (Faust 1995).

Dibenzo(*a,h*)anthracene is considered to be a carcinogenic PAH, but little is know about the systemic toxicity of this chemical. Neither an oral RfD nor an inhalation RfC has been derived for benzo(*b*)fluoranthene in either IRIS or HEAST (EPA 2000; EPA 1997). Benzo(*b*)fluoranthene is classified by EPA in weight-of-evidence Group B2, probable human carcinogen (EPA 2000).

See also the toxicity profile for PAHs.

1,1-Dichloroethene. 1,1-Dichloroethene, also known as vinylidine chloride, is a colorless liquid that is used primarily in the production of polyvinylidine chloride (PVC) copolymers and as an intermediate for synthesis of organic chemicals. The major application for PVC copolymers is the production of flexible films for food packaging such as Saran® wrap (Faust 1994c).

1,1-Dichloroethene does not occur naturally but is found in the environment as a result of releases associated with its production and transport and with the production of its polymers. Because of its high volatility, releases to the atmosphere are the greatest source of ambient 1,1-dichloroethene. Smaller amounts are released to surface water and soil, where they are subject to volatilization. In the atmosphere, reaction with photochemically generated hydroxyl radicals is believed to be the predominant removal mechanism. Human exposure to 1,1-dichloroethene is potentially highest in the workplace and near hazardous waste sites at which the compound may contaminate environmental media (Faust 1994c).

The primary effect of acute exposure to high concentrations [about 4,000 parts per million (ppm)] of 1,1-dichloroethene vapor in humans is central nervous system depression, which may progress to unconsciousness. Occupational exposure has been reported to cause liver dysfunction in workers. 1,1-Dichloroethene is irritating when applied to the skin, and prolonged contact can cause first-degree burns. Direct contact with the eyes may cause conjunctivitis and transient corneal injury (Faust 1994c).

In experimental animals, the liver and kidneys are target organs for the toxic effects of 1,1-dichloroethene. Subchronic oral exposure of rats for 90 days to 1,1-dichloroethene in drinking water produced slight hepatotoxic effects at 200 ppm (Rampy et al. 1977). In a chronic toxicity study with rats, the animals receiving oral exposure to drinking water for 2 years produced hepatocellular changes in males at ~100 ppm and in females at ~50 ppm. Gavage administration of 10 mg/kg-day, 5 days/week for 2 years produced chronic inflammation of the kidney in male and female rats and liver necrosis in male and female mice (Quast et al. 1983). Exposure by inhalation to 55 ppm 1,1-dichloroethene, 6 hours/day, 5 days/week for up to 1 year produced fatty liver changes in rats and focal degeneration and necrosis in mice (Lee et al. 1997).

EPA has calculated a chronic oral RfD of 0.009 mg/kg-day based on a lowest observed adverse effect level (LOAEL) of 9 mg/kg-day from chronic oral studies with rats (EPA 2000). The liver was identified as the target organ for toxicity (EPA 2000). An inhalation RfC is not given in IRIS or HEAST (EPA 2000; EPA 1997). EPA has assigned 1,1-dichloroethene to weight-of-evidence Group C, possible human carcinogen (EPA 2000). The oral cancer slope factor for this volatile organic is 0.6 per (mg/kg-day) (EPA 2000). An inhalation unit risk of 5.0×10^{-5} per ($\mu g/m^3$) has been calculated by EPA (EPA 2000).

Indeno(*1,2,3-cd*)pyrene. Indeno(*1,2,3-cd*)pyrene is a crystalline solid. No commercial production or use of this compound is known. It is found in fossil fuels; occurs ubiquitously in products of incomplete combustion; and has been identified in soil, groundwater, and surface water at hazardous waste sites. No commercial production or use of this compound is known (Faust 1994d).

No absorption data for indeno(*1,2,3-cd*)pyrene are available; however, analogy to structurally related PAHs, primarily benzo(*a*)pyrene, suggests that it would be absorbed from the gastrointestinal tract, lungs, and skin. *In vivo* metabolites identified in mouse skin include the *trans*-1,2-dihydrodiol and 8- and 9-hydroxy forms of indeno(*1,2,3-cd*)pyrene. Similar metabolites were formed *in vitro* in rat liver microsomes (Faust 1994d).

Indeno(*1,2,3-cd*)pyrene is considered to be a carcinogenic PAH, but little is know about the systemic toxicity of this chemical. Neither an oral RfD nor an inhalation RfC has been derived for indeno(*1,2,3-cd*)pyrene in either IRIS or HEAST (EPA 2000; EPA 1997). Indeno(*1,2,3-cd*)pyrene is classified by EPA in weight-of-evidence Group B2, probable human carcinogen (EPA 2000).

See also the toxicity profile for PAHs.

Lead. Humans have used lead for thousands of years because of its malleability, resistance to corrosion, and abundance. This metal can be a component of solder, paint, and gasoline, but these uses have declined dramatically in recent years as awareness of the toxicity associated with lead exposure has increased. Currently, in the United States the predominant use of lead is in batteries. Lead occurs at an average concentration of 10 mg/kg in soil, but soil levels are substantially elevated in many areas exposed to emissions from smelters and automobiles or in areas where lead-containing paint chips have fallen onto soil (Davidson 1994).

EPA has not derived inhalation and oral RfD values for lead because it has not been possible to establish the NOAEL or LOAEL for this metal. Health effects have tentatively been associated with blood levels as low as 10 μg/dL (Davidson 1994).

In the absence of an oral or inhalation RfD for lead, EPA has developed an uptake/biokinetic model to estimate blood-lead levels on the basis of total lead uptake from exposures via diet, drinking water, air, soil, and paint. Application of this model to potential exposures is not discussed in this report; however, further information can be obtained from EPA (Davidson 1994).

At blood levels greater than 40 μg/dL, lead can cause miscarriage, sterility in males, anemia, and damage to the central nervous system and kidneys. Lead exposure resulting in these high blood levels is rare today. Blood levels of 30 µg/dL and higher have been associated with defects in vitamin D metabolism and with lowered intelligence quotient scores in children. At blood levels of 20 µg/dL and lower, the effects become more difficult to define. Some studies report a dose-related increase in blood pressure in adult males starting at blood levels of about 10 µg/dL. Additionally, fetuses and young children are particularly sensitive to lead toxicity; even low-level lead exposure during pregnancy and early childhood can cause reduced birth weight, premature birth, and delayed development (Davidson 1994).

Lead can cause varied toxicological effects, depending on the level of exposure. From studies on rats and mice, EPA has classified lead in weight-of-evidence Group B2, probable human carcinogen (EPA 2000). However, the doses that induce cancer are higher than those associated with other health effects of lead, such as reproductive toxicity, developmental toxicity, and increased blood pressure (Davidson 1994).

Naphthalene. Naphthalene also belongs to the group of chemicals called PAHs that are found in various types of fossil fuel, including coal, oil, gas, and other organic substances (ATSDR 1989b).

Humans exposed via inhalation, combined inhalation and dermal exposure, and combined inhalation and oral exposure have developed hemolytic anemia (lowered hemoglobin, hematocrit, and erythrocyte values). In severe cases, the hemolytic anemia was accompanied by jaundice, high serum levels of bilirubin, cyanosis, and kernicterus with pronounced neurological signs (EPA 2000). In laboratory experiments, the target organs appeared to be the kidneys, thymus, liver, and spleen (EPA 2000).

EPA has calculated an oral RfD of 0.02 mg/kg-day based on decreased mean body weight in exposed laboratory animals (EPA 2000). The RfC for naphthalene is 0.003 mg/m^3 based on respiratory effects in exposed rats (EPA 2000). EPA classifies naphthalene in weight-of-evidence Group C, possible human carcinogen (EPA 2000).

Polycyclic Aromatic Hydrocarbons. The PAHs are a group of chemicals that are formed during the incomplete burning of wood and fuel, including coal, oil, gas, and other organic substances (ATSDR 1989b). Exposure to PAHs may occur via inhalation, ingestion, and dermal contact. In any medium, PAHs most often exist as complex mixtures of compounds, and these compounds have been divided into (1) carcinogenic PAHs and (2) noncarcinogenic PAHs.

Carcinogenic Polycyclic Aromatic Hydrocarbons. Available data indicate that benzo(*a*)pyrene is one of the most potent of the carcinogenic PAHs. Other PAHs considered to be carcinogenic are benzo(*a*)anthracene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, chrysene, dibenzo(*a,h*)anthracene, and indeno(*1,2,3-cd*)pyrene.

The arrangement of aromatic rings in the benzo(*a*)pyrene molecule and other PAHs gives it a "bay-region" that is often correlated with carcinogenic properties. In general, bay-region PAHs and some of their metabolites are known to react with cellular macromolecules, including DNA, which may account for the toxicity and carcinogenicity of these compounds (Francis 1992). The primary toxicological concern about exposure to this group of PAHs is carcinogenicity. No case reports or epidemiological studies on the significance of human exposure to individual PAHs are available. Coal tar and other materials known to be carcinogenic to humans, however, contain PAHs (Francis 1992). Lung and skin cancers in humans have been associated with chronic exposure by inhalation and dermal contact, respectively, to mixtures of compounds that include carcinogenic PAHs (ATSDR 1989b). Several individual PAHs administered to different animal species by various routes have been found to be carcinogenic at both local and systemic sites. Long-term experimental studies resulted in tumors in the liver, mammary gland, respiratory and gastrointestinal tracts, and skin (ATSDR 1989b). Carcinogenic PAHs are also reported to be mutagenic in a variety of test systems.

Although reproductive effects in mice fed benzo(*a*)pyrene and adverse effects in their offspring, including birth defects and decreased body weight, have been reported, no reproductive toxicity from PAH exposure has been demonstrated in humans (ATSDR 1989b). Toxic effects have also been observed in rapidly dividing cells of the intestinal epithelium, testes, and ovaries (oocytes). Animal studies also indicate that exposure to bay-region PAHs can damage the hematopoietic system, leading to progressive anemia as well as agranulocytosis. The lymphoid system can also be affected, resulting in lymphopenia.

Not all of the carcinogenic PAHs appear to be as potent as benzo(*a*)pyrene (ICF-Clement 1988; EPA 1993). Recent guidance published by EPA (1993) recommends that a series of relative potency values (orders of magnitude) be used for the risk assessment of oral exposure to PAHs, with carcinogenic potency being compared to that of benzo(*a*)pyrene.

Noncarcinogenic Polycyclic Aromatic Hydrocarbons. PAHs not considered to be carcinogenic include acenaphthene, benzo(*g,h,i*)perylene, naphthalene, and phenanthrene.

PAHs are toxic to the skin. For example, naphthalene is a primary skin irritant and causes erythema and dermatitis on repeated contact (Sittig 1981), and acenaphthene is irritating to the skin and mucous membranes of humans and animals (Faust 1994a). Other noncarcinogenic effects of PAHs have been observed in animals; however, of these, only effects of the blood and blood-forming system and of the skin have also been reported in humans (ATSDR 1989b). Animal studies indicate that PAHs may adversely affect the gastrointestinal tract, liver, kidneys, lungs, and hematopoietic system and may suppress the immune system after both short- and long-term exposure. Oral exposure of animals to acenaphthene caused reproductive effects, including decreased ovary weights, decreased ovarian and uterine activity, and fewer and smaller corpora lutea (Faust 1991; Faust 1994a). No mutagenic or carcinogenic effects of the noncarcinogenic PAHs have been reported.

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Table B-1. Summary of Toxicity Data for Chemicals of Potential Concern, SWMU 27H, Building 1071

Chemical	CSF_o (1/mg/kg/day)	Ref	CSF_i (1/mg/kg/day)	Ref	WOE	RfD_o (mg/kg/day)	Ref	UF-MF	Target Organs	RfD_i (mg/kg/day)	Ref	UF-MF	Target Organs
1,1-Dichloroethene	6.00E-01	I	1.75E-01	I	C	9.00E-03	I	1,000	Liver				
Benzo(*a*)anthracene	7.30E-01	E	3.10E-01	E	B2								
Benzo(*a*)pyrene	7.30E+00	I	3.10E+00	E	B2								
Benzo(*b*)fluoranthene	7.30E-01	E	3.10E-01	E	B2								
Cadmium–water			6.30E+00	I		5.00E-04	I	10	Develop				
Chromium VI			4.10E+01	H	A[a]	3.00E-03	I	300	Clinical	3.00E-05	I	90	Resp
Dibenzo(*a,h*)anthracene	7.30E+00	E	3.10E+00	E	B2								
Indeno(*1,2,3-c,d*)pyrene	7.30E-01	E	3.10E-01	E	B2								
Lead					B2								
Naphthalene					C	2.00E-02	I	3,000	Clinical	9.00E-04	I		

[a] Inhalation only.

CSF_i = Inhalation cancer slope factor.

CSF_o = Oral cancer slope factor.

Ref = Source of information: E = EPA's National Center for Environmental Assessment (EPA 1999); H = Health Effects Assessment Summary Tables (EPA 1997); I = IRIS (EPA 2000).

RfD_i = Inhalation reference dose.

RfD_o = Oral reference dose.

UF-MF = Product of the uncertainty and modifying factors.

Target Organs = Primary organ systems affected by noncarcinogenic chemicals.

Clinical = Endpoints included clinical effects such as change in body weight, enzyme levels, etc. Effects cannot be associated with any specific organ system.

Develop = Developmental toxicity.

Resp = Respiratory system.

WOE = Cancer weight-of-evidence classification.

ATTACHMENT C
TO SWMU 27H, BUILDING 1071
TO THE
REVISED FINAL PHASE II RCRA FACILITY INVESTIGATION REPORT
FOR
16 SOLID WASTE MANAGEMENT UNITS
AT
FORT STEWART, GEORGIA

ANALYTICAL DATA FOR THE SUPPLEMENTAL GROUNDWATER CHARACTERIZATION (OCTOBER/NOVEMBER 2000)

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Location: SWMU 27H, Building 1071
Station : 7N-MW-01

7N4172 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 11/01/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

Location: SWMU 27H, Building 1071
Station : 7N-MW-02

7N4272 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 10/31/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.2	UG/L		=	

Location: SWMU 27H, Building 1071
Station : 7N-MW-03

7N4372 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 10/31/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

Location: SWMU 27H, Building 1071
Station : 7N-MW-04

7N4472 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 10/31/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	.2	UG/L	J	J	

Location: SWMU 27H, Building 1071
Station : 7N-MW-05

7N4572 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 10/31/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

Location: SWMU 27H, Building 1071
Station : 7N-MW-06

7N4672 **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 11/01/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

Location: SWMU 27H, Building 1071
Station : 7N-MW-07

7N4772 0.0 - 0.0 FT **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 11/01/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

Location: SWMU 27H, Building 1071
Station : 7N-MW-08

7N4872 0.0 - 0.0 FT **Field Sample Type:** Grab **Matrix:** Groundwater **Collected:** 10/31/2000

Sample Type	Volatile Organics	Result	Units	Qualifiers Lab	Qualifiers Data	Validation Code
REG	1,1-Dichloroethene	1.0	UG/L	U	U	

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10 of 2

CHAIN OF CUSTODY RECORD

COC NO.: G16049

PROJECT NAME: Ft. Stewart-SWMU 18

PROJECT NUMBER: 01-1624-04-1041-200

PROJECT MANAGER: Jeff Longaker

Sampler (Signature) Laura Lumley (Printed Name) Laura Lumley

LABORATORY NAME: General Engineering Laboratory

LABORATORY ADDRESS:
2040 Savage Raod
Charleston, SC 29417

PHONE NO: (843) 556-8171

Sample ID	Date Collected	Time Collected	Matrix	VOC	SVOC	RCRA Metals	SVOC, RCRA Metals	TCLP VOC	TCLP Lead	1,1 dichloroethene	No. of Bottles/ Vials:	OVA SCREENING	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
244672	10/31/00	1000	water	2	2						4		33601 007
244972	10/31/00	1335		2	2						4		008
244572	10/31/00	1520		2							2		33601 009
244472	11/1/00	1010		2							2		010
244172	11/1/00	1505		2							2		011
244672	11/1/00	1045		2							2		012
244772	10/31/00	1610		2							2		013
244372	10/31/00	1615		2							2		014
TB1666	10/31/00	0600		2							2		015
TB1667	11/1/00	0740		2							2		016
7N4172	11/1/00	1120								2	2		33606 001
7N4672	11/1/00	1215								2	2		002
7N4772	11/1/00	1335								2	2		003

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3
2001197
1

RELINQUISHED BY: Laura Lumley COMPANY NAME: SAIC	Date/Time 11/2/00 1140	RECEIVED BY: Mike Kinslow COMPANY NAME: GEL	Date/Time 11-2-00 15:30	TOTAL NUMBER OF CONTAINERS: Cooler ID: #10	Cooler Temperature: FEDEX NUMBER:
RECEIVED BY: COMPANY NAME: GEL	Date/Time 11/2/00 1140	RELINQUISHED BY: COMPANY NAME:	Date/Time		
RELINQUISHED BY: COMPANY NAME: GEL	Date/Time 11/2/00 1140	RECEIVED BY: COMPANY NAME:	Date/Time		

C-4

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2012

CHAIN OF CUSTODY RECORD

COC NO.: G16049

PROJECT NAME: Ft. Stewart-~~SWMU-16~~ 16 SWMUs

PROJECT NUMBER: 01-1624-04-1041-~~200~~ 900

PROJECT MANAGER: Jeff Longaker

Sampler (Signature) (Printed Name) Laura Lumley

LABORATORY NAME: General Engineering Laboratory

LABORATORY ADDRESS:
2040 Savage Raod
Charleston, SC 29417

PHONE NO: (843) 556-8171

Sample ID	Date Collected	Time Collected	Matrix	VOC	SVOC	RCRA Metals	SVOC, RCRA Metals	TCLP VOC	TCLP Lead	1,1 dichloroethene	No. of Bottles/ Vials:	OVA SCREENING	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
7N4472	10/31/00	1030	water							2	2		33606 004
7N4572	10/31/00	1105								2	2		005
7N4372	10/31/00	1245								2	2		006
7N4672	10/31/00	0935								2	2		007
7N4272	10/31/00	1150								2	2		008
247A11	11/1/00	1210	sediment		1						1		33610 001
247B11	11/1/00	1225			1						1		002
247C11	11/1/00	1245			1						1		003
247D11	11/1/00	1250			1						1		004
247E11	11/1/00	1310			1						1		005
247011	11/1/00	1200			1						1		006

11/2/00

RELINQUISHED BY: Laura Lumley	Date/Time 11/2/00 1140	RECEIVED BY: Vicki Kailow	Date/Time 11-2-00 15:30	TOTAL NUMBER OF CONTAINERS: 46	Cooler Temperature: 6°
COMPANY NAME: SAIC		COMPANY NAME: GEL		Cooler ID: #10	FEDEX NUMBER:
RECEIVED BY:	Date/Time 11/2/00 1140	RELINQUISHED BY:	Date/Time		
COMPANY NAME: GEL		COMPANY NAME:			
RELINQUISHED BY:	Date/Time 11/2/00 1150	RECEIVED BY:	Date/Time		
COMPANY NAME: GEL		COMPANY NAME:			