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REMEDIAL INVESTIGATION (RI) REPORT
OPERABLE UNIT 5 (OU-5)
(SITE 8 MEDIA OTHER THAN GROUNDWATER)
for
NAVAL AIR WARFARE CENTER WARMINSTER
WARMINSTER, PENNSYLVANIA

Northern Division

Naval Facilities Engineering Command

Contract No. N62472-90-D-1298

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REMEDIAL INVESTIGATION (RI) REPORT
FOR OPERABLE UNIT 5 (OU-5)
SITE 8 MEDIA OTHER THAN GROUNDWATER

NAWC WARMINSTER

COMPREHENSIVE LONG - TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) PROGRAM

Submitted to:
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Environmental Branch, Mail Stop No. 82
Naval Facilities Engineering Command
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EXECUTIVE SUMMARY

INTRODUCTION

On behalf of the Naval Facilities Engineering Command, Northern Division, Tetra Tech NUS Incorporated (TtNUS) is submitting this remedial investigation (RI) report for Operable Unit 5 (OU-5) at the former Naval Air Warfare Center (NAWC) in Warminster, Pennsylvania. OU-5 addresses soil, surface water, and sediment associated with Site 8. Groundwater in the vicinity of Site 8 is being addressed under Operable Unit 3 (OU-3).

SCOPE AND OBJECTIVES

The main areas of concern at NAWC Warminster involve several inactive waste sites, which have been grouped into four general areas (Areas A, B, C, and D) for investigative purposes. Site 8 is part of Area C, which lies north of the inactive main runway at the base. Based on preliminary RI results, a removal action was conducted at Site 8 in February 1999. The objectives of the final RI were to describe the nature and extent of contamination at Site 8 after performing this removal action and to provide a baseline risk assessment based on this information. The results of the risk assessment were used to determine whether additional response actions are necessary for the site.

To date, environmental investigations at the base have been addressed in several long-term remedial phases. Three separate investigations, Phases I, II, and III, were conducted at Site 8 between October 1989 and March 1999. This report addresses Site 8 only. It includes the results of additional surface and subsurface investigations performed at Site 8 since the removal action for Site 8 surface soils was performed.

FACILITY HISTORY AND DESCRIPTION

The former NAWC Warminster property is located in the township of Warminster, Bucks County, Pennsylvania. The total area of the facility is approximately 734 acres. The facility lies in a populated suburban area surrounded by private homes, various commercial/industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

Commissioned in 1944, NAWC Warminster's main mission prior to closing was research, development, testing, and evaluation for naval aircraft systems. NAWC Warminster also conducted studies in anti-submarine warfare systems and software development. Historically, wastes were generated during aircraft

maintenance and repair, pest control, fire-fighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils.

Under the Base Realignment and Closure (BRAC) Program, the Department of Defense (DOD) realigned NAWC Warminster. The realignment was completed in September 1996. The base is now closed and is being redeveloped for non-military use by the Bucks County Federal Lands Reuse Authority (FLRA). The FLRA is currently coordinating reuse planning for the base property, and most Navy activities have been eliminated.

The former base property currently has about 300 workers employed in a full-time status, and 1,000 people reside at the facility year round. The residents living at the facility are the nearest population center, but most work at a nearby Navy base in Willow Grove, Pennsylvania. The closest off-base home is about 200 feet away.

SITE 8 BACKGROUND INFORMATION

Site 8 is found at the northeast end of an abandoned runway. The site included two areas on the runway which were used for fire training exercises from 1961 to 1986. Typically, flammable materials (such as contaminated aviation jet fuels) were poured on the runway, ignited, and extinguished to simulate fire-fighting procedures. These two areas on the runway were contained by berms.

An estimated 3,000 gallons of aviation fuel were burned annually at the site. Historical aerial photos and background information indicate that fire training exercises were initially conducted about 240 feet from the end of the runway and were conducted near the end of runway in later years. Aerial photos indicate runoff from the runway in these areas often bypassed the berms and drained west of the runway. In response to the findings of an inspection by the Pennsylvania Department of Environmental Resources, the Navy ceased fire training activities at Site 8 by December 1986. Based on the results of testing performed at the time, a remaining berm was reportedly graded around the end of the runway.

Between 1965 and 1967, flight suit testing activities were initiated about 300 feet from the end of the runway (Structure S1). This structure was a corrugated metal building that was used to test the durability of aviation flight suits in fire as part of research and development (R&D) activities. The floor of the structure contained water on top of which was placed a small quantity of unknown flammable liquid. Once ignited, a flight suit, attached to a mechanical arm, was passed through the flames in order to test the suit's ability to withstand fire. The structure was dismantled and the materials removed by the Navy in 1997.

Based on the results of soil testing in both the fire-training and flight suit testing areas, about 675 tons of surface soil were excavated, transported, and disposed in an off-base landfill as part of the 1999 removal work. Soils were excavated along the western edge of the runway extension near the former location of structure S1. The excavation measured about 130 feet in length, 20 feet in width, and up to 2.5 feet in depth. The purpose of this action was to address surface soils primarily contaminated with levels of lead that presented an unacceptable human health risk. The action also lowered the carcinogenic risk associated with arsenic concentrations in surface soils.

Since 1991, various construction materials (e.g., lumber, piping, concrete vaults) have been stored on the surface of the runway extension. With the exception of a soil pile remaining at the end of the runway, no structures or other significant debris are currently present at the site. This soil was excavated during the installation of transfer piping that runs adjacent to the western perimeter of the runway. The Navy plans to remove this soil pile in the near future.

SITE 8 CHARACTERISTICS

Surface soils in the vicinity of the Site 8 consist of the Urban land Lansdale Complex, 0 to 8 percent slopes. As determined by soil borings, the soil thickness at Site 8 ranged from approximately 7 to 13 feet. The soils encountered in these borings were brown to reddish-brown silty clay to clayey silt.

Site 8 is drained by a concrete swale that discharges directly to an intermittent stream through a culvert beneath Kirk Road north of the site. The intermittent stream flows off base to the north approximately 750 feet until it joins with an unnamed tributary of Little Neshaminy Creek near Werner Park. The intermittent stream is periodically dry during base flow conditions, however, pools of standing water are sometimes evident within the channel. There are no wetlands along the drainage path or nearby intermittent stream. Farther downstream, near Jacksonville Road, the unnamed tributary was 2 feet wide and 3 inches deep and characterized by a sandy, mud bottom. The banks were 2 feet high. This stream flows through small woodlots and an older subdivision with mature silver maple and green ash shading the banks.

There are no known critical habitats of endangered species located within 1 mile of the site.

RI FIELD ACTIVITIES FOR SITE 8

RI field activities were performed at Site 8 between 1989 and 1999. The field work focused on characterizing known and potential sources of contamination in the vicinity of the site. These sources were identified by the results of previous investigations and by analyzing historical aerial photographs. Field work included soil gas

sampling, geophysical surveys, surface soil sampling and analysis, subsurface soil sampling and analysis, and a wetlands assessment. The subsurface studies consisted of drilling soil borings and excavating test pits to better determine the nature and extent of subsurface contamination. In addition, a surface water and sediment sampling and analysis program was conducted to evaluate the impacts of Site 8 on the nearby stream (an unnamed tributary of Little Neshaminy Creek).

The geophysical survey was used to delineate the approximate boundaries of known and suspected sites where the wastes potentially disposed may produce electromagnetic signatures that could potentially be identified through this type of survey. Soil gas surveys were employed in areas of suspected subsurface disposal of wastes containing volatile organic compounds (VOCs). The locations of the soil gas surveys took into consideration those potential sources identified from aerial photos, the geophysical survey, the results of previous investigations, and historical information regarding the locations of subsurface disposal sites.

Test pits and soil borings were used to characterize actual subsurface conditions at known or potential disposal sites. The locations of the test pits and soil borings were selected based on the results of the soil gas and geophysical surveys, as well as on aerial photo records, field observations, and previous field work findings. Subsurface soil/waste samples were obtained from the test pits/borings to characterize the materials encountered.

Surface soil sampling and analysis were conducted in areas where surface disposal of wastes was a potential concern. In addition, a background sampling and analysis program was performed to provide a background database for various environmental media. Three rounds of surface water and sediment sampling and analysis were conducted to determine the nature and extent of contamination in the nearby stream. A wetlands assessment was also performed to provide a qualitative appraisal of the plants and animals associated with any wetlands downstream of Site 8.

NATURE AND EXTENT OF CONTAMINATION FOR SITE 8

The western edge next to Site 8 was noted as being visibly stained during the Phase I RI, and historical aerial photos also indicated stained soils in this area. Part of the soils in this area have since been disturbed or excavated during the installation of groundwater transfer piping for the OU-3 groundwater remedy.

During the Phase I RI, one geophysical (electromagnetic) anomaly was detected north of Site 8. Test pit excavations at this location revealed a deactivated, lead-encased electric line. The soil borings and test pits advanced or dug in the vicinity of Site 8 failed to reveal the presence of waste materials.

During Phase I, elevated VOC levels were detected in soil gas samples west of the Site 8 runway, near the mock-up airplane used for fire-fighting training exercises. A few scattered soil gas detections, ranging from 1.2 to 4.6 ug/l, were also reported for benzene/toluene/ethyl benzene/xylene (BTEX) compounds during Phase III RI work.

Prior to the Site 8 soil removal action, VOCs, semivolatile organics, pesticides, polychlorinated biphenyls (PCBs), dioxins, and furans were found in the Site 8 surface soil samples. Several metals were also detected at levels above background soil concentrations. The presence of these compounds may be related to storage activities, the burning of flammable waste materials, or the application of pesticides or fertilizers in the vicinity of the site. Contaminant concentrations for benzo(a)pyrene, benzo(b)fluoranthene, arsenic, and lead exceeded soil screening levels for surface soils in two or more samples. The screening levels were based on state and federal risk-based concentrations for residential soil and federal screening criteria for the leaching of soil contaminants to groundwater.

Following the removal action, concentrations for benzo(a)pyrene, OCDD, and lead exceeded soil screening levels for surface soils in two or more samples. Only one sample contained a lead concentration greater than the removal action clean-up goals of 500 mg/kg. This sample consisted of a mixture of soil, crushed asphalt, gravel, and stone and was not considered to be representative of actual surface soil conditions. None of the surface soil samples contain contaminant levels greater than screening levels for soil under an industrial land use scenario.

Low levels of semivolatile organics, pesticides, dioxins, and furans were found in the Site 8 subsurface soil samples. Only two organic compounds [OCDD and benzo(a)pyrene] were found in samples at concentrations above the range of background soil levels and respective soil screening criteria. Several metals (e.g., antimony, copper, manganese, nickel, thallium) were also detected at levels above representative background soil concentrations; however, only beryllium and thallium exceeded applicable soil screening criteria.

Only metals were detected in the Site 8 surface water samples. For barium and manganese, stream concentrations near Site 8 were slightly higher than background surface water concentrations for both total and dissolved analyses

Among the sediment sample results, only semivolatile organics [polycyclic aromatic hydrocarbons (PAHs) and phthalates] and metals were detected. However, the detected levels were only slightly higher than the background sediment concentrations. The presence of semivolatile organics in stream sediment may be related to runoff from the nearby road or other urban features (e.g., roofs).

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

Carcinogenic risks related to Site 8 surface soil were approximately 2.58 X 10^{-5} (via ingestion), 3.48 X 10^{-6} (via dermal contact), and 2.59 X 10^{-7} (via inhalation) for future residential users. For current industrial employees, the estimated cancer risks were 7.35 X 10^{-6} (via ingestion), 2.48 X 10^{-6} (via dermal contact), and 3.36 X 10^{-8} (via inhalation). These risks are driven by arsenic and 1,2,3,4,6,7,8-HpCDD. The total cancer risk for these receptors are within the target risk range of 10^{-4} to 10^{-6}.

Carcinogenic risks related to Site 8 subsurface soil were 7.77 X 10^{-7} (via ingestion), 8.40 X 10^{-8} (via dermal contact), and 1.55 X 10^{-10} (via inhalation) for future lifetime residential users. For future industrial employees, the estimated cancer risks were 2.22 X 10^{-7} (via ingestion), 5.99 X 10^{-8} (via dermal contact), and 2.02 X 10^{-11} (via inhalation). The total cancer risk for these receptors are below the target risk range.

Blood-lead levels in residential children (age 1-6) were evaluated using the average lead concentration (119 mg/kg) in surface soil. The estimated percentage of children with a blood-lead level above 10 ug/dL was 0.35%, below the protective level of 5%. Thus, average effects to children are not expected from surface soil lead concentrations.

Noncarcinogenic risks for Site 8 surface and subsurface soils did not exceed unity for any receptors.

Estimated cancer and noncancer risks for human receptors under a recreational scenario were not found to be significant for nearby surface water and sediments.

The ecological risk assessment did not reveal that the stream north of Site 8 is threatened by contamination related to NAWC Warminster. No apparent stress on aquatic species was observed during the RI work.

CONCLUSIONS

Based on the findings of the RI, significant conclusions regarding the nature and extent of contamination at Site 8 include the following:

- Site 8 does not show the presence of VOC-contaminated soils, and therefore does not appear to be the source of tetrachloroethene (PCE) contamination in Area C groundwater.
- The removal action has reduced the lead, arsenic, and PAH levels in surface soils west of the runway extension near structure S1.

- Subsurface soils in the vicinity of the site are not significantly impacted.

- Surface water and sediment samples collected from the tributary near Site 8 show contaminant concentrations only slightly higher than respective background levels.

The total carcinogenic risks posed by surface soil to the residential child and lifetime resident were 2.26×10^{-5} and 2.94×10^{-5}, respectively. These are the highest carcinogenic risks identified under the reasonably anticipated potential land use scenarios for Site 8, based on available RI information. These risks fall within the range identified in the National Oil and Hazardous Substances Pollution Contingency Act (NCP) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, as amended) and therefore may be considered safe to human health. Noncarcinogenic risks are also considered acceptable under similar land use scenarios.

Based on the nature and extent of contamination remaining at Site 8 and the risk assessment results, and in accordance with CERCLA and the NCP and its related laws and regulations, it appears that no further response action is warranted at Site 8 to protect human health and the surrounding environment from unsafe soils. In addition, surface water and sediment sampling and analysis downgradient of Site 8 indicates that the site has not adversely impacted the nearby surface water body or streambed.

GLOSSARY

AR	-	Arsenic
AR1254	-	Aroclor-1254
AR1260	-	Aroclor-1260
ARARs	-	Applicable or relevant and appropriate requirements
AWQC	-	Ambient Water Quality Criterion
B(A)A	-	Benzo(a)fluoranthene
B(A)P	-	Benzo(a)pyrene
B(B)F	-	Benzo(b)fluoranthene
BCF	-	Bioconcentration factor
BE	-	Beryllium
BG	-	Background
BGS	-	Below ground surface
B&R	-	Brown & Root Environmental
BRAC	-	Base Realignment and Closure
BTAG	-	Biological Technical Assistance Group
BTEX	-	Benzene, toluene, ethylbenzene, and xylenes
BTV	-	Benchmark Toxicity Value
CCl_4	-	Carbon Tetrachloride
CD	-	Cadmium
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERFA	-	Community Environmental Response Facilitation Act
Cis-1,2-DCE	-	Cis-1,2-Dichloroethene
CLP	-	Contract Laboratory Program
COC	-	Chemical of concern
CR	-	Chromium
Cr^{+6}	-	Hexavalent Chromium

GLOSSARY (continued)

CRDL	-	Contact required detection level
CRQL	-	Contract required quantitation level
CSF	-	Cancer Slope Factor
CTO	-	Contract Task Order
CU	-	Copper
D	-	Dump
DAF	-	Dilution and attenuation factor
D(A,H)A	-	Dibenz (a,h) anthracene
1,1-DCA	-	1,1-Dichloroethane
1,4-DCB	-	1,4-Dichlorobenzene
4,4'-DDD	-	1,1bis(4-Chlorophenyl)2,2-Dichloroethene
4,4'-DDE	-	1,1bis(4-Chlorophenyl)1,1-Dichloroethylene
4,4'-DDT	-	1,1bis(4-Chlorophenyl)Trichloroethene
DEHP	-	Bis(2-Ethylhexyl)phthalate
DG	-	Disturbed ground
DNAPL	-	Dense non-aqueous phase liquid
DOD	-	Department of Defense
EBS	-	Environmental Baseline Survey
ECD	-	Electron Capture Detector
EE/CA	-	Engineering Evaluation/Cost Analysis
EEI	-	Environmental Effects Index
EEQ	-	Environmental Effects Quotient
EIS	-	Environmental Impact Statement
EM	-	Electromagnetic
EPA	-	United States Environmental Protection Agency
EPIC	-	Environmental Photographic Interpretation Center

GLOSSARY (continued)

ERA	-	Ecological risk assessment
ER-L	-	Effects range-low
EX	-	Excavation
FE	-	Iron
FID	-	Flame Ionization Detector
FLRA-BC	-	Federal Land Re-Use Authority - Bucks County
FOC	-	Fractional Organic Carbon
FS	-	Feasibility Study
GC	-	Gas chromatograph
GPM	-	Gallons per minute
GPS	-	Global positioning system
GS	-	Ground scar
HNUS	-	Halliburton NUS
HI	-	Hazard Index
HPCDD	-	Heptachlorinated dibenzo-p-dioxin
HPCDF	-	Heptachlorinated dibenzofuran
HRS	-	Hazard Ranking System
HQ	-	Hazard Quotient
IEUBK	-	Integrated Exposure and Update Biokinetic Model
IM	-	Impoundment
I(123CD)P	-	Indeno(1,2,3-cd)pyrene
IRP	-	Installation Restoration Program
KD	-	Partioning coefficient
K_{oc}	-	Organic carbon/chemical partitioning coefficient
K_{ow}	-	Octanol/water partitioning coefficient

GLOSSARY (continued)

LOAEL	-	Lowest observed adverse effect level
LQ	-	Liquid
MCLs	-	Maximum contaminant level
mg/kg	-	Milligrams per kilogram
mg/l	-	Milligrams per liter
MM	-	Mounded material
MN	-	Manganese
MSC	-	Medium-specific concentration
MSL	-	Mean sea level
MW	-	Monitoring well
NADC	-	Naval Air Development Center
NAWC	-	Naval Air Warfare Center
NBCMA	-	Northampton, Bucks County Municipal Authority
NCP	-	National Oil and Hazardous Substances Pollution Contingency Act
NEESA	-	Navy Energy and Environmental Support Activity
NFESC	-	Navy Facilities Engineering Service Center
NOAEL	-	No observed adverse effect level
NOEL	-	No observed effect level
NPL	-	National Priorities List
NWI	-	National Wetlands Inventory
OCDD	-	Octachlorinated dibenzo-p-dioxin
OCDF	-	Octachlorinated dibenzofuran
OF	-	Outfall
OS	-	Open storage
OU	-	Operable Unit
P	-	Pit

GLOSSARY (continued)

PA	-	Preliminary Assessment
PADEP	-	Pennsylvania Department of Environmental Protection
PAH	-	Polycyclic aromatic hydrocarbon
PB	-	Lead
PCBs	-	Polychlorinated biphenyls
PCE	-	Tetrachoroethene
PE	-	Polyethylene
PECDD	-	Pentachlorinated dibenzo-p-dioxin
PECDF	-	Pentachlorinated dibenzofuran
PEM5C	-	Palustrine, energent, narrow-leaved persistent, seasonal
PF01A	-	Palustrine, forested, broad-leaved deciduous, temporary
PID	-	Photoionization detector
PQL	-	Practical Quantitation Limit
QA/QC	-	Quality Assurance/Quality Control
RAB	-	Restoration Advisory Board
RBC	-	Risk-based concentration
RCRA	-	Resource Conservation and Recovery Act
RfD	-	Risk reference dose
RI	-	Remedial Investigation
ROD	-	Record of Decision
R2OWH	-	Riverine, lower perennial, open water, permanent
R2OWHx	-	Riverine, lower perennial, open water, permanent excavated
S	-	Structure
SARA	-	Superfund Amendments and Authorization Act
SB	-	Antimony

GLOSSARY (continued)

SB	-	Soil boring
SCS	-	Soil Conservation Science
SD	-	Sediment
SDA	-	Surface disposal area
SI	-	Site Inspection
SMC	-	Science Management Corporation
SOW	-	Statement of work
SS	-	Surface soil
SSLs	-	Soil screening levels
SW	-	Surface water
TAL	-	Target analyte list
TBC	-	To be considered
1,1,1-TCA	-	1,1,1-Trichloroethane
1,1,2-TCA	-	1,1,2-Trichloroethane
TCE	-	Trichloroethane
TCDD	-	Tetrachlorinated dibenzo-p-dioxin
TCDF	-	Tetrachlorinated dibenzofuran
TCL	-	Target compound list
TCLP	-	Toxicity characteristic leaching procedure
TEFs	-	Toxicity Equivalent Factors
TEQs	-	Toxic Equivalents
TIC	-	Tentatively identified compound
TOC	-	Total organic carbon
TP	-	Test pit
TPH	-	Total petroleum hydrocarbon
TR	-	Trench

GLOSSARY (continued)

UCL	-	Upper confidence limit
U.S.G.S.	-	United States Geological Survey
UST	-	Underground storage tank
ug/kg	-	Micrograms per kilogram
ug/l	-	Micrograms per liter
VOCs	-	Volatile organic compounds
WMA	-	Warminster Municipal Authority
ZN	-	Zinc

1.0 INTRODUCTION

In response to Contract Task Order No. 159 under Contract N62472-90-D-1298, Tetra Tech NUS, Incorporated (TtNUS) is submitting this remedial investigation (RI) report for Operable Unit 5 (OU-5) (Site 8 media other than groundwater) at the former Naval Air Warfare Center (NAWC) (formerly the Naval Air Development Center), Warminster, Pennsylvania. This work is part of the Navy's Installation Restoration Program (IRP), which is designed to identify contamination of Navy and Marine Corps facilities resulting from past operations and to institute corrective measures, as needed.

IRP activities are typically performed in four distinct phases. The first phase consists of a preliminary assessment (PA). Phase II involves a site inspection (SI). The third phase is an RI/FS, which is intended to characterize physical and chemical parameters and risks associated with the facility. The last phase consists of remedial actions designed to control and mitigate contamination. This report is prepared under Phase III IRP activities.

1.1 PURPOSE OF REPORT

The purpose of this report is to describe investigation results for Site 8 soils and the stream north of the site, draw conclusions based on these results, and recommend any additional actions. Data from these investigations support the baseline risk assessment, which is used to help identify disposal locations warranting possible remediation. The risk assessment is included as part of this report (Section 6.0).

This report addresses surface soils, subsurface soils, and wastes at Site 8. This report also addresses surface waters and sediments potentially impacted by the site. Groundwater impacts associated with this area have previously been reported and are currently being addressed as Operable Unit 3 (OU-3) (Halliburton NUS, 1994b and 1994c). Therefore, groundwater at Site 8 is not addressed by this report.

Section 300.430 (a)(1)(ii)(A) of the National Oil and Hazardous Substances Pollution Contingency Act (NCP) provides that hazardous substance facilities should generally be remediated in operable units when early actions are necessary or appropriate to achieve a significant and accelerated risk reduction, when phased analysis or response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of a total cleanup. Several operable units at NAWC Warminster have been identified to facilitate these objectives. OU-5 includes media other than groundwater associated with Site 8.

Based on preliminary RI results, a removal action was conducted at OU-5 in February 1999. This report describes the nature and extent of contamination at OU-5 after this response action was performed. The report also discusses the results of RI work accomplished before the removal action took place.

The main focus of the RI was to characterize soils and wastes in potential source areas at the site, particularly for suspected sources that were not addressed under the base-wide Environmental Baseline Survey (EBS). The RI also investigated nearby surface waters and sediments potentially impacted by Site 8.

1.2 FACILITY BACKGROUND AND HISTORY

This section describes NAWC Warminster and provides a brief synopsis of the facility's background and history. More detailed discussion is provided in the RI work plans.

1.2.1 Facility Description

NAWC Warminster is located in the township of Warminster, Bucks County, Pennsylvania. The facility can be found on the United States Geological Survey (U.S.G.S.) Hatboro 7.5-minute topographic quadrangle map, a portion of which is reproduced as Figure 1-1. The total area of NAWC Warminster is approximately 734 acres. The facility lies in a populated suburban area surrounded by private homes, various commercial/industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

The facility is located on a ridge, generally oriented east-west, with elevations ranging from 297 feet at the northwestern property boundary to 377 feet at the eastern boundary. Slopes are gentle and average 3 to 5 percent. The northern portion of the facility (about 65 percent) drains into small, unnamed tributaries of Little Neshaminy Creek. The remaining portion drains into unnamed tributaries of Pennypack Creek.

The main areas of investigation at NAWC Warminster include several waste sites covering more than 15 acres (Figure 1-2). All sites are located within the NAWC Warminster property and include the following:

- Three waste burn and disposal pits (Sites 1, 3, and 6)
- Two sludge disposal pit areas (Sites 2 and 7)
- Two landfills located on the north and south sides of the active runway (Sites 4 and 5)
- One fire training area (Site 8)
- A series of eight unlined impoundments (Impoundment Area)

These sites, along with other suspected sources at the base, have been grouped into four general areas based on geographic location (i.e., their proximity to one another), similarities regarding source and waste characteristics (i.e., methods of waste disposal and types of wastes deposited), and their common effects on nearby receptors (e.g., aquifers, surface water bodies, and human populations) (Figure 1-2). The general areas are

- Area A, which is located in the northwestern corner of the base
- Area B, which is located south of the main runway
- Area C, which is located north of the main runway
- Area D, consisting of the main building complex at the base

Historically, wastes were generated during aircraft maintenance and repair, pest control, firefighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils. None of the sites are currently used for waste disposal. A description of Site 8 can be found in Section 1.4 of this report.

The longest runway, which is inactive, is generally located along the topographically highest area at the facility. Many of the primary facility buildings are located west of the airstrip, along Jacksonville Road. A housing development for military enlisted personnel is within the southeastern portion of NAWC Warminster. A wastewater treatment plant is located in the northwestern corner of the facility.

Approximately 100 employees currently work at the former base, and 1,000 people reside at the enlisted personnel's housing area year round. The residents living at the enlisted housing area are the nearest population center, but most work at a nearby Navy base in Willow Grove, Pennsylvania. The closest off-base home is about 200 feet away.

NAWC Warminster is underlain by the Stockton Formation, which provides water for more than 100,000 people within the area. Local surface water bodies are used for recreation and industrial purposes.

1.2.2 Facility History

The facility was originally the location of Brewster Aeronautical Corporation, a manufacturer of military aircraft. In 1944, the Navy assumed full control of the Brewster plant. The Naval Air Modification Unit was installed at the base to add design modifications to military aircraft produced at other locations. After World War II, activities at the base were altered; in 1949, the facility was designated the Naval Air Development Center (NADC), and its main mission, research, development, testing, and evaluation for Naval aircraft systems, was established. NAWC Warminster also conducted studies in anti-submarine warfare systems

and software development. The facility name was changed from NADC to NAWC, Aircraft Division, on January 1, 1992. In 1996, NAWC Warminster was realigned under the Base Realignment and Closure (BRAC) Program managed by the Department of Defense (DOD). This realignment, which is due to the downsizing of the entire DOD budget, was implemented in September 1997. The realignment resulted in the relocation of NAWC Warminster activities to Naval Air Station (NAS) Patuxent River, Maryland. The base is now closed and is being redeveloped for non-military use by the Federal Lands Reuse Authority (FLRA).

The U.S. Environmental Protection Agency (EPA) officially recognized the NAWC Warminster sites as possibly needing investigation in September 1979. In November 1979, EPA completed a PA. In 1980, the Department of the Navy began its environmental investigative work at NAWC Warminster. The first study, known as the Clay/Law Report, inventoried disposal activities at each of the eight sites. Since 1980, a variety of environmental consultants under Navy contracts have studied these sites. The first of the resulting reports, prepared by JRB Associates in 1983, concluded that on-site contamination existed but probably was not affecting off-site water supply wells.

In 1985, EPA completed a PA/SI Report. In 1986, NAWC Warminster was proposed for inclusion on the National Priorities List (NPL) based on a Hazard Ranking System (HRS) score greater than 28.50. EPA used the HRS to assess the relative threat from releases of hazardous substances from the eight NAWC Warminster sites to surrounding groundwater and surface water. The facility score was based on the likelihood that a hazardous substance would be released from the sites, the toxicity and amount of hazardous substances at the sites, and the people and sensitive environments potentially affected by contamination at the sites.

On October 4, 1989, NAWC Warminster was placed on the final NPL. That same year, EPA submitted a draft Interagency Agreement to the Navy for formalizing and scheduling remedial activities. The contents of this agreement were negotiated in 1990. In 1991, TtNUS (formerly Halliburton NUS Corporation, then Brown & Root Environmental) was tasked to complete RI/FS activities at the facility.

1.2.3 Environmental Investigations

Since 1979, NAWC Warminster, regulatory agencies, and others have been involved in various regional environmental response actions for the study area. Some regional actions have been specific investigations of the NAWC Warminster sites. A number of wells within Warminster Township and other nearby townships have been sampled for VOCs, and contamination by VOCs has made some groundwater unsuitable for potable use.

Since 1989, several remedial investigations and feasibility studies have been conducted at NAWC Warminster for the various areas of concern (i.e., Area A, Area B, Area C, and Area D). The Phase I RI was performed between October 1989 and April 1991 by SMC Environmental Services Group (SMC

Martin, 1991). Phase II was performed between May 1992 and April 1993 (HNUS, 1992, 1993a). In October 1993, focused RI/FS work for groundwater contamination attributable to the base began and is continuing (HNUS, 1994a). Phase III, which addresses potential source areas and their impacts to soils, surface waters, and sediments, began in January 1995 and is ongoing (Brown & Root Environmental, 1996a). The Phase III RI field work for OU-5 was completed in March 1999.

Area D (with the exception of groundwater) was evaluated separately from other RI work. Except for Phase I, all other investigations have been conducted by TtNUS. A Technical Review Committee (later a Restoration Advisory Board), which consists of representatives of the Navy, EPA, the Pennsylvania Department of Environmental Protection (PADEP), the Bucks County Health Department, the Northampton Township Municipal Authority, the Warminster Township Municipal Authority, and Upper Southampton Township, assisted in the planning and review of these activities

The following sections briefly summarize the status of investigations and response actions for each of the four areas of concern.

1.2.3.1 Area A Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): RI activities involved mapping VOCs in soil gas and detecting magnetic and conductive anomalies through electromagnetic surveys. Approximate site boundaries were identified and confirmation of site contamination was made through soil borings, installation of new overburden and shallow bedrock monitoring wells, and groundwater sampling and analysis. Other media (surface water and sediment) were also sampled and tested. Test pits were excavated, local wells were inventoried, and a fracture-trace analysis was conducted. A biological characterization of a nearby stream was also done (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work helped determine the nature and extent of groundwater contamination, evaluate shallow groundwater flow and add to the hydrogeologic database, and ascertain possible remedial alternatives. Activities included installing additional overburden and shallow bedrock monitoring wells, sampling and analyzing groundwater, surface water, sediment, and soils, and evaluating aquifer characteristics through water-level monitoring and a pumping test. Groundwater-related RI and FS reports for OU-1 were released in April 1993 (HNUS, 1992, 1993a, and 1993b).

- Focused RI/FS for Groundwater (1993 -): Investigated groundwater conditions within and downgradient of Area A, as well as in other areas of the base. Monitoring wells were installed

and water samples collected for analysis. A water-level study and a more comprehensive aquifer pump test were also performed (HNUS, 1995e).

- Phase III (1995 -): The primary RI objective was to characterize sources of contamination, primarily soils and wastes at known and potential waste disposal sites. RI work included a soil gas survey, multiple surface geophysical surveys, test pits and soil borings, along with soil and waste sampling and analysis. A surface water and sediment sampling and analysis program was performed to evaluate the impacts of Area A on a nearby stream. An assessment of wetlands near Area A was also conducted (HNUS, 1994d; B&R Environmental, 1996a).

Response Actions

- Operable Unit 1 (OU-1): At the end of Phase II, the Navy and EPA selected an interim remedy for contaminated shallow groundwater attributable to Area A at the base, referred to as OU-1. The OU-1 Record of Decision (ROD) was signed in September 1993. The interim remedy included installing extraction wells and building a treatment system, was constructed by July 1999.

- During the construction of the OU-1 remedy, the Navy excavated and disposed of contaminated soils in an off-base landfill that were beneath the footprint of the treatment plant building or along the route of groundwater transfer piping near Area A. This work was performed in 1996.

- Using Navy funds, one commercial property with a contaminated well was connected to the Warminster Municipal Authority system in the summer of 1995. This property was located north of Area A, specifically Site 2.

- OU-6: Based on the Phase III RI, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated soils and wastes from several locations within Sites 1, 2, and 3 between August 1998 and January 1999. An Action Memorandum for the Area A soil removal action was signed by the Navy in June 1998.

1.2.3.2 Area B Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): Activities were similar in scope to Area A. An air sampling program was also performed to evaluate the potential for atmospheric contamination in nearby residences (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work was similar to Area A. Several off-base well samples were also collected for analysis. Groundwater-related RI and FS reports for OU-1 were prepared in April 1993 (HNUS, 1992, 1993a, and 1993b).

- Focused RI for Groundwater (1993 -): Investigated groundwater conditions within and downgradient of Sites 5, 6, and 7. The focused groundwater scope of work was similar to Area A. Based on this work, a draft hydrogeologic study for Area B was released in April 1995 (HNUS, 1995b)

- Phase III (1995 -): The Phase III RI objective was to characterize sources of contamination, primarily soils and wastes at known and potential waste disposal sites. RI work was similar to what was conducted for Area A. Additional investigations for Sites 6 and 7 were performed in 1996 and 1997 to support limited removal actions for these sites. Following the removal actions, RI and FS reports for Sites 6 and 7 were prepared and are currently under review. A supplemental study for Site 5 is also being planned at this time (B&R Environmental, 1996a).

Response Actions

- OU-1: At the end of Phase II, the OU-1 ROD was signed to implement an interim remedy for contaminated shallow groundwater attributable to Area B. Extraction wells were installed in December 1994, however, the groundwater sample results indicated the general absence of significant contamination. The interim remedy is currently on-hold, and is now being reevaluated.

- OU-2: Following Phase II, the Navy performed sampling of off-base drinking water wells in the vicinity of NAWC Warminster. Results from well water samples collected during the testing indicated that at several residences, the groundwater had levels of VOCs greater than EPA's Maximum Contaminant Levels (MCLs). Beginning in April 1993, the Navy installed water treatment systems at these residences despite the lack of clear evidence that the Navy was responsible for all of the elevated contaminant levels of concern. In the summer of 1994, EPA and the Navy connected homes in the Casey Village Area (located south of Sites 5, 6, and 7) to

the Warminster Municipal Authority and Upper Southampton Water and Sewer Authority systems.

- OU-7: Based on the Phase III RI findings, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated soils and wastes from several locations within Sites 6 and 7 in 1997.

1.2.3.3 Area C Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): Activities were similar in scope to Area A (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work was similar to Areas A and B. One off-base well sample was tested (HNUS, 1992).

- Focused RI for Groundwater (1993 - 1994): Investigated groundwater conditions within and downgradient of Sites 4 and 8. The focused groundwater scope of work was similar to Areas A and B. Based on this work, separate RI and FS were submitted for Area C groundwater in August 1994 reports (HNUS, 1994b and 1994c). A schematic design for shallow groundwater remediation was completed in July 1994.

- Phase III (1995 - 1999): The Phase III RI objectives and field work were similar to what were conducted for Areas A and B. A maintenance area and septic drain field, both located between Site 4 and Site 8, were also investigated within Area C (B&R Environmental, 1996a). An engineering evaluation/cost analysis (EE/CA) report was prepared to help support a removal action for Site 4 in July 1995 (HNUS, 1995d). A supplemental study for Site 8 was conducted between July 1998 and March 1999 to complete RI work for this site.

Response Actions

- OU-2: Following Phase II, the Navy performed sampling of off-base drinking water wells in the vicinity of Area C. In 1994, EPA and the Navy connected homes along Kirk Road to the Warminster Municipal Authority system.

- OU-3: The interim OU-1 remedy for Areas A and B was modified to incorporate the additional volume of contaminated groundwater associated with OU-3. The ROD for OU-3, was signed in March 1995. Construction of the groundwater treatment plant was completed in May 1996. Six

extraction wells were installed in Area C, and piping and electrical wiring were run between these wells and the treatment plant. The system began full operation in July 1996.

- The Action Memorandum for the Site 4 removal action was signed in June 1996. Based on the Phase III RI and EE/CA findings, the Navy excavated and disposed of contaminated soils and wastes from eight buried trenches at Site 4 in the fall of 1996. All work was completed in July 1997.

- OU-5: Based on the Phase III RI findings, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated surface soils along the western edge of the Site 8 runway extension in February 1999. The Action Memorandum for the Site 8 removal action was also signed in February 1999 (U.S. Navy, 1999).

1.2.3.4 Area D Investigations and Response Actions

Investigations

- Focused RI for Groundwater (1993 - 1996): Investigated groundwater conditions within and downgradient of Area D. The focused RI groundwater scope of work was similar to the investigations for Areas A, B, and C. Based on this work, separate RI and FS reports were submitted for Area D groundwater in October 1996 (B&R Environmental, 1996c and 1996d).

- Area D RI (1996 - 1998): The Area D RI objective was to characterize sources of contamination, primarily soils and wastes at potential waste disposal sites within the main building complex at the base, including the hangar area east of Jacksonville Road. RI work included a soil gas survey, soil borings, and soil sampling and analysis. The RI report for Area D media other than groundwater was released in September 1998 (TtNUS, 1998). Based on the Area D RI results for media other than groundwater, an FS report was not warranted.

Response Actions

- OU-4: At the end of the focused groundwater RI for Area D groundwater, an interim ROD for OU-4 was released in September 1997. The interim remedy included installing extraction wells and connecting these wells to the existing groundwater treatment system and was completed by July 1999.

- To date, no CERCLA response actions for specific Area D sources have been conducted. However, the Navy has removed several petroleum-related aboveground and underground storage tanks (USTs) within Area D and other areas at the base.

The results and findings of all previous investigations are maintained in two local information repositories that contain the Administrative Record for NAWC Warminster. One repository is located at the base; the second can be found at the Bucks County Library, Doylestown Branch.

1.3 SITE 8 DESCRIPTION AND HISTORY

Site 8, a former fire-fighting training area, is part of Area C. Area C includes Sites 4 and 8 and nearby locations where releases may have resulted in groundwater contamination, which has been identified both on and off base in this area. These locations include, but are not limited to, a maintenance area and septic system tile field associated with Quarters A, the former residence of the base commander. Details regarding the nature and extent of groundwater contamination in this area can be found in the RI report for OU-3 at NAWC Warminster (HNUS, 1994b).

1.3.1 Site Description

Site 8 is located north of the main airstrip at the northeastern end of an abandoned runway and is about 250 feet from the base boundary and 600 feet from the former base commander's residence (Figure 1-3). Historically, most surface runoff from the site has drained to a concrete swale about 100 feet north of the northwestern corner of the runway extension. A second concrete swale about 120 feet east of the northeastern corner of the runway extension has also received some runoff from the site. A small park (Werner Park) is located across Kirk Road to the north and northeast of Site 8. Scattered single-family houses are located southeast and northeast of Werner Park.

1.3.2 Site History

The Navy initially reported Site 8 as a disposal site in the Navy Shore Activity Disposal Fact Form (U.S. Navy, 1980) and Notification of Hazardous Waste Sites (U.S. Navy, 1981). The site reportedly consisted of a 75- by 75-foot portion of the runway surrounded on three sides by a double berm. ~~The berms were approximately 6 feet high.~~ The site included two areas on the runway which were used for fire training exercises from 1961 to 1986. Typically, flammable materials were poured on the runway, ignited, and extinguished to simulate fire-fighting procedures. The Fact Form reported that about 3,000 gallons of contaminated aviation jet fuels from the fuel farm storage area near Area A were burned at this location per year from 1961 through at least 1980, the date the Fact Form was compiled. In the past, surface water (about 6 to 12 inches) was observed to temporarily collect within this area after rainfall events.

An evaluation of historical aerial photographs subsequently found that the

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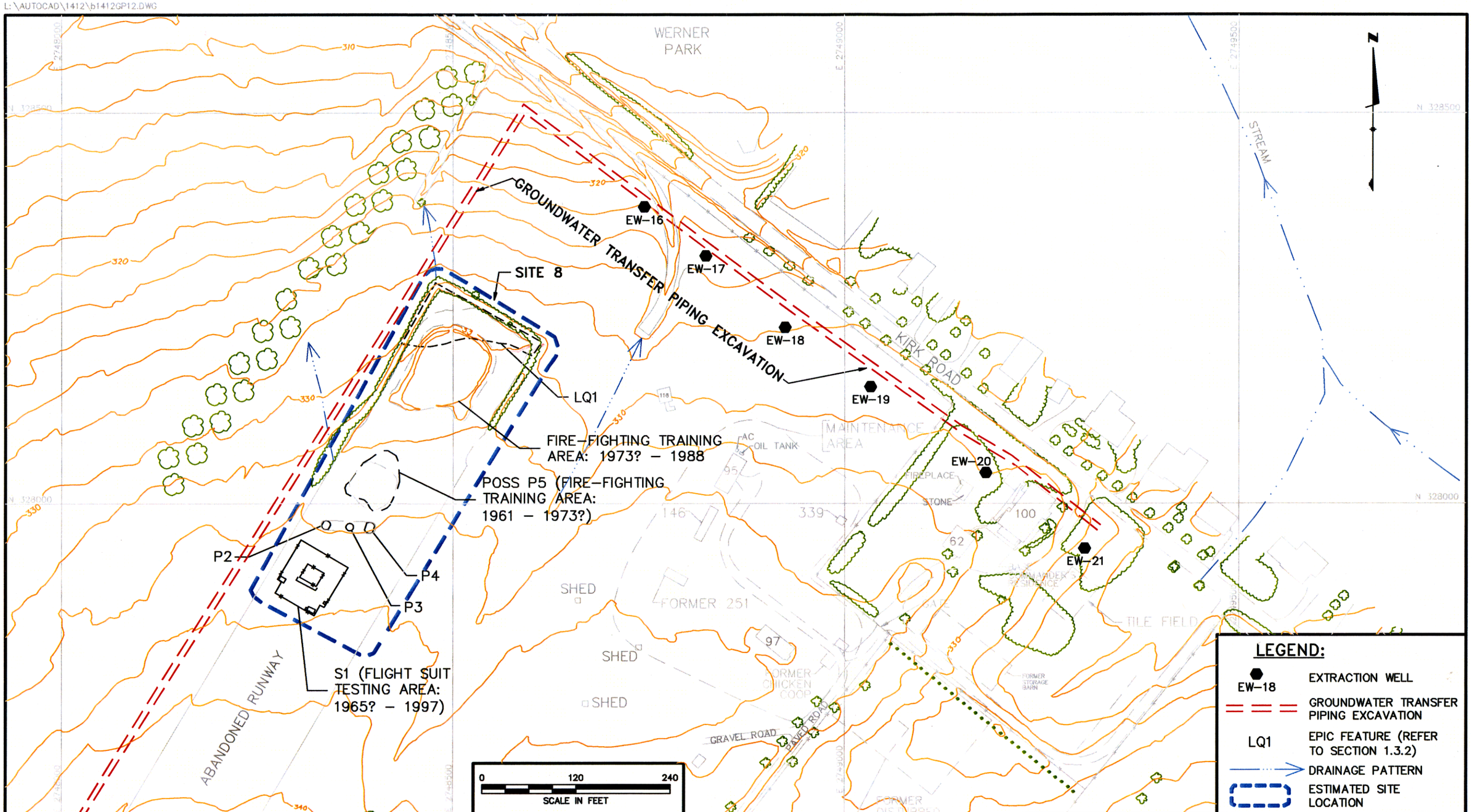

NO.	DATE	REVISIONS		CHKD	APPD	REFERENCES
2	8/5/99	ADDRESSED DRAFT REPORT COMMENTS	EEH			
1	4/22/99	GROUNDWATER TRANSFER LINE ADDED	LDL			

DRAWN BY DT DATE 9/30/96
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS SHOWN

Tetra Tech NUS, Inc.

AREA C AND SITE 8 LAYOUT
FORMER NAWC WARMINSTER, PA

1412 | 4010

FIGURE 1-3 | 2

00151 FOIA

While site-specific information is not available, typical contaminants associated with aviation jet fuels include hydrocarbons similar to kerosene. Both aliphatic and aromatic hydrocarbons are present in jet fuels. Aromatic hydrocarbons comprise about 10 to 20 percent of this fuel. Benzene, toluene, ethylbenzene, xylenes, and PAHs are commonly chemicals associated with jet fuels. PAHs typically include pyrene, benzo(a)pyrene, anthracene, and phenanthrene (ASTM E 1739, 1995).

Significant additional site background and historical information were provided by an aerial photographic site analysis report for the base (EPA, 1994). This report evaluated aerial photographs from March 1938 through March 1990 and identified several features within Site 8 that suggested possible or probable disposal pits and other miscellaneous features. These features are displayed on Figure 1-3. The following information regarding the site analysis report is pertinent to this report .

The historical aerial photos and background information indicate that at least two areas on the abandoned runway were used as burn areas. The use of the runway extension for fire-fighting training appears to have begun after 1958. Aerial photographs taken through 1958 did not show the presence of any significant features. Initially, fire-training exercises were conducted about 240 feet from the end of the runway (POSS P5). In a photograph from March 1965, two berms were evident on the runway – one berm along the perimeter of the end of the runway and a second V-shaped berm within the runway (Figure 1-4). Dark staining and an aircraft were apparent within the V-shaped berm. Ponding of a dark liquid was apparent along the western perimeter of the runway adjacent to this berm. Similar ponding of liquid and/or soil staining was also apparent along the western perimeter of the runway in other photos compiled by EPA (see Figures 1-5, 1-6, and 1-7). These same photos also indicated liquids bypassing the berm at the runway perimeter and draining from the northwest corner of the runway toward the western concrete swale.

Photography from October 1967 showed similar features, as noted in March 1965. Flight suit testing activities were initiated about 300 feet from the end of runway in a new structure (structure S1) between 1965 and 1967. According to the Navy, structure S1 was a corrugated metal building located south of the Site 8 fire-fighting training area that was used to test the durability of aviation flight suits. The floor of the structure contained water, on top of which was place a small quantity of flammable liquid. Once ignited, a flight suit, attached to a mechanical arm, was passed through the flames in order to test the suit's ability to withstand fire. The structure was enlarged before August 1971 (Figure 1-5). The structure was dismantled and the materials removed by the Navy in 1997 to an off-site landfill.

In a photograph from March 1973, up to three smaller depressions or pits (P2, P3, and P4) were identified on the runway immediately north-northeast of structure S1 (Figure 1-6). A smaller fire training area was noted about 100 feet northeast of the older fire training area near the end of the runway. In addition, standing liquid was observed at the northern end of the runway (LQ1). Drainage from POSS P5 was observed extending into the grassy area immediately north of the older fire training area.

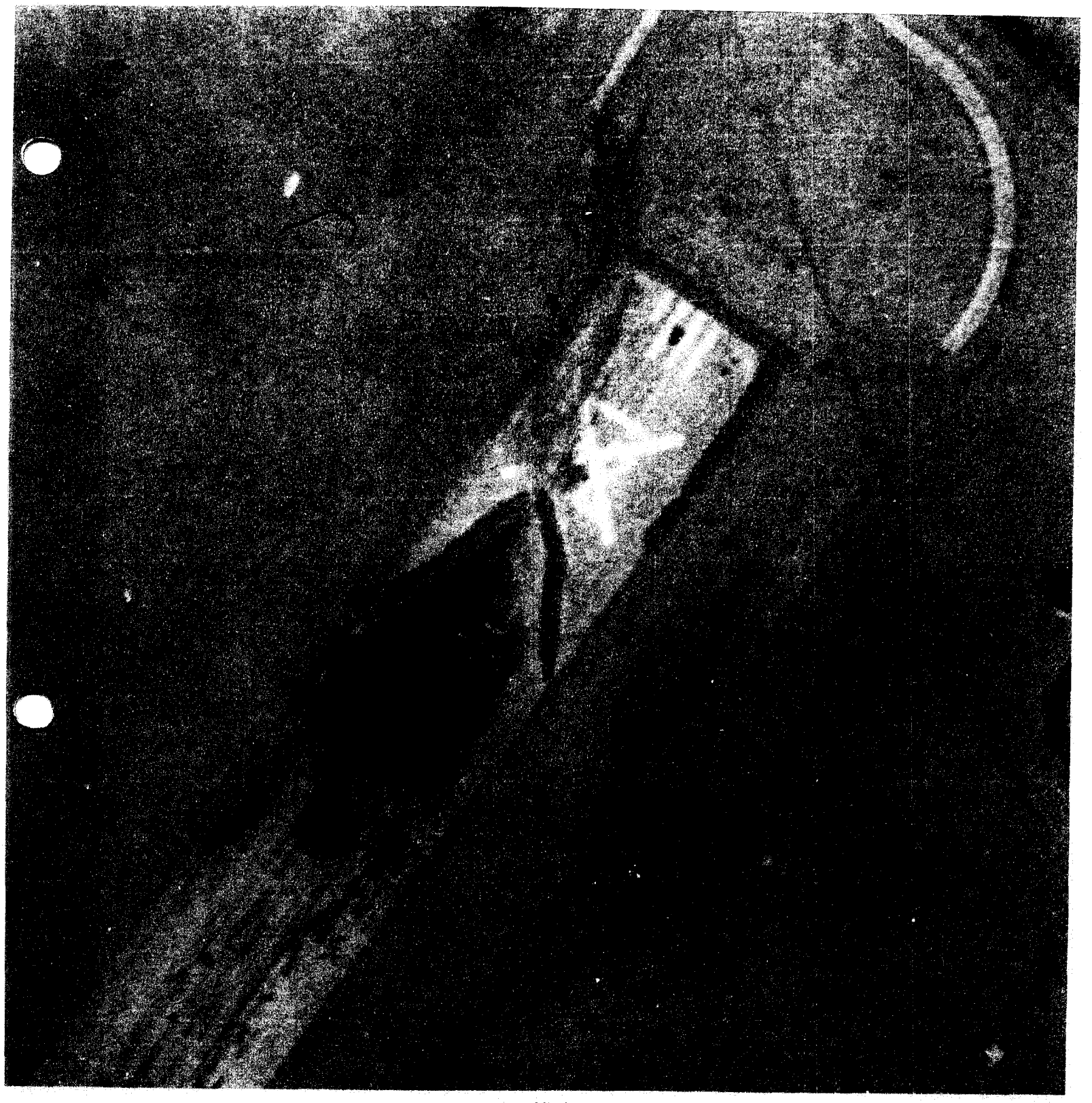

FIGURE 1-4
SITE 8 AERIAL PHOTOGRAPH
NAWC WARMINSTER, PA
MARCH 31, 1965

Source: Aerial Photographic Site Analysis, Naval Air Development Center, Warminster, Pennsylvania. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. TS-PIC-93053, May 1994 (not to scale).

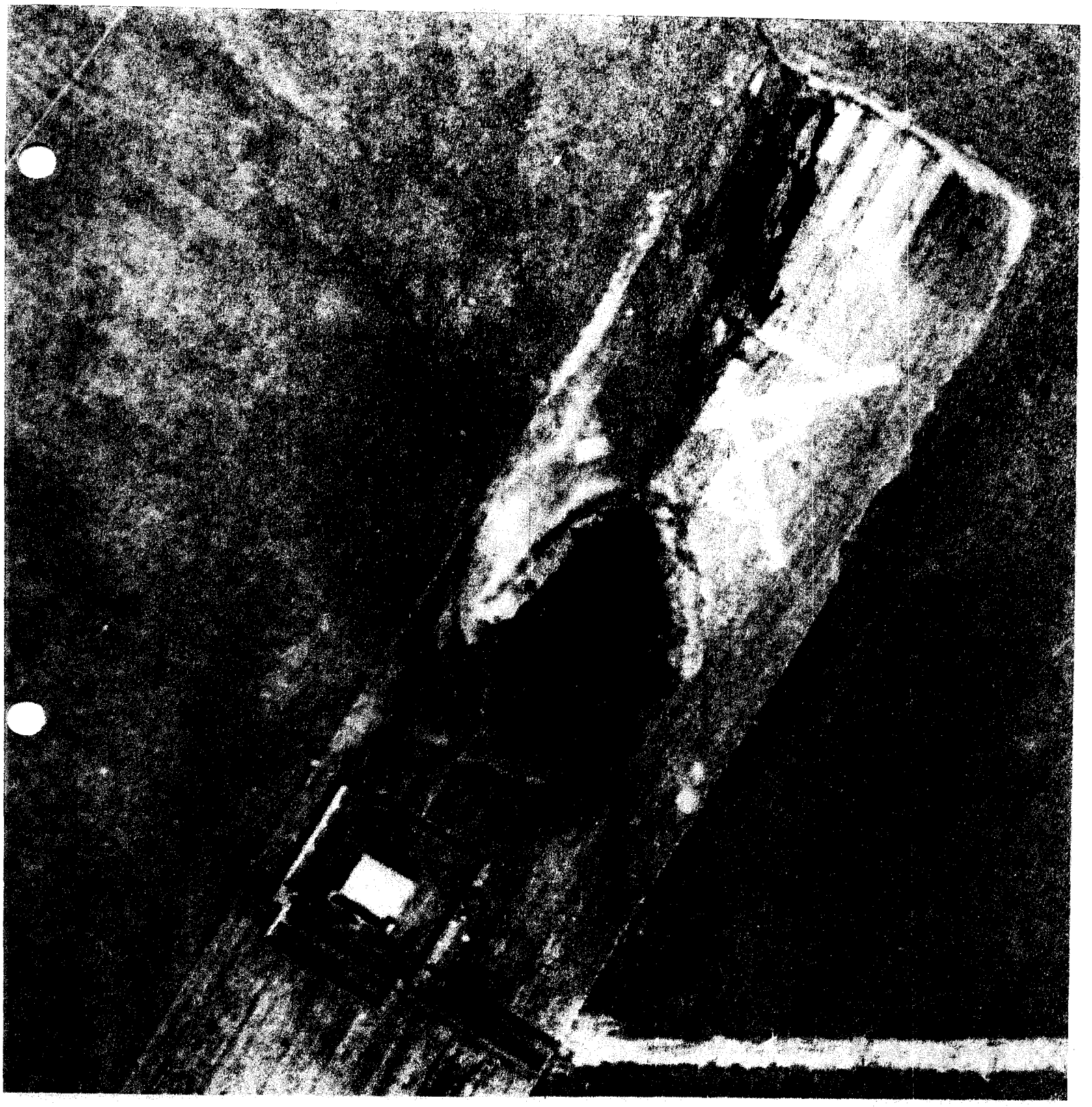

FIGURE 1-5
SITE 8 AERIAL PHOTOGRAPH
NAWC WARMINSTER, PA
APRIL 13, 1970

Source: Aerial Photographic Site Analysis, Naval Air Development Center, Warminster, Pennsylvania. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. TS-PIC-93053, May 1994 (not to scale).

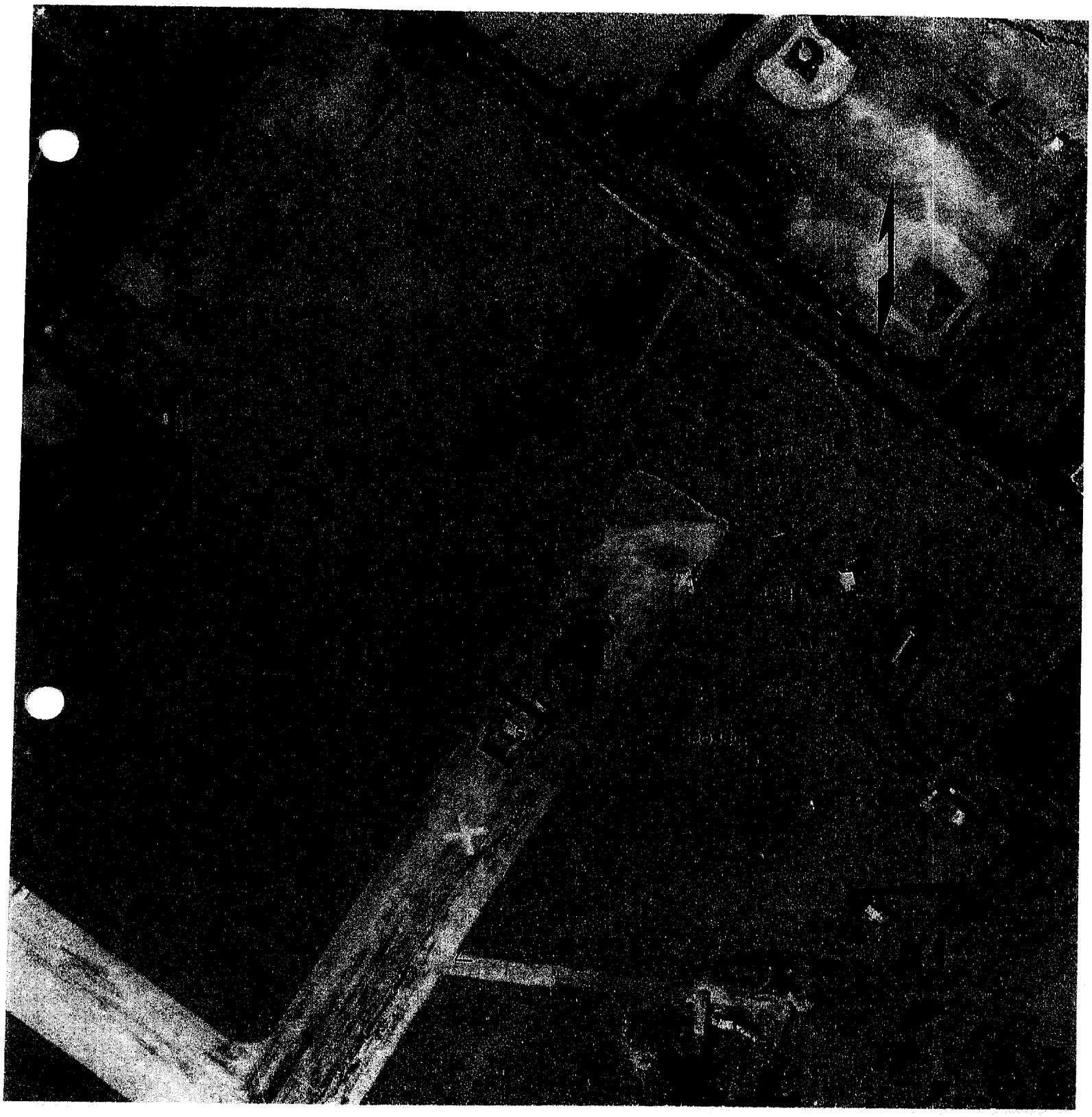

FIGURE 1-6
SITE 8 AERIAL PHOTOGRAPH
NAWC WARMINSTER, PA
MARCH 24, 1973

Source: Aerial Photographic Site Analysis, Naval Air Development Center, Warminster, Pennsylvania. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. TS-PIC-93053, May 1994 (not to scale).

Other recognizable features (e.g., berms, ash, and drainage patterns) in the March 1973 photograph were similar to preceding photographs.

By 1977, analysis of aerial photographs indicated that pits P2, P3, P4, and P5 were no longer evident at Site 8, although fire-fighting training still appeared to be conducted at the site. Photographs from 1977 through 1988 revealed no significant change from these observations. In a photograph from 1988, the analysis revealed that almost all ash residues and containment berms were no longer evident. A photograph from March 1990 indicated that the Site 8 runway extension had been further cleaned and that all fire-fighting training had ceased (Figure 1-7). Since 1988, Site 8 has been used on occasion to store construction materials, such as lumber, piping, concrete vaults, and steel girders.

1.3.3 Previous Response Actions

In November 1986, PADEP conducted an inspection of the fire-fighting training area. The inspection revealed oil soaked soils and stressed vegetation along a drainageway leading from the open burning area. PADEP had previously observed oily and contaminated water leaking from the ground and running on the surface. A notice of violation was issued on November 18, 1986 (PADER, 1986) (Appendix K).

In response, the Navy suspended all activities at the site (U.S. Navy, 1986) (Appendix K). Soil samples were collected in December 1987 to evaluate the nature and extent of contamination. A total of five soil samples were reportedly taken from eroded areas near the site, berm soil, and a background area. The liquid within the bermed area was also analyzed along with a sample from the nearby stream. Petroleum hydrocarbons were detected at 580 mg/kg in the berm soil. Other petroleum hydrocarbon concentrations contained in the soil samples from eroded areas ranged from 28 to 180 mg/kg. No metals or PAHs were detected in the site-related soil samples at levels significantly above background. The two aqueous samples were analyzed for semivolatile organic compounds; only bis(2-ethylhexyl)phthalate was detected at levels of 20 ug/l in the bermed area liquid and 30 ug/l in the stream sample (QC, 1998). Appendix K includes the analytical results from this sampling. The Navy then removed the berms surrounding the runway extension and disposed of these soils in the vicinity of the site. The exact locations where berm materials were disposed could not be precisely determined, however, a photograph from 1988 revealed several unvegetated areas around the perimeter of the extension that may be the approximate locations where the berm materials were deposited (Figure 1-8).

In 1996, the Navy constructed the OU-3 groundwater treatment system for Area C groundwater. Groundwater conveyance piping from the Area C extraction wells was installed north and west of the Site 8 runway extension (Figure 1-3). As part of this work, the Navy excavated a trench adjacent to the western edge of the runway, approximately 5 feet in width and 6 feet in depth. Surface soils on either side of ~~overlying the deepest portion of~~ the trench were also removed; this ~~the~~ shallower excavation was about 15 feet in width and 2 feet in depth as centered on the piping, which ~~is~~ was located about 25 feet from the northwestern ~~edge~~ corne of the runway. In the immediate vicinity of Site 8, no odors, stained soils, or elevated field

FIGURE 1-7
SITE 8 AERIAL PHOTOGRAPH
NAWC WARMINSTER, PA
MARCH 8, 1990

Source: Aerial Photographic Site Analysis, Naval Air Development Center, Warminster, Pennsylvania. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. TS-PIC-93053, May 1994 (not to scale).

FIGURE 1-8
SITE 8 AERIAL PHOTOGRAPH
NAWC WARMINSTER, PA
JUNE 25, 1988

Source: Aerial Photographic Site Analysis, Naval Air Development Center, Warminster, Pennsylvania. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Las Vegas, NV. TS-PIC-93053, May 1994 (not to scale).

instrument readings were reportedly encountered during excavation activities (OHM, 1999). The excavated soils were used to backfill the length of the piping, and any excess materials were piled to the north of the runway extension. The Navy plans to remove this soil pile in the near future.

Based on preliminary RI results (including the results of supplemental investigations conducted in 1998 and 1999 at Site 8), the Navy signed an Action Memorandum (Appendix H) for a removal action at Site 8 on February 4, 1999. The purpose of this action was to address soils contaminated with lead and arsenic along the western edge of the runway extension, near the former location of structure S1. The soil removal action was performed in February 1999. The objectives of the removal action were to

- Prevent actual or potential exposures to contaminated surface soils presenting unacceptable risks.
- Protect groundwater quality by reducing infiltration of water into and through contaminated soils of concern.
- Prevent the release of hazardous substances at Site 8 to nearby surface water and sensitive ecosystems.

Approximately 675 tons of surface soils were excavated, transported to, and disposed of in the GROWS Municipal Waste Landfill in Tulleystown, Pennsylvania. The soils did not require treatment prior to disposal. Soils were excavated to a depth of 2 feet below the ground surface. Verification samples were analyzed to confirm that no remaining surface soils exceeded the clean-up goal. A clean-up goal for lead of ~~1000~~ 500 mg/kg was established to verify the completeness of the removal action. ~~This value was selected to meet the state's direct contact value for non-residential land use regarding lead. None of the verification samples contained lead at levels greater than this goal~~. The verification sample results are included in the analytical database for Site 8 surface soils as part of this report (Appendix I). Section 4.4.2 provides more detailed information regarding the removal action at the site, including the location of the soils removed and the results of the verification sampling.

1.4 SUMMARY OF PREVIOUS INVESTIGATIONS AT SITE 8

During 1981, JRB personnel noted an apparent drum storage area adjacent to the bermed fire training area (JRB, 1981). Materials reportedly kept within this drum storage area were lubricants, waste oils, and transformer coolant oils. In the past, residents along the unnamed tributary north of the site complained about a white, foamy material floating on the stream surface after fire-fighting training exercises were held.

In July 1982, a monitoring well was installed adjacent to Site 8 (JRB Associates, 1983). The well has been sampled several times, with minimal impacts noted. In 1983, a surface water sample adjacent to Site 8 was analyzed; this sample did not detect any priority pollutant list (PPL) contaminants.

In 1988, base personnel reported that the soil berms and associated residues, soils from several eroded areas near the berms, and trapped liquids within the berms had been analyzed before being removed from the runway extension (QC, 1988). These materials were reportedly deposited in areas downhill from the site along all three sides of the runway extension (SMC Martin, 1991). The extent of the berm soils and residues that were spread adjacent to the site was not confirmed. The area surrounding the site was regraded after the removal.

During an October 1988 site visit (SMC Martin, 1989), a white, foamy material was observed to be floating in puddles of water that had collected on the runway extension. This material was suspected to be aqueous film-forming foam (AFFF), a common substance used during fire-fighting training exercises. Several empty drums, a stripped automobile, and a scrapped aircraft frame were present on a portion of the runway extension. These types of items were reportedly used during exercises. No drum storage area was observed during the October 1988 site visit, as was the case in 1981.

An EM conductivity survey and soil gas survey were performed at Site 8 during Phase I RI work. The EM survey consisted of six profile lines running parallel to the runway and two profiles running perpendicular to the runway. Thirty-five soil gas readings were taken around the edges of the Site 8 runway. Based on the locations of the pits from the aerial photos, the soil gas survey may not have extended to the southern (upgradient/upslope) edge of Site 8.

During the Phase I RI, surficial contamination in the form of soil staining was found at this site immediately west of the runway extension, the V-shaped berm, and adjacent to the former location of the mock-up plane used for fire-fighting training exercises (SMC Martin, 1991). During subsequent RIs, several empty drums and at least one small, storage tank were observed along the eastern side of the runway. However, no visibly stained soils were observed.

Surficial and subsurface soil samples were obtained from three locations at Site 8 during the Phase II RI. Two locations were near the runway to correspond to areas of high soil gas readings found during Phase I. The remaining location was chosen to determine background soil levels. No borings were extended through the runway to sample soils beneath the fire-fighting training area.

Both surface water and sediment samples were collected from the stream downgradient of Site 8 during Phase I and Phase II. A biological characterization of the area north of Site 8 (as well as Area C) was also performed as part of Phase I.

Site visits conducted between 1991 and 1998 revealed the presence of construction materials (e.g., lumber, concrete vaults, and piping) on the surface of the runway extension. Soils excavated along the route of the OU-3 groundwater conveyance piping were piled north of the runway extension in 1996, where they still remain. At the present time, no structures or other significant debris are present near the site. The runway extension asphalt surface contains cracks and holes but is relatively intact. Several of the holes appear to be associated with the removal of structure S1. Some debris has collected in these cracks and holes, but it is not known if the debris contains potentially hazardous waste residues.

Several groundwater investigations have been conducted in and around Area C since the early 1980s. In January 1994, the Navy began focused RI activities for groundwater contamination associated with Area C. Groundwater data suggest that releases from Site 8 may not be the source of PCE in groundwater in this area (HNUS, 1994b and 1994c).

The Phase III RI work for Site 8 begin in January 1995 and was completed in March 1999. The scope of this work is further discussed in Section 2.2.

1.5 CURRENT STATUS

As part of the DOD realignment of NAWC Warminster, the FLRA has been charged with developing the property and bringing new opportunities for employment at the base. The redevelopment plan for the base calls for an office/business park campus in the vicinity of Site 8 (Ernst and Young, 1998; FLRA, 1999). Surrounding residential land use for Ivyland Borough is planned west of Site 8, and other adjacent property is targeted for open-space recreational land use on the part of Warminster Township.

The FLRA has submitted an economic development conveyance (EDC) application for base property east and west of Jacksonville Road. The FLRA and the Navy will soon negotiate the sale and transfer of this property, including the Site 8 area.

1.6 REPORT ORGANIZATION

This report presents the results and recommendations related to the following field activities performed at Site 8:

- Electromagnetic surveys
- Soil gas surveys
- Test pit excavations
- Surface water and sediment sampling and analysis
- Surface soil sampling and analysis
- Subsurface soil sampling and analysis

- Wetlands assessment
- Surveying
- Performance of response actions

Section 1.0 discusses the purpose, scope, and objectives of the report and provides a brief background summary for Site 8. Section 2.0 details the field activities and other tasks performed (with an emphasis on Phase III RI work) and describes the objectives and methods of each investigative task conducted at the site. Section 3.0 presents the physical characteristics of the site based on existing literature, previous investigations, and recently developed information.

Section 4.0 describes the nature and extent of contamination discovered at Site 8 during field investigation tasks. Section 5.0 summarizes the routes of migration and persistence of contaminants found at the site. These two factors are used to determine the possibility of contamination reaching areas of public or environmental concern. Section 6.0 presents the potential risks posed by the site to human health and the environment given the limiting factors of contaminant fate and transport.

Several appendices have been enclosed as part of the RI report; these present specific results of the field investigations (e.g., analytical data) and other reference information.

2.0 SITE 8 REMEDIAL INVESTIGATIONS

2.1 INTRODUCTION

This section summarizes the nature of RI work performed at Site 8. Specific findings regarding the physical characteristics of the site and the nature and extent of contamination are presented in Sections 3.0 and 4.0.

RI work addressing soils, surface water, and sediment in the vicinity of Site 8 has been conducted in phases, as discussed in Section 1.4. The Phase I RI (SMC Martin, 1991) included limited soil gas and geophysical surveys, as well as surface water and sediment sample analysis. The Phase II RI (HNUS, 1992) was limited to sampling of soils, surface water, and sediment from several locations near Site 8. Based on the findings of the Aerial Photographic Site Analysis Report (EPIC, 1994), a more comprehensive Phase III RI was performed beginning in 1995.

The Phase III RI work plan to study NAWC Warminster was submitted as a final document on January 16, 1995 (HNUS, 1995a). The work plan incorporated comments received from Restoration Advisory Board (RAB) members. The plan described RI activities that were to be implemented to help characterize the potential sources of contamination within Areas A, B, and C, including Site 8.

Phase III RI field activities focused on characterizing surface soils, subsurface soils, buried materials, surface waters, and sediments potentially impacted by suspected sources at Site 8. The results from the Phase III RI for Site 8 were reported in a draft Phase III RI report, which was issued in November 1996 (Brown & Root Environmental, 1996a).

Following the review of the draft Phase III RI report, the Navy conducted several supplemental soil investigations at Site 8 to address remaining concerns regarding the nature and extent of contamination related to the site. The supplemental field work was performed between July 1998 and March 1999.

Based on the RI work, a removal action was performed at Site 8 in February 1999. The results of post-removal soil sampling, which characterize the Site 8 soils present at this time, are included in the analytical database for Site 8 surface soils.

This section primarily discusses the field investigation procedures that were performed at Site 8 during the Phase III RI. Field work activities conducted as part of the Phase I RI (SMC Martin, 1991) and as part of the Phase II RI (HNUS, 1992) are discussed in the Phase I and II RI reports and are not presented in this section. However, the collective results of all RI work at Site 8 are summarized in Section 4.0. Table 2-1 summarizes the RI field work and supporting activities performed at Site 8 during all three RI phases.

2.2 GENERAL FIELD INVESTIGATION PROCEDURES

The Phase III RI field work at Site 8 was performed between January 1995 and March 1999. Tasks included

- Soil gas surveys
- Soil borings
- Test pit excavations
- Surface water and sediment sampling and analysis
- Surface and subsurface soil sampling and analysis
- Wetlands assessment
- Surveying

2.2.1 Scope of Work

The Phase III RI work for Site 8 focused on characterizing the potential sources of contamination, particularly with regard to soils and wastes. In addition, a surface water and sediment sampling program was conducted to evaluate the impacts of Site 8 on the nearby stream.

The primary tools of investigation included a soil gas survey, test pits and soil borings (with subsurface soil/wastes sampling), and surface soil/waste sampling. These methods were applied, as appropriate, in an integrated manner to characterize the potential source areas of contamination targeted for investigation.

A soil gas survey was employed in areas of suspected disposal of wastes containing volatile organics. One objective of the soil gas survey was to identify potential sources of the chlorinated VOCs detected in local groundwater. The locations of the soil gas survey took into consideration identified potential sources from aerial photos, the Phase I RI geophysical survey, past investigation data, field observations, and historic information regarding the locations of subsurface disposal sites.

TABLE 2-1
SUMMARY OF RI FIELD WORK AND OTHER ACTIVITIES AT SITE 8
NAWC WARMINSTER, PENNSYLVANIA

TASK	PHASE I RI	PHASE II RI	PHASE III RI	COMMENTS
Electromagnetic (EM) Survey	X			
Soil Gas Survey	X		X	
Surface Soil Sampling and Analysis		X	X	
Subsurface Soil Sampling and Analysis using Soil Borings		X	X	
Subsurface Soil Sampling and Analysis using Test Pits			X	
Confirmation Soil Borings and Test Pit Excavations	X			
Surface Water and Sediment Sampling and Analysis	X	X	X	
Horizontal Survey		X	X	
Biological Characterization	X			
Wetlands Assessment			X	
Aerial Photograph Interpretation			X	
Verification Sampling and Analysis			X	Post-Removal

Test pits and/or test borings were used to characterize actual subsurface conditions in potential subsurface disposal sites. The decision regarding which of these investigative methods was proposed was based on expected site characteristics and cultural features. The locations of the test pits/borings were selected based on the results of the Phase III RI soil gas and Phase I RI geophysical surveys, as well as on aerial photo records, field observations, and previous field work findings. Subsurface soil/waste samples were obtained from the test pits/borings to characterize the materials encountered.

Surface soil/waste sampling was conducted in areas where surface disposal of wastes was a potential concern. In areas of obvious waste disposal on the ground surface (i.e., waste piles or stained soils), the samples were taken directly from the affected materials. In areas of suspected surface disposal where no visible sign of wastes was evident, samples were obtained at various points within the suspected area of disposal. In addition, a basewide background surface soil sampling program was performed to provide a background database with which to compare potentially impacted soil results.

In addition, several supplemental investigations were conducted after the draft Phase III RI report was submitted in order to further characterize the surface and subsurface soil contamination at Site 8:

- On July 20, 1998, four surface soil samples were collected on the western edge of the existing runway and three surface soil samples (including one duplicate) were collected from the drainage area and ditch northwest of the runway. The samples from along the runway were analyzed for lead and arsenic only; the drainage ditch samples were analyzed for Target Analyte List (TAL) metals.

- On September 29, 1998, five surface soil samples and one subsurface sample were collected on the western side of the existing runway. These samples were analyzed for lead only.

- On February 15, 1999, 17 verification samples (including one duplicate) were collected along the western side of the existing runway following a soil removal action. These samples were analyzed for lead and arsenic.

- On March 9, 1999, nine surface soil samples (including one duplicate) and four subsurface samples were collected from the eastern side of the existing runway. Four of the surface samples (including the one duplicate) were collected near the location of a previously collected sample that had shown the presence of dioxin. These samples were analyzed for dioxin only. The remaining surface and the subsurface samples were analyzed for arsenic, lead, vanadium, and PAHs.

Sampling plans were prepared for each of the supplemental investigations. Following each of these investigations, separate letters were submitted summarizing the significant findings.

The methodologies for the Phase III RI field work are explained in the remainder of this section.

2.2.2 Soil Gas Survey

The soil gas survey objective was to measure the concentrations of VOCs in soil gas around suspected source locations. Elevated VOC levels in soil gas could indicate soil and/or groundwater contaminated with VOCs. Information obtained from the soil gas survey was combined with data from the Phase I RI EM survey to better locate subsurface soil borings and test pits.

Soil gas survey lines were laid out along the edges of the runway extension within Site 8 and generally matched the profile lines used during the EM survey. Figure 2-1 shows the soil gas survey area. The Phase I EM survey results, the EPIC aerial photograph analysis, and the findings from previous investigations (e.g., Phase I RI, Phase II RI) were used to focus the soil gas survey on the most likely suspected source locations. The soil gas survey line spacing was 50 feet. The samples were analyzed for both halogenated and aromatic volatile organic contamination.

Soil gas sampling was performed using the hollow probe method. The probe and probe tip were driven into the ground to a specified depth using an electric hammer drill (Bosch hammer) or a power auger. The sampling depths ranged between 3 and 5 feet. After reaching the target sampling depth, the hollow probe was lifted to retract the probe adapter and expose the lowest 2 to 4 inches of soil at the bottom of the hole. Polyethylene (PE) tubing with a threaded endpiece was tightened to the expendable point adapter at the bottom and connected at the surface to silicon tubing attached to a peristaltic pump. The peristaltic pump was used to purge the assembly before sampling and to extract air from the interstitial soil pore space. At some locations, at least two soil gas samples were extracted and analyzed. A Tedlar bag was connected to the sampling pump, filled with soil vapor, and sealed until analysis. The hollow probe and adapter assembly were removed and decontaminated between samples following standard protocol. A fresh length of PE tubing was used for each hole.

Soil gas analysis was performed in the on-base field trailer using a Hewlett Packard gas chromatograph (GC) equipped with a 30-meter, 0.25 mm inner-diameter (ID). capillary column that was coupled to a photoionization detector (PID) in-series with an electron capture detector (ECD). The GC was optimized for rapid (less than 7.5 minutes per run) analysis for acetone, 2-butanone, benzene, toluene, ethylbenzene, total xylenes, styrene, PCE, TCE, 1,1,1-trichloroethane, carbon tetrachloride, chloroform, 1,1-dichloroethene, 1,2-dichloroethene, 1,2-dichloroethane, and 1,1-dichloroethane.

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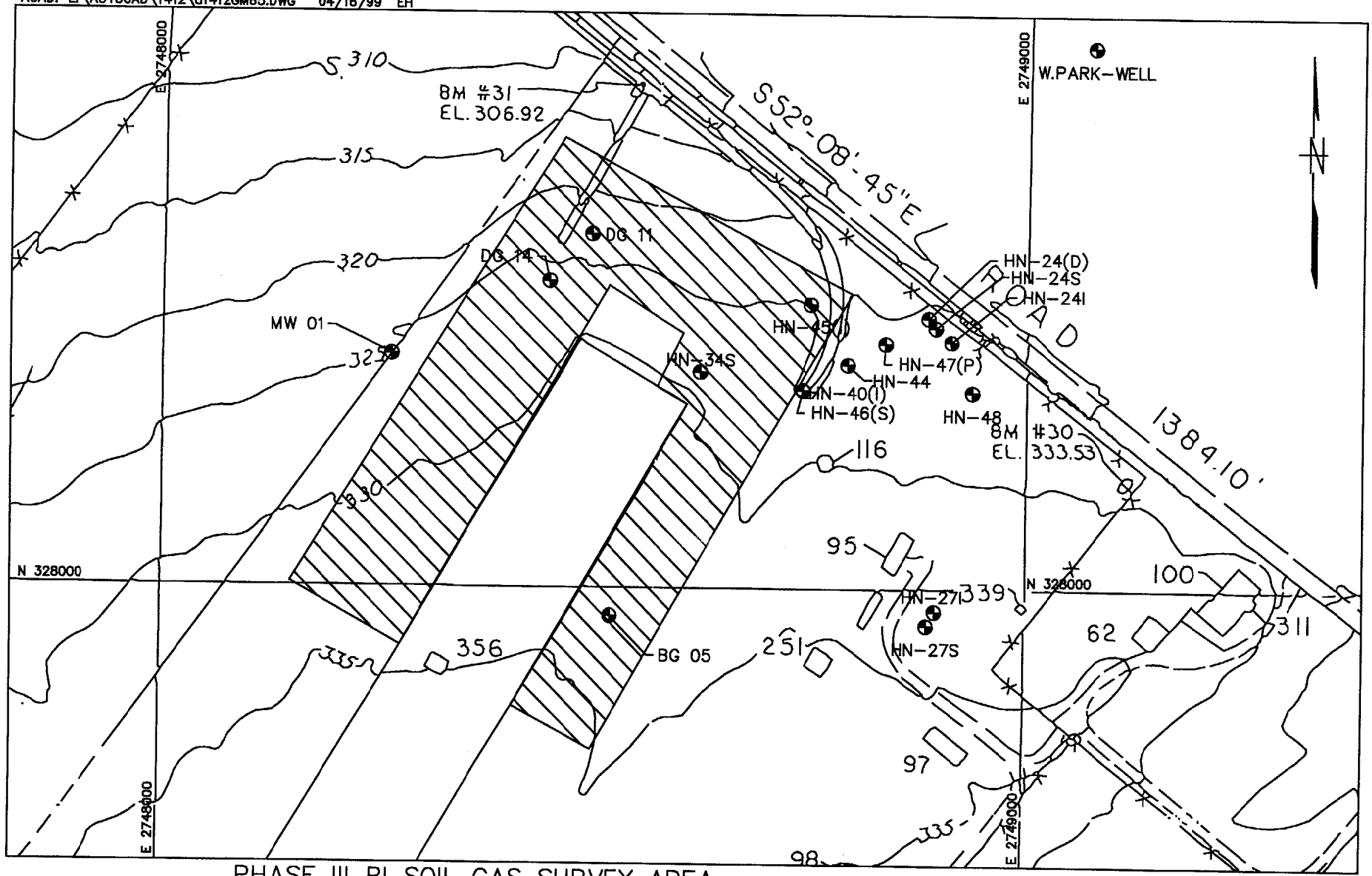

PHASE III RI SOIL GAS SURVEY AREA

SITE 8

FORMER NAWC WARMINSTER, PA

0 160 320

SCALE IN FEET

FIGURE 2-1

Tetra Tech NUS, Inc.

Calibration standards were diluted from certified methanolic standards into water using 40 ml VOC vials, leaving a 10 ml headspace. 400 µl vapor aliquots were injected after standards were heated to 70°C for 5 minutes and shaken for 30 seconds. An initial 3-point calibration was performed and the practical quantitation limit (PQL) for each compound was established as one-half of the lowest concentration standard. The method achieved PQLs in the range of 0.03 to 0.3 ug/l for trichlorinated and tetrachlorinated compounds, followed by PQLs between 2 and 6 ug/l for compounds with carbon double bonds or aromatic rings, and PQLs between 15 and 50 ug/l for dichlorinated alkanes, acetone, and 2-butanone.

A continuing calibration standard was analyzed at the beginning of each day and repeated after every 15 injections. Subsequent continuing calibrations were assessed to verify stable system response; if response decreased by -60 percent or increased by +100 percent for more than one compound, then new calibration factors were required for all compounds. In the event of calibration error caused by systematic problems (e.g., syringe or detector malfunction), corrective action was taken and followed by a new standard injection and calibration factor update.

Analytical quality control procedures were followed for field blanks, field duplicates, syringe blanks, holding times, and decontamination. Duplicate samples and Tedlar bag blanks were collected at a frequency of one per 20 soil vapor samples. Syringe blanks were run for every 20 injections and after highly contaminated samples. High-level samples were followed by syringe cleaning and bake-out. Tedlar bags were flushed with three volumes of air between each use and were discarded if leaks were found. Syringe performance (plunger resistance, methanol dispensing, and injection spike size) was monitored to ensure the absence of leaks or blockage.

Syringes were repaired/replaced at the first symptom of malfunction. Analyses were required to be performed within 8 hours of sample collection.

Results were reported in units of aqueous ug/l, equivalent to the corresponding calibrated headspace concentration. For compounds quantifiable on both detectors, the detector having lower detection limits was consistently reported except when sample levels were above the linear range. A screening-level data validation was performed via electronic linking of sample and associated blank data files, after which results were incorporated into a database.

The Site 8 soil gas survey results (including analytical data) were evaluated and plotted on color contour maps. The data were color contoured such that shades of orange, red, and purple represent high soil vapor data values. Shades of blue were used to represent background conditions as based upon this data set. Site surface features and suspected disposal location boundaries were used to make final

interpretations regarding possible soil gas anomalies. An interpretation of the soil gas survey results is provided in Section 4.3 of this report.

A summary of the Site 8 Phase III soil gas sample analyses is included in Appendix B.

2.2.3 Soil Borings

Soil borings were drilled and sampled to gather data about the extent, nature, and depth of contamination. The locations of the borings were determined after data gathered during the soil gas survey were reviewed. Most borings were completed by using a drilling rig with cleaned, decontaminated, hollow-stem augers. The cuttings were inspected for any waste material or VOCs as the auger brought them to the surface. Each boring was drilled until a significant amount of waste was encountered or to about 10 feet below ground surface, unless bedrock or some other impenetrable surface was encountered above 10 feet. The actual depth of each boring was specific to the suspected source being investigated. Upon completion, all boreholes were backfilled with the cuttings.

A PID was primarily utilized at each boring to detect any VOCs that may have been present. The PID has a detection limit of approximately 1 ppm. A majority of the soil borings were sampled continuously using a split-spoon sampler from the ground surface to the top of bedrock. Samples selected for laboratory analysis were based on elevated PID readings, evidence of wastes or buried materials (e.g., odors or staining), and other observations suggesting potential contamination if they were recorded. If no evidence of contamination was found, samples from just above the weathered bedrock interface were selected for analysis. Samples were analyzed for various analytes in accordance with the Phase III RI work plan and any addenda to the work plan.

Each boring was logged by a geologist. Information recorded by the geologist included lithology, waste materials encountered, PID concentrations, the depth at which waste was found, and any other pertinent observations. This information was recorded on logs presented in Appendix D. Each boring location was determined in relation to a fixed point so that the exact location of the boring could be determined in the future should the need arise. The locations of all soil boring samples are displayed in Figure 2-4.

All field data were peer reviewed and checked for accuracy upon the completion of the boring survey.

2.2.4 Test Pit Excavations

Two test pits were excavated at Site 8 during Phase III (Figure 2-4). The objectives of the test pits were to visually identify the extent and nature of waste material thought to be present in this area and to obtain

soil/waste samples for chemical analysis. The test pit locations were selected after the Phase III soil gas survey and Phase I geophysical survey results were reviewed.

The test pits were completed by the use of a backhoe to dig a trench approximately 5 feet wide. The lengths of the pits were about 20 feet. The target depth of each pit was approximately 8 feet or until bedrock or groundwater was encountered or to the maximum of depth of wastes or fill material encountered.

A PID was utilized at each test pit to detect any VOCs that may have been present. Each test pit was logged by a geologist. Information recorded by the geologist included lithology, waste encountered, volatile organic concentrations, the depth at which waste was found, and any other pertinent observations. Copies of test pit logs have been included in Appendix C.

Upon completion, each test pit was backfilled with the excavated soil. The location of each test pit was confirmed in relation to a fixed point so that the location of the test pit could be determined exactly in the future should the need arise.

2.2.5 Surface Water/Sediment Sampling and Analysis

Surface water and sediment samples downstream from Site 8 were collected during all three RI phases. The purpose of this sampling program was to determine if surface water bodies adjacent to the base were impacted by Area C and Site 8. Sampling occurred within the unnamed tributary of Little Neshaminy Creek downgradient of Site 8 and at the stormwater outfall at the base perimeter that discharges to this stream. Sample locations are shown in Figure 2-2. Hydrologic characteristics for Area C are presented in Section 3.2.

During Phase I, only one surface water sample (C10) was collected because the stream was dry. Two sediment samples (C10 and C11) were obtained from the stream north of Area C and downstream of Site 8. These samples were analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) metals. The surface water sample analyzed for metals was not filtered.

During Phase II, two surface water and two sediment samples (C12 and C13) were collected. Sample locations generally corresponded to Phase I locations. These samples were tested for TCL organics, TAL inorganics, and cyanide. The surface water samples were analyzed for both filtered and unfiltered metals.

During Phase III, one surface water sample (C8) and two sediment samples (C6 and C8) were taken. Sediment sample C6 was collected from the outfall just north of Kirk Road, which is northwest of Site 8.

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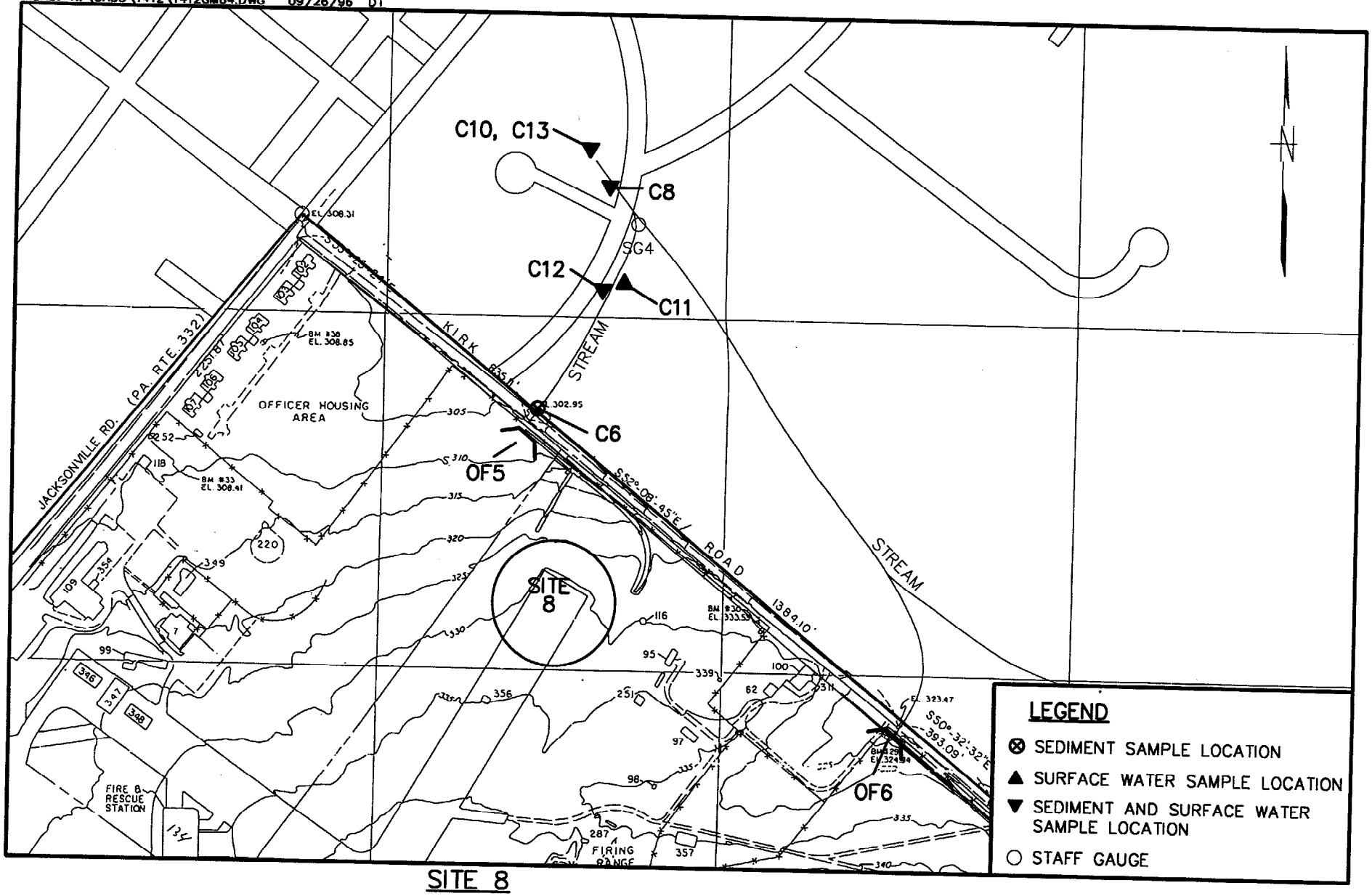


SITE 8

SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

FORMER NAWC WARMINSTER

0 400 800

SCALE IN FEET

FIGURE 2-2

Tetra Tech NUS, Inc.

The samples were analyzed for TCL organics, TAL inorganics, and cyanide. The surface water sample was analyzed for both filtered and unfiltered metals.

Surface water and sediment analytical results are discussed in Sections 4.6 and 4.7, respectively.

Surface water samples were collected by directly filling a sample bottle. All surface water samples were transferred with a minimum amount of agitation into sample bottles specially prepared by the laboratory. Vials for volatile organic analyses were kept free of any air bubbles. Volatile organic vials were filled before the remaining water sample bottles. Each sample was screened with a PID. Field measurements of temperature, pH, and specific conductivity were obtained for all surface water samples.

After a surface water sample was collected, the associated sediment sample was obtained slightly upstream of the surface water sampling point. The sediment was collected using a stainless-steel shovel or trowel. The volatile organic vial was filled first, leaving as little air space as possible. The remaining sediment sample bottles were then filled. Downstream samples were collected first, and samples from locations farthest upstream were collected last.

The surface water and sediment samples were preserved in coolers containing ice, following sampling. Sample logsheets including sample identification, date and time of collection, field measurements, analysis parameters, and other pertinent information were completed for each sample.

2.2.6 Surface Soil Sampling and Analysis

Surface soil sampling was performed at Site 8 during Phase II and Phase III. The surface soil sample locations are shown in Figure 2-3.

During Phase II, surficial soil samples were obtained from two locations near the western side of the runway (samples SS-08-17 and SS-08-18). These sample locations were chosen to correspond to an area of high soil gas readings found during Phase I.

During Phase III, 11 additional surface soil samples (including one duplicate) were taken along the western edge of the existing runway (samples SS-08-01 through SS-08-06 and SS-08-12 through SS-08-16), three samples were taken along the northern edge (samples SS-08-07 through SS-08-09), and one sample (and duplicate) was collected along the eastern edge (sample SS-08-10/11). The intent of collecting these samples was to determine whether any releases of hazardous substances had occurred on any side of the Site 8 runway extension, including the portion of Site 8 near structure S1. Several samples (e.g., SS-08-0.5 through SS-08-09) were collected at locations where the former berm soils may have been placed.

Most surface soil samples at Site 8 were analyzed for TAL metals. Samples were also analyzed for TCL volatile and semivolatile organics, pesticides/PCBs, and dioxins/furans, as needed.

Based on the analytical results of the above surface soil samples, further investigation of Site 8 surface soils was conducted. On July 20, 1998, four surface soil samples (SS-08-19 through SS-08-22) were collected on the western edge of the existing runway and three surface soil samples (SS-08-28/29 and SS-08-30) were collected from the drainage area and ditch northwest of the runway. The purpose of these samples was to delineate the extent of an area of elevated lead and arsenic concentrations at the western edge of the runway and to determine if surface water runoff had carried contaminated soil to the nearby drainage ditch. The samples from along the runway were analyzed for lead and arsenic only; the drainage ditch samples were analyzed for TAL metals.

On September 29, 1998, five surface soil samples (samples SS-08-23 through SS-08-27) were collected on the western side of the existing runway. These samples were analyzed for lead only. The purpose of these samples was to further characterize the extent of lead contamination in this area.

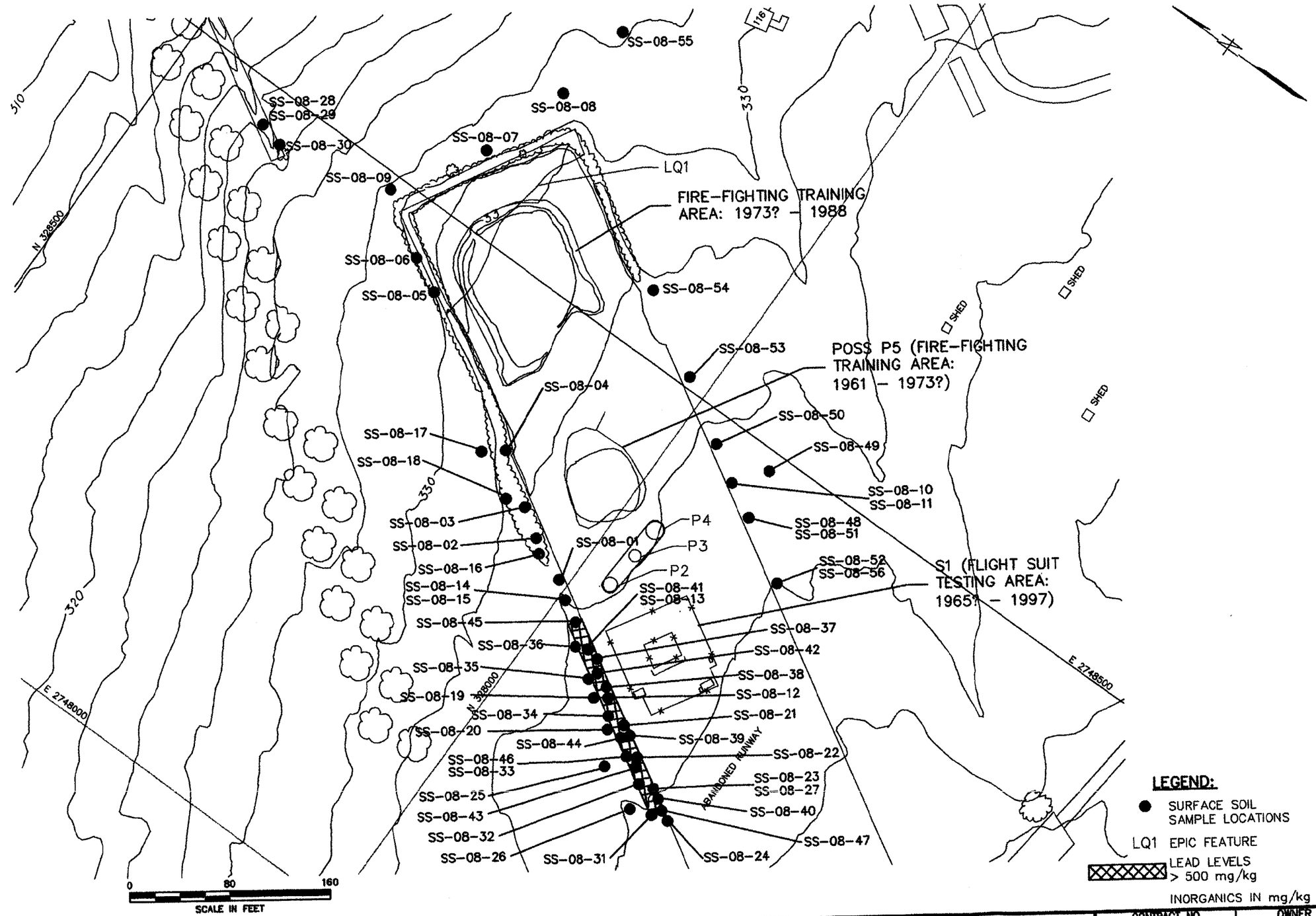
On February 15, 1999, 17 verification samples (samples SS-08-31 through SS-08-47) were collected along the western side of the existing runway following a soil removal action. These samples were analyzed for lead and arsenic.

On March 9, 1999, nine surface soil samples (samples SS-08-48 through SS-08-56) were collected from the eastern side of the existing runway. Four of the surface samples (including the one duplicate) were collected near the location of a previously collected sample (SS-08-10/11) that had a detection of dioxin. These samples were analyzed for dioxin. The remaining samples were analyzed for arsenic, lead, vanadium, and PAHs.

Surface soil samples were taken from the uppermost soil horizon encountered after the overlying grass or sod layer was removed at each location with a shovel. Based on RI field notes, none of the Site 8 surface soil samples exhibited signs of potential contamination, including odors, stains, or elevated field instrument readings. The range in depth of these samples was between 6 and 30 inches. All soil samples were placed directly into sample containers supplied by the laboratory using a stainless-steel sample trowel.

2.2.7 Subsurface Soil Sampling

Subsurface soil sampling was performed at Site 8 during Phase II and Phase III. Figure 2-4 shows the subsurface soil sample locations. The primary objective of this sampling was to assess whether the site might be the source of potential groundwater contamination related to VOCs.



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CHECKED BY N. TEAMERSON
COST/SCHED.-AREA
SCALE 1" = 80'

TETRA TECH NUS, INC

SURFACE SOIL
SAMPLE LOCATION MAP
SITE 8
FORMER NAWC, WARMINSTER, PA

2-12

CONTRACT NO. N63472-90-D-1298
OWNER NO. 1412
APPROVED BY N. TEAMERSON DATE
APPROVED BY DATE
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REV. 1

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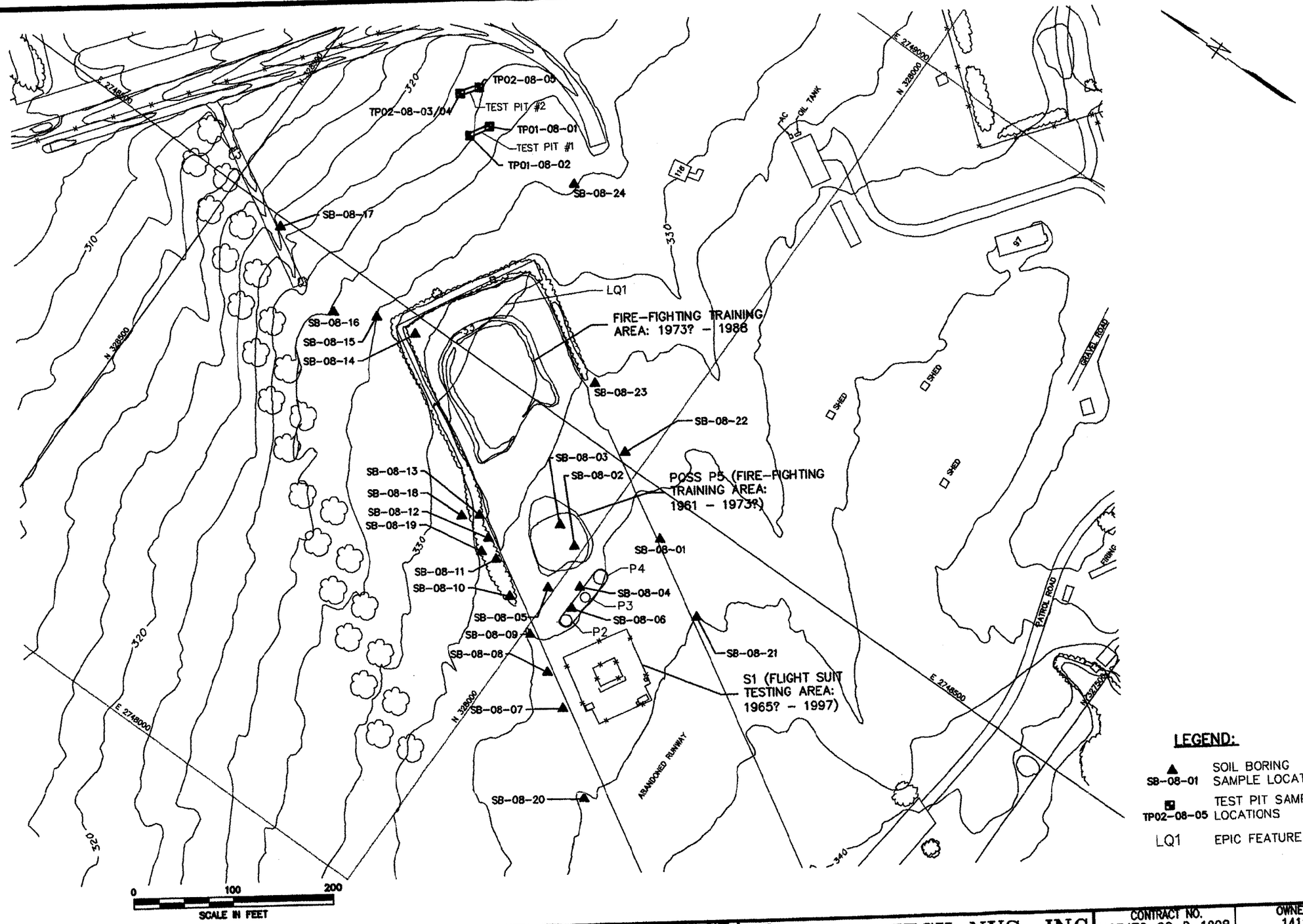

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COST/SCHED.-AREA
SCALE 1" = 100'

TETRA TECH NUS, INC.

TESTPIT AND SOIL BORING SAMPLE LOCATION MAP
SITE 8
FORMER NAWC, WARMINSTER, PA

2-14

CONTRACT NO. N63472-90-D-1298
OWNER NO. 1412
APPROVED BY N. TEAMERSON
DATE
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REV. 1

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During Phase II, two subsurface soil samples (SB-08-18 and SB-08-19) were obtained from two locations near the western side of the runway. These samples were chosen to correspond to an area of high soil gas readings found during Phase I and were analyzed for full-scan TCL/TAL parameters.

During Phase III, seven subsurface soil samples (SB-08-07 through SB-08-13) were taken along the western edge of the Site 8 runway, four samples (SB-08-14 through SB-08-17) were collected along the northern edge, one sample (SB-08-01) was collected along the eastern edge, and five samples (SB-08-02 through SB-08-06) were collected beneath the existing runway. All of these samples were analyzed for TCL semivolatile organics and TAL metals, and some samples were also tested for TCL volatile organics, pesticides, PCBs, and dioxin/furans. These samples were collected to further investigate soil gas anomalies, EPIC features, and the nature and extent of subsurface soil contamination. Several soil boring samples were collected at locations where the former berm soils may have been placed, including samples SB-08-15, SB-08-16, and SB-08-23. The range in depth of the subsurface soil samples was between 6 and 9 feet below the ground surface, except for samples SB-08-21 through SB-08-24, where the range was between 3.0 and 3.5 feet.

In addition, two test pits were excavated north of the Site 8 runway. Four subsurface samples (TP01-08-01, TP01-08-02, TP02-08-03/04, and TP02-08-05) were collected from these test pits. All test pit samples were analyzed for TAL metals and TCL volatile organics.

Several subsurface soil samples were also collected during the supplemental investigations at Site 8. On September 29, 1998, one subsurface soil sample (SB-08-20) was collected from along the western side of the existing runway and analyzed for lead. The purpose of this sample was to determine if the lead contamination that had been observed in the surface soils in this area extended to the subsurface soils.

On March 9, 1999, four subsurface soil samples (SB-08-21 through SB-08-24) were collected from the eastern side of the runway and analyzed for arsenic, lead, vanadium, and PAHs.

Most subsurface soil samples were obtained using hollow-stem augers and split-spoon samplers. The samples were collected from the split-spoon barrels using stainless-steel sample trowels and were placed into sample containers supplied by the laboratory. Some of the subsurface soil samples were collected using a hand auger. The physical characteristics of the soils were described and recorded based on visual observation and were screened for VOCs using PID/FID equipment. None of the Site 8 subsurface soil borings or samples showed evidence of potential contamination (e.g., odors, stains, discolorations, or elevated field instrument readings). Boring logs are included in Appendix D of this report.

All soil samples were preserved in coolers containing ice following sampling. Sample logsheets including sample identification, date and time of collection, analysis parameters, and other pertinent information were completed for each sample.

2.2.8 Background Sampling

2.2.8.1 Background Soil Sampling

Background surface soil samples were collected during Phase III. A total of 10 surface soil samples were obtained from both ends of the main runway at the base. The background sample locations are shown in Figure 2-5. These samples were analyzed for TCL pesticides, PCBs, and TAL metals. Samples were not tested for TCL volatile organics or semivolatile organics because these substances were not considered to be naturally occurring or used for pest control/lawn maintenance purposes.

As part of this report, analytical results have also been included for the eight background subsurface soil samples that were taken during the Area B hydrogeologic investigation (HNUS, 1995b). These samples were collected from the soil/bedrock interface during the drilling of monitoring wells in this area. Only those subsurface soil samples from background monitoring well locations or from locations clearly outside suspected source boundaries within Area B were included in the analytical database for background soils. At most locations, hollow-stem augers fitted with a center plug were advanced to near the soil/bedrock interface (as determined during the installation of well casings). The plug was withdrawn, and the samples were obtained with a standard 2-inch by 24-inch, stainless-steel, split-spoon sampler. One sample was obtained with a hand auger. All samples were tested for TCL volatile organics and TAL metals. Samples were collected at depths ranging from 2.5 to 9 feet.

Analytical results were also incorporated for the background soil samples collected during the Site 4 (EE/CA) field investigation (HNUS, 1995d) and the Site 6 removal action investigation (B&R Environmental, 1996b).

Background soil samples obtained during the Phase II RI (HNUS, 1992) and the associated results have also been included in the analytical database for background soil concentrations.

The analytical results of the RI background soil samples are shown in Table 2-2. The results from all background surface and subsurface soil samples were combined into one data set for data evaluation purposes and to compare background soil levels to site-related soil concentrations.

TABLE 2-2
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN BACKGROUND SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data					
Substance	Freq. of Detection	Range of Positive Detection Min.		Range of Positive Detection Max.		Sampling Round and Location of Maximum	Exposure Point Concentration
Aluminum	29/29	4780	-	18100		BG-12	15100
Antimony	1/21	13.6 J				BG-16	4.45
Arsenic	25/29	0.28	-	12.1	J	BG-11	11.6
Barium	25/27	34.1	-	225		BG-28	75.7
Beryllium	25/29	0.31	-	1.7	K	BG-23-D	0.878
Calcium	23/27	240	-	1910		BG-24	813
Chromium	29/29	7.9 J	-	35.3	JK	BG-12	21.6
Cobalt	25/28	1.6	-	22.1		BG-23-D	10.5
Copper	27/29	3.6 K	-	30.6		BG-29	14
Iron	29/29	6980	-	410500		BG-30	34800
Lead	29/29	1.6 J	-	96.5	J	BG-13	16.3
Magnesium	25/29	518	-	4960		BG-24	2260
Manganese	29/29	30.9	-	2010		BG-28	601
Mercury	1/27	0.37				BG-23	0.0483
Nickel	18/25	4.1 J	-	21.7	J	BG-23-D	11.7
Potassium	25/27	89.1	-	3050		BG-24	1060
Sodium	4/18	55.2	-	86.7		BG-25	86.7
Thallium	3/29	0.37	-	0.42		BG-23-D	0.42
Vanadium	29/29	15.4	-	45		BG-12	32.1
Zinc	25/27	9	-	60		BG-13	32.9
4,4'-DDD	1/20	16 JP				BG-12	3.05
4,4'-DDE	1/20	820				BG-12	17.4
4,4'-DDT	1/20	1440 JP				BG-12	25
Aroclor-1254	1/20	51				BG-13	43
1,4-Dichlorobenzene	1/11	43				BG-11	43
Benzo(b)fluoranthene	1/11	58 J				BG-13	58
Benzo(k)fluoranthene	1/11	46 J				BG-13	46
Bis(2-ethylhexyl)phthalate	1/11	50 J				BG-16	50
Chrysene	1/11	51 J				BG-13	51
Fluoranthene	1/11	92 J				BG-13	92
Phenanthrene	1/11	51 J				BG-13	51
Pyrene	1/11	100 J				BG-13	100
Acetone	4/18	8	-	12	J	BG-24	12
Chloromethane	2/19	3 J				BG-26	3
Toluene	3/19	2 J				BG-17	2

Notes

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separ
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.

2.2.8.2 Background Stream Sampling

For Site 8, surface water and sediment samples were collected in off-base locations (north of Area C) that were considered unaffected by past site-related activities. These locations were used as the background sample set for Site 8 surface water and sediment data sets.

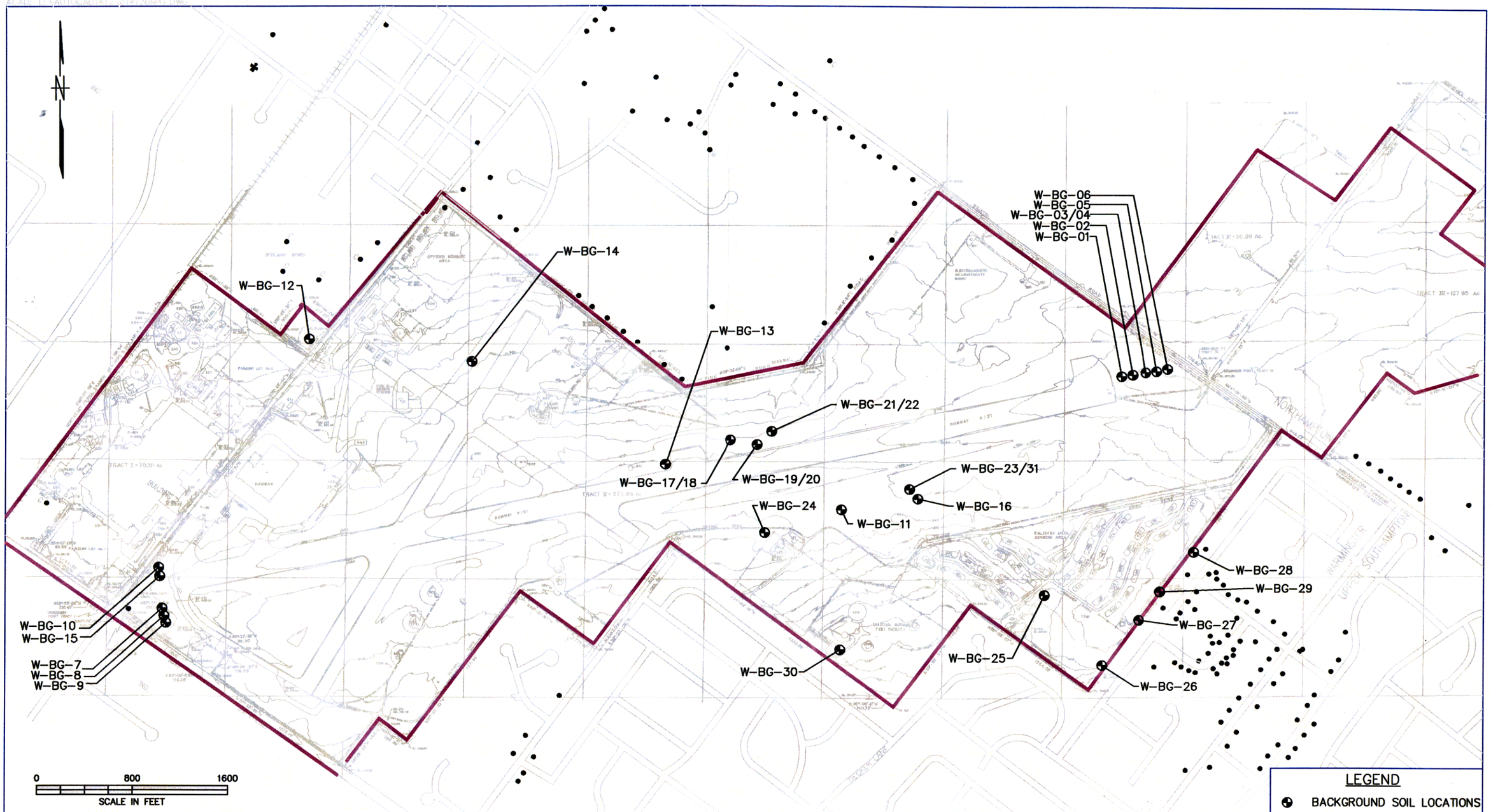
The background stream sample locations included C8, C10, and C13. These were collected farther downstream from Site 8 along a tributary of Little Neshaminy Creek. The three samples were in the same watershed as Site 8 and Area C. Also, these samples were taken in a relatively non-urban setting around Area C and were considered to be more representative of undisturbed surface water and sediment conditions. All other stream samples near Site 8 were considered to be potentially impacted by the site. No "true" upstream samples could be collected for Site 8.

The background occurrence and distribution tables for surface water are shown in Table 2-3 (total inorganics) and Table 2-4 (dissolved inorganics). No organic contaminants were detected in background surface water for Site 8. Similar tables for sediment are displayed in Table 2-5 (inorganics) and Table 2-6 (organics).

2.2.9 Wetlands Assessment

To supplement the Phase III RI, a wetlands assessment was performed in June 1994 to provide a qualitative appraisal of the plants and animals that could potentially be harmed by the inadvertent release of hazardous substances attributable to NAWC Warminster. As part of this assessment, the approximate wetland boundaries along the unnamed tributary of Little Neshaminy Creek downgradient from Site 8 were identified on United States Geologic Survey (USGS) maps. Plants and animals associated with these wetlands were identified and used to characterize the wetlands according to procedures found in the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, 1979). Wetlands were identified using the routine determination on-site inspection method (United States Army Corps of Engineers, 1987), including swamps, marshes, bogs, and similar areas. This method involves the use of USGS topographic maps, Soil Conservation Service soil surveys, aerial photographs, United States Fish and Wildlife Service National Wetlands Inventory (NWI) maps, and site-specific vegetation, soils, and hydrological information.

The results of the wetlands assessment are provided in Section 3.6 of this report. These results were used, along with the Phase I RI biological characterization and the analytical results from surface water and sediment sampling, to help complete the ecological risk assessment for NAWC Warminster. The biological characterization was completed on a qualitative, descriptive level, and it did not involve sampling procedures for area biota.



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Tetra Tech NUS, Inc.

BACKGROUND
SOIL SAMPLE LOCATIONS
FORMER NAWC, WARMINSTER, PA

CONTRACT NO. 1412
OWNER NO. 4010
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TABLE 2-3

OCCURRENCE AND DISTRIBUTION OF TOTAL INORGANICS IN SURFACE WATER IN BACKGROUND - SITE 8

WARMINSTER, PENNSYLVANIA

(ug/L)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
BARIUM	155	NONPARAMETRIC DIST	1 / 2	60	60
CALCIUM	17100	NORMAL OVER LOGNORMAL	2 / 2	15900 - 18300	18300
IRON	630	NONPARAMETRIC DIST	1 / 1	630	630
MAGNESIUM	6915	NONPARAMETRIC DIST	2 / 2	6590 - 7240	7240
MANGANESE	67	NONPARAMETRIC DIST	1 / 2	83	83
POTASSIUM	1415	NONPARAMETRIC DIST	2 / 2	1130 - 1700	1700
SODIUM	9470	NONPARAMETRIC DIST	2 / 2	8980 - 9960	9960

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 2-4

OCCURRENCE AND DISTRIBUTION OF DISSOLVED INORGANICS IN SURFACE WATER IN BACKGROUND - SITE 8

WARMINSTER, PENNSYLVANIA

(ug/L)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
BARIUM	56.2	NONPARAMETRIC DIST	2 / 2	53 - 59.4	59.40
CALCIUM	17150	NONPARAMETRIC DIST	2 / 2	15200 - 19100	19100
MAGNESIUM	6920	NONPARAMETRIC DIST	2 / 2	6230 - 7610	7610.00
MANGANESE	49	NONPARAMETRIC DIST	2 / 2	25 - 73	73
POTASSIUM	1300	NONPARAMETRIC DIST	2 / 2	1290 - 1310	1310
SODIUM	9485	NONPARAMETRIC DIST	2 / 2	9440 - 9530	9530

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TA 2-5

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT IN BACKGROUND - SITE 8

WARMINSTER, PENNSYLVANIA

(mg/kg)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
ALUMINUM	3390	NONPARAMETRIC DIST	3 / 3	2920 - 4000	4000
ARSENIC	2.55	NONPARAMETRIC DIST	2 / 2	2.3 - 2.8	2.8
BARIUM	32.33	NONPARAMETRIC DIST	2 / 3	31.4 - 40.6	40.6
BERYLLIUM	0.57	NONPARAMETRIC DIST	2 / 2	0.52 - 0.62	0.62
CALCIUM	1175	NONPARAMETRIC DIST	2 / 2	1060 - 1290	1290
CHROMIUM	9.20	NONPARAMETRIC DIST	3 / 3	7.7 - 11.7	11.7
COBALT	4.4	NONPARAMETRIC DIST	1 / 1	4.4 - 4.4	4.4
COPPER	6.45	NONPARAMETRIC DIST	2 / 2	5.4 - 7.5	7.5
IRON	8670	NONPARAMETRIC DIST	3 / 3	5800 - 11200	11200
LEAD	11.5	NONPARAMETRIC DIST	2 / 3	9.8 - 24.6	24.60
MAGNESIUM	1180	NONPARAMETRIC DIST	2 / 2	1040 - 1320	1320
MANGANESE	194.33	NONPARAMETRIC DIST	3 / 3	144 - 220	220
NICKEL	5.2	NONPARAMETRIC DIST	2 / 2	4.4 - 6	6
POTASSIUM	354.5	NONPARAMETRIC DIST	2 / 2	288 - 421	421
SODIUM	182.5	NONPARAMETRIC DIST	1 / 2	340 - 340	340
VANADIUM	12.8	NONPARAMETRIC DIST	3 / 3	11.8 - 13.6	14
ZINC	48.7	NONPARAMETRIC DIST	3 / 3	32.9 - 57.2	57

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 2-6

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT IN BACKGROUND - SITE 8

WARMINSTER, PENNSYLVANIA

(ug/kg)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
ANTHRACENE	1299	NONPARAMETRIC DIST	1 / 2	97	97
BENZ(A)ANTHRACENE	245.00	NONPARAMETRIC DIST	2 / 2	210 - 280	280
BENZO(A)PYRENE	1380	NONPARAMETRIC DIST	1 / 2	260	260
BENZO(B)FLUORANTHENE	1410.00	NONPARAMETRIC DIST	1 / 2	320	320
BENZO(G,H,I)PERYLENE	1325	NONPARAMETRIC DIST	1 / 2	150	150
BENZO(K)FLUORANTHENE	1350	NONPARAMETRIC DIST	1 / 2	200	200
CARBAZOLE	288	NONPARAMETRIC DIST	1 / 1	287.5	288
CHRYSENE	265	NONPARAMETRIC DIST	2 / 2	190 - 340	340
DIBENZ(A,H)ANTHRACENE	1277	NONPARAMETRIC DIST	1 / 2	53	53
FLUORANTHENE	465	NONPARAMETRIC DIST	2 / 2	380 - 550	550
INDENO(1,2,3-CD)PYRENE	1345.00	NONPARAMETRIC DIST	1 / 2	190	190
PYRENE	460	NONPARAMETRIC DIST	2 / 2	330 - 590	590

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

2.2.10 Surveying

Surveying was conducted as part of the Phase III RI in order to determine the exact location of the grids used for the soil gas survey and to better locate soil sample locations. At least two corners of each survey grid were surveyed for horizontal location or tied into existing site structures (including existing surveyed monitoring well locations) to provide reference points for locating the entire grid.

The horizontal survey utilized survey traverse control established in 1985, 1986, and 1987 during aerial mapping of the entire base and field survey location of all utilities. All coordinates are based on the Pennsylvania State Plane Coordinate System (South Zone, 1927 Datum). The error of closure of all horizontal survey work is better than 1 part in 10,000. All elevations are based on the North American Vertical Datum of 1929.

To determine the survey locations, three horizontal traverses, which began and ended on property corner monuments, were conducted. At least three corner monuments were tied on each traverse. All three traverses closed relative to the Survey Map entitled "Survey Map, U.S. Naval Air Development Center, Warminster Township, Bucks County, Pennsylvania" with a tolerance better than the proposed standard of 1 part in 10,000. Tabulated survey data from Phase III are provided in Appendix E.

2.3 ANALYTICAL PROCEDURES AND DATA VALIDATION

2.3.1 Analytical Procedures

During Phase I, samples were analyzed as specified by EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition. Samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals. Samples analyzed for TAL metals were not filtered. Data packages were submitted under Naval Energy and Environmental Support Activity (NEESA) Level C requirements.

For Phase II, a subcontracted NEESA-approved laboratory analyzed aqueous and solid matrix samples collected at NAWC Warminster for full TCL organics, TAL inorganics, cyanide, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), and a variety of physical-chemical parameters (e.g., hardness, alkalinity, total suspended solids, chlorides, grain size). Data packages were submitted under NEESA Level D requirements.

During Phase III, several laboratories analyzed aqueous and solid matrix samples for full TCL organics, TAL inorganics, cyanide, and dioxins/furans. The most frequently used analytical methods selected for these analyses are presented in Table 2-7. Most data packages were submitted under Naval Facilities Engineering Service Center (NFESC) Level D requirements.

For the supplemental Site 8 investigations, some data packages were submitted under reduced requirements for laboratory deliverables, particularly for quick-turnaround metal results associated with the post-removal verification sampling.

Section 2.4 summarizes the number of samples collected during the Site 8 investigations and provides information regarding the laboratory analyses performed on these samples. The complete analytical database is presented in Appendix A to this report.

2.3.2 Data Validation

Most of the Site 8 analytical data were fully validated as part of the scope of RI work. Some data were only reviewed for false positives and false negatives. The data validation process served three basic functions:

- An independent quality assurance check of the truthfulness of laboratory results.
- A means of evaluating laboratory performance and determining the impact of noncompliances to the data.
- Through the use of data qualifiers, it lends interpretative guidance as to the proper usage and limitations of the data.

The validation process was a systematic review and evaluation of the analytical data conducted according to applicable and relevant quality control criteria, including

- EPA's National Functional Guidelines for Evaluating Laboratory Analyses
- Method-specific quality control criteria
- Navy-specified technical guidelines
- TtNUS data validation formats and standard operating procedures

TABLE 2-7
SUMMARY OF ANALYTICAL PARAMETERS
PHASE III RI

MEDIA	ANALYSIS	METHOD	CRQL/CRDL
Surface Water	TCL volatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 ug/l
	TCL semivolatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 to 25 ug/l
	TAL metals	CLP SOW ILMO 2.1	0.2 to 5000 ug/l
	Cyanide	CLP SOW ILMO 2.1	10 ug/l
	TCL pesticides/PCBs	CLP SOW OLMO 1.8 and OLMO 1.9	0.05 to 5.0 ug/l
Soil, Sediment, and Waste	TCL volatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 ug/kg
	TCL semivolatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	330 to 830 ug/kg
	Cyanide	CLP SOW ILMO 2.1	2 mg/kg
	TCL pesticides/PCBs	CLP SOW OLMO 1.8 and OLMO 1.9	1.7 to 170 ug/kg
	TAL metals	CLP SOW ILMO 2.1	0.1 to 1000 mg/kg
	Dioxins/Furans	CLP SOW DFLMO 1.1	1.0 - 5.0 ug/kg
	Hexavalent Chromium	SW-846 - 3060/7197	1.0 mg/kg
	Total Organic Carbon	SW-846 - 9060A and EPA Method 415.1	5 mg/kg
	Total Solids	EPA Method 160.3	NA
	Grain Size	ASTM 421-85/D422-63	NA

Organic data were evaluated based on

- Data completeness
- Holding times
- (GC/MS) tuning and mass calibration (when applicable)
- Initial and continuing calibrations
- Laboratory blank analyses
- Field blank analyses (when applicable)
- Internal standards performance
- Surrogate spike recoveries
- Matrix spike/matrix spike duplicate results
- Field duplicate precision (when applicable)
- Compound detection limits
- Compound identification
- Compound quantitation
- Tentatively Identified Compound (TIC) evaluation (when applicable)

Inorganic data were evaluated on the basis of

- Data completeness
- Holding times
- Initial and continuing calibrations
- Contract-required detection limit (CRDL) standard analyses
- Laboratory and field blank analyses (when applicable)
- Matrix spike results
- Laboratory control sample results and duplicate analyses
- Field duplicate precision (when applicable)
- Inductively Coupled Plasma (ICP) interference check sample results
- ICP serial dilution analyses
- Furnace atomic absorption results
- Analyte detection limits
- Analyte quantitation

Data validation reports were generated from these results and conclusions drawn from the validation process described above. The specific format of the data validation report varies with the applicable protocol, but all reports address the following:

- Explanation of the findings of the data evaluation process, giving interpretations of actions taken on the data and limits of data usability.

- Presentation of the qualified analytical results.

- A validation worksheet and/or support documentation section depicting the problem areas and noncompliances addressed in the data validation memoranda and supporting the validation actions taken.

The formal data validation process and the supporting documentation is essential for the following reasons:

- To ensure the accuracy and integrity of the analytical data
- To ensure the defensibility of the data
- To provide a platform from which remediation/risk assessment issues can be addressed

2.4 SAMPLE COLLECTION AND ANALYTICAL TESTING PROGRAM

This section summarizes the number of samples collected at Site 8 during the Phase III RI (or to support the Phase III RI report) and provides information regarding the types of laboratory analyses performed on these samples. These numbers do not reflect field Quality Assurance/Quality Control (QA/QC) samples and laboratory QA/QC samples such as matrix spikes, matrix spike duplicates, and sample duplicates.

Table 2-8 summarizes the number of surface soil samples taken during RI work at Site 8. A total of 49 site-related surface soil samples and 13 background surface soil samples were collected. A majority of these samples were collected during the Phase III RI. Table 2-8 also displays similar information for subsurface soil samples, including those obtained through soil borings and test pits. A total of 29 site-related subsurface soil samples and 16 background subsurface soil samples were obtained.

Tables 2-9 summarizes the number of surface water and sediment samples obtained during RI work. Most of these samples were taken as part of Phase III RI field activities. Background surface water and sediment samples are reflected in these tables.

TABLE 2-8
SOIL ANALYTICAL TESTING SUMMARY FOR SITE 8
NAWC WARMINSTER, PENNSYLVANIA

PARAMETER	SITE 8 SURFACE SOIL	SITE 8 SUBSURFACE SOIL	BACKGROUND	
			SURFACE SOIL[2]	SUBSURFACE SOIL[4]
Total Samples[1]	49[3]	28[3]	13[3]	16[3]
TCL Volatile Organics	15	14	13	16
TCL Semivolatile Organics	19	23	13	8
TCL Pesticides/PCBs	16	7	13	8
TAL Metals	46	28	13	16
Cyanide	11	2	13	10
Dioxin	13	4	0	0
Hexavalent Chromium	0	0	0	0

1 Number of samples does not include QA/QC samples (e.g., duplicates).

2 Background samples were collected within 2 feet of the ground surface.

3 Includes samples collected during previous RI phases.

4 Background samples were collected at depths greater than 3 feet from the ground surface.

TABLE 2-9
SURFACE WATER AND SEDIMENT ANALYTICAL TESTING SUMMARY FOR SITE 8
NAWC WARMINSTER, PENNSYLVANIA

PARAMETER	SITE 8 SURFACE WATER	SITE 8 SEDIMENT	BACKGROUND	
			SURFACE WATER	SEDIMENT
Total Samples[1]	1	3	3	3
TCL Volatile Organics	1	3	3	3
TCL Semivolatile Organics	1	3	3	3
TCL PCBs/Pesticides	1	3	3	3
TAL Metals and Cyanide – Total[2]	1[2]	3	3	3
TAL Metals and Cyanide – Dissolved[2]	0	-	3	-

[1] Number of samples does not include QA/QC samples (e.g., duplicates).

[2] Samples were not analyzed for cyanide during Phase I and Phase II.

3.0 PHYSICAL CHARACTERISTICS

Several environmental studies applicable to NAWC Warminster sites have been completed over the last 10 years. A number of these studies, including JRB Associates (1981 and 1983), Sloto and Davis (1983), Satterthwaite (1984), and Earth Technology Corporation (1985), have provided information on local surface features, soils, meteorology, surface water hydrology, demography and land use, and hydrogeology.

A description of the physical characteristics of NAWC Warminster has been prepared on the basis of published information, reports of previous site studies, and information obtained and interpreted during the course of the RI. Section 3.0 provides a brief, general overview of the overall physical characteristics of the facility and specific physical characteristics for both Area C and Site 8.

3.1 METEOROLOGY

The climate of the area is humid continental and is modified by the Atlantic Ocean. Temperatures range between an average of 76°F (24.4°C) in July and 32°F (0°C) in January. The average daily temperature for the NAWC location is 53.3°F (11.8°C). Precipitation averages 42.5 inches per year (106.25 cm per year), and snowfall averages 22 inches per year (55 cm per year). The distribution of precipitation is fairly even throughout the year. The relative humidity for the site averages 70 percent. The mean wind speed for this area is 9.6 mph with a prevailing direction of west-southwest (NAWC Warminster Emergency Response Plan, August 13, 1990).

3.2 SURFACE WATER HYDROLOGY AND TOPOGRAPHY

NAWC Warminster is situated on an upland area divided between two local drainage basins, the Little Neshaminy Creek Basin to the north and the Southampton Creek Basin to the south. The northern 65 percent of the facility (including Areas A and C) drains toward the north through several swales and storm sewers into small unnamed tributaries of Little Neshaminy Creek. The southern 35 percent of the facility (including Area B) drains toward the south to the headwaters of Southampton Creek, a tributary of Pennypack Creek. Both local drainage basins lie within the regional drainage basin of the Delaware River. Various studies conducted on the site have revealed that no areas within NAWC Warminster are included in the 100-year or 500-year floodplain.

NAWC Warminster is located on a local topographic high. The crest of the hilltop trends east-west within the facility and is roughly coincident with the location of the main runway. Surface topography across Area C slopes away from the main runway to the north, precluding surface water flow onto Area C from surrounding properties. Slopes range from nearly level to eight percent and average three to five percent. The slope

across Site 8 is approximately two percent. The surface elevation of Site 8 ranges from a high of approximately 335 feet mean sea level (msl) to low of approximately 310 feet (msl).

Site 8 is drained primarily by a concrete swale located about 100 feet northwest of the runway extension. The swale discharges directly to an intermittent stream through a culvert beneath Kirk Road north of the site (Figure 1-3). The intermittent stream is channelized and flows to the north approximately 750 feet until it joins with an unnamed tributary of Little Neshaminy Creek. The intermittent stream was dry during base flow conditions observed during Phase I sampling. During Phases II and III, there was no surface water flow within the intermittent stream; however, pools of standing water were evident within the channel. This indicates that most surface water flow in this stream takes place during and shortly after precipitation.

The unnamed tributary of Little Neshaminy Creek begins in Munro Park north of Area C, flows north under Jacksonville Road, through Ivyland Borough, and under Bristol Road, where it joins a smaller tributary that begins near Jacksonville Road on the northwestern side of the base (i.e., Area A). This tributary is about 2 feet wide and 2 to 3 inches deep, with sand and gravel bottom sediments. A fringe of trees up to 100 feet wide is often found along the stream as it flows toward the north.

3.3 SOILS

According to the Soil Survey of Bucks and Philadelphia Counties, Pennsylvania (United States Department of Agriculture, Soil Conservation Service, 1975), Site 8 is underlain by Urban land Lansdale Complex soils, 0 to 8 percent slopes.

Urban land occurs in highly developed areas where urban structures and works cover so much of the land type that identification of the soils is not practical. Most areas have been graded, and the original soil material has been disturbed, filled over, or otherwise altered prior to construction. As a consequence of these activities, the soil and foundation materials may be highly variable. Urban land Lansdale complex consists of approximately 60 percent urban land, 35 percent Lansdale soils, and five percent other soils. Also included are some areas of various types of fill material. This complex has good drainage and is nearly level to gently sloping.

The soil thickness at Site 8 ranged from 7 to 10 feet. These values were obtained from soil borings installed at Site 8. The soils encountered in these borings were generally described as brown to reddish-brown silty clay to clayey silt.

3.4 GEOLOGY

3.4.1 Regional Geology

NAWC Warminster is located in the Piedmont physiographic province, and Triassic Lowlands section of southeastern Pennsylvania. The province is extensive and gently undulating and generally slopes to the southeast. The land forms have been modified by erosion to form moderate slopes and gently rounded hills with a dendritic drainage pattern.

The bedrock underlying NAWC Warminster belongs to the late Triassic age Stockton Formation. The Stockton Formation is unconformably underlain by basement rocks of Ordovician to PreCambrian age that crop out approximately 2 miles south of the facility. The Stockton Formation is conformably overlain by the shale- and argillite-rich Lockatong Formation, also of late Triassic age, that outcrops approximately 2.5 miles north of the facility.

Within the general area surrounding NAWC Warminster, the beds of the Stockton are reported to strike to the northeast and dip from 7 to 16 degrees to the northwest, with an average regional dip of about 12 degrees (Rima, et al., 1962). Based on its outcrop width and this regional dip, the Stockton Formation is estimated to be approximately 2,200 feet thick beneath NAWC Warminster.

The Stockton Formation is extensively faulted by small displacement normal faults and is cut by well-developed joint systems. The joint sets occur in a discernible and predictable pattern. The most frequently occurring joint sets trend perpendicular and parallel to the strike of the bedding. Another commonly occurring joint set trends to the northwest at an angle of about 50 degrees from strike (Rima, et al., 1962).

The Stockton Formation is composed of fine- to coarse-grained arkosic sandstone and conglomerate interbedded with shale and siltstone. These rocks are interpreted to have been deposited by coalescing alluvial fans that deposited sediment eroded from highlands to the south (Sloto and Davis, 1983). Throughout the Stockton Formation, units of varying lithology are irregularly interbedded, with coarse-grained units commonly overlying fine-grained units. Beds commonly pinch out or form gradational contacts with overlying or underlying beds over lateral distances greater than several hundred feet (Rima, et al., 1962).

The Stockton Formation is divided into the lower arkose, middle arkose, and upper shale members. Detailed geologic mapping of these three members is not available within Bucks County. However, projections from geologic maps for the area 1 mile west of the NAWC Warminster indicate that the facility is underlain by the middle arkose member of the Stockton Formation (Rima, et al., 1962).

The middle arkose member of the Stockton Formation consists of beds of fine- and medium-grained arkosic sandstone with interbedded red shale, siltstone, and very fine-grained red sandstone and a few beds of coarse-grained arkose. Beds of shale and siltstone are more common in the upper portion of the member, and coarser-grained units are more common in the lower portion. Many of the beds in the middle arkose member are well sorted and weakly cemented, which creates a relatively high porosity compared to the lower and upper members (Rima, et al., 1962). The thickness of the middle arkose member beneath NAWC Warminster is unknown but is estimated to range from approximately 500 feet thick near the southeastern boundary of the facility to about 1,500 to 2,000 feet thick near the northwestern boundary.

The lower arkose member of the Stockton Formation underlies the middle arkose member and is projected to outcrop approximately 2,000 feet or more southeast of the base. The lower arkose member is dominated by coarse-grained arkosic sandstone and conglomerate. Beds of medium-grained arkosic sandstone are common, though less abundant than the coarser-grained units. The lower arkose member is estimated to be approximately 1,700 to 1,800 feet thick in the vicinity of NAWC Warminster (Rima, et al., 1962).

The upper shale member of the Stockton Formation is not present in the vicinity of the base, but it overlies the middle arkose member several miles northwest of the facility. The upper shale member consists of shale, siltstone, and fine-grained arkosic sandstone. The sandstone is most common in the lower portion of this member.

3.4.2 Geology of Site 8

The geology within Site 8 consists of a thin veneer of residual soils overlying the sedimentary bedrock of the Stockton Formation. The soils primarily consist of silt and clay with some rock fragments and extend to an average depth of about 10 feet below the ground surface. The transition from soils to weathered bedrock to competent bedrock is gradational due to the effects of weathering on the bedrock surface.

The bedrock beneath Site 8 consists of alternating sequences of predominantly gray and brown, fine-grained arkosic sandstone and red-brown siltstone and mudstone. Individual beds or defined sequences of rock units of predominantly one lithologic type range in thickness from a few feet to approximately 50 feet across the area. Major lithologic sequences can be traced over significant portions of this area, although the thinner beds are often difficult to correlate and may pinch out over distances of several hundred feet.

Within Area C, a bedrock strike of north 70 degrees east and a dip of 9 degrees to the northwest were measured based on correlations between geophysical logs from selected well borings. The dip of the rock units is similar to the overall topographic slope of the ground surface within Area C. Fractures were

encountered at various depths in each well boring. Both the coarser-grained sandstone units and the fine-grained siltstones and mudstones were fractured to varying degrees. No generalizations regarding the frequency of fracturing relative to rock type were identified. Both cross-cutting fractures and bedding-plane fractures were identified through the interpretation of drilling and geophysical logs and borehole camera tapes.

More detailed information on the geology and hydrogeology of Area C is presented in the RI report for OU-3 (HNUS, 1994b).

3.5 HYDROGEOLOGY

3.5.1 Regional Hydrogeology

The fractured bedrock of the Stockton Formation is the major source of groundwater in the vicinity of NAWC Warminster. The middle arkose member of the Stockton Formation is considered to be the most productive bedrock aquifer in Bucks County.

Within the water-bearing zones in the fine- and medium-grained sandstones of the Stockton Formation, groundwater is transmitted chiefly through fractures, joints, and bedding planes (secondary permeability and porosity). Primary porosity is generally minimal in these rock units. The shale and siltstone beds are commonly too fine grained to transmit large amounts of groundwater through primary porosity, and the fractures are typically not as well developed compared to the coarser-grained units. Consequently, the shale and siltstone beds often act as confining layers to groundwater. The bulk of the groundwater is transmitted through the fractures and, to a lesser extent, the primary porosity of the sandstones.

The Stockton Formation in the vicinity of NAWC Warminster forms a complex, multi-aquifer system. The individual water-bearing zones of the Stockton Formation may belong to one of three different aquifer types which, in descending subsurface order, include

- Overburden (weathered bedrock) aquifer
- Shallow bedrock aquifer
- Deeper bedrock aquifer

The overburden aquifer consists of soil and saprolite (weathered bedrock) derived from the erosion of the truncated edges of the inclined bedrock layers. The overburden aquifer (where present) generally extends to an average depth of about 20 feet.

The shallow bedrock aquifer may extend to depths of about 75 to 120 feet below the ground surface. The shallow bedrock aquifer is recharged by vertical percolation through the overburden and is the primary reservoir for groundwater storage in the Stockton Formation. The shallow bedrock aquifer occurs within the weathered and unweathered shallow bedrock and is generally under water-table or unconfined conditions. The shallow bedrock aquifer may consist of numerous discrete water-bearing fracture zones. Horizontal groundwater migration in response to regional gradients (controlled by topography or long-term well pumping) is significant in the shallow bedrock aquifer.

The deeper bedrock aquifers underlie the shallow bedrock aquifer and typically occur at depths greater than about 75 to 120 feet below the ground surface. Water within the deeper bedrock occurs under semi-confined or confined conditions. Leakage from one water-bearing unit to another occurs when there is a difference in the hydraulic head between the units. Groundwater flow is from the unit with a higher hydraulic head to the unit with a lower hydraulic head and can be either upward or downward. Pumping effects may either amplify or reduce the leakage rate, depending on whether the pumping increases or decreases the difference in hydraulic head.

Groundwater flow directions within the Stockton Formation are variable and are controlled by topography, bedrock structure, and the locations of groundwater discharge points such as streams and wells.

3.5.2 Hydrogeology of Site 8

Groundwater within Site 8 is primarily encountered within the bedrock of the Stockton Formation. Saturated conditions have generally not been encountered in the overlying residual soils at Site 8. The groundwater occurrence and movement within the bedrock are primarily through the secondary porosity created by the extensive fracture network. Some minor primary porosity also contributes to the system, especially in the sandstone units. In general, the coarser-grained units yield more water than the finer-grained units, although significant water-yielding fractures were encountered in all lithologies.

The groundwater flow direction in the shallow bedrock (to a depth of approximately 100 feet) across Area C and Site 8 is slightly west of due north, with an average horizontal gradient of 0.03. The flow direction and gradient are similar to the slope of the ground surface. The groundwater flow direction is subparallel to the bedrock dip direction and is in the direction of overall surface water drainage towards an unnamed tributary of Neshaminy Creek.

Deeper groundwater flow directions (below about 120 feet) across the study area generally trend to the north-northeast. There is a marked upward vertical gradient between the deeper and shallower portions of the bedrock aquifer. Hydraulic head differences of more than 15 feet have been measured at some well

cluster locations. Some of the deep wells are flowing artesian wells. The confined conditions are apparently created by the presence of a thick, predominantly fine-grained, interbedded mudstone and sandstone unit. Wells installed directly below this rock unit exhibit much higher hydraulic heads than adjacent shallower wells installed above the rock unit.

3.6 ECOLOGY

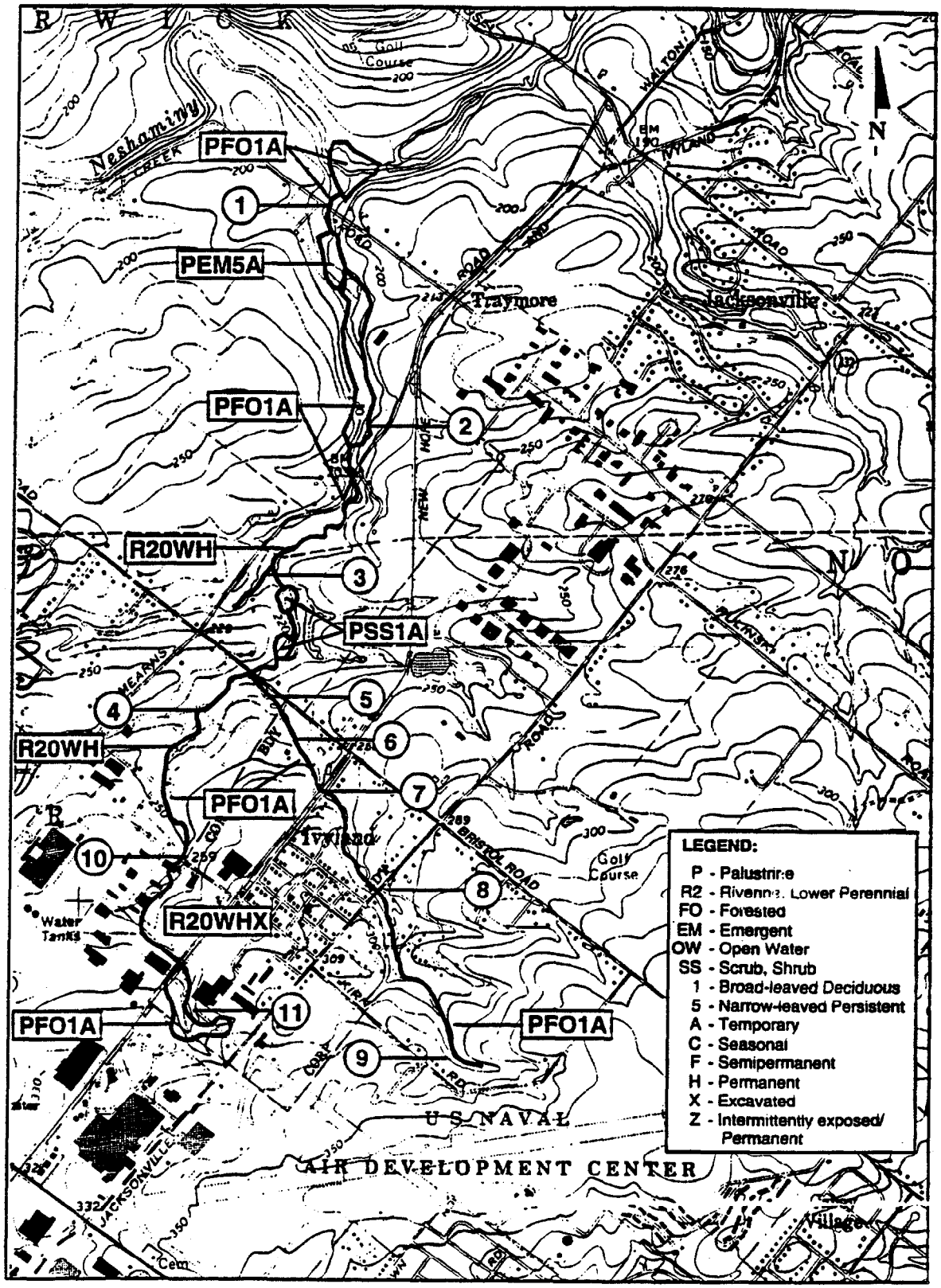
Openland, woodland, and wetland habitats are all found within or near the facility. These include mowed fields and lawns, nonforested overgrown land, wooded areas, forested wetlands, scrub/shrub wetlands, and streams and their adjacent riparian areas. There are no known critical habitats of endangered species located within 1 mile of the facility (NUS, 1985).

A relatively large forested area borders the perennial stream north of Area C. This undisturbed forested area extends back along the stream to Kirk Road near Site 4, and this contiguous wooded area offers the most secluded and physically diverse habitat observed during the Phase I biological characterization (SMC Martin, 1991). Snails, earthworms, and amphipods are common in sediments and leaf packs from downstream portions of Area C, as are small numbers of mayfly larvae. In addition to sightings of various songbirds, signs of rabbits, raccoons, and white-tailed deer are also found in the downstream portion of this area.

The wetlands assessment conducted during Phase III (HNUS, 1994c) classified a wetland along the unnamed tributary to little Neshaminy Creek near Munro Park as primarily palustrine, forested, broad-leaved deciduous, temporary (PF01A) (Figure 3-1). The stream was 2 feet wide and 3 inches deep and was characterized by a sandy mud bottom. The banks were 4 to 6 feet high. Mature green ash, silver maple, box elder, black cherry, and black walnut shade the banks. A dense sub-canopy is dominated by black cherry and green ash saplings and spicebush. The herbaceous layer was very lush and dominated by jewelweed, poison ivy, and jack-in-the-pulpit.

The soil at the bottom of the bank near this stream was hydric, with saturated conditions located at the surface and standing water 8 inches in depth. The wetlands did not extend into the floodplain.

The stream begins and flows through Munro Park parallel to and approximately 200 to 300 feet from the base property boundary. The upland forest associated with the stream provides excellent habitat for a large variety of wildlife. Birds were observed throughout this area, including wood thrush, tufted titmouse, black-capped chickadee, European starling, common crow, house sparrow, gray catbird, common yellowthroat,



Note: Map based on USFWS NWI and USGS Hatboro Quadrangle.

Miles 0 .25 .50

Kilometers 0 .25 .50 .75

SCALE 1 : 24,000

Figure 3-1. Wetlands Along the Streams North of NAWC Warminster

American robin, chimney swift, common grackle, turkey vulture, blue jay, and downy woodpecker. Unidentified fish up to 3 inches long were observed in the stream north of Area C. Crawfish and aquatic insect larvae were also seen in this stream.

This portion of the stream is one of two points that are the closest surface water to the base and is probably fed by a combination of rainfall (watershed runoff), stormwater runoff from roads, and groundwater. Urban impacts from residential septic tanks, lawn runoff (pesticides and fertilizers), and industrial runoff from parking lots and storage facilities are minimal upstream of this point. No fish kills, stressed vegetation, or other evidence of pollution or contaminated water were observed anywhere along this stream.

Farther downstream, the tributary was 2 feet wide and 3 inches deep and characterized by a sandy, mud bottom (Point 8). The banks were 2 feet high. The (NWI) map indicated that the streambed and banks were classified as PF01A. The stream flows through small woodlots and an old subdivision with mature silver maple and green ash shading the banks. The wetlands did not extend into the floodplain. Aerial photographs indicated that the fringe of trees bordering the stream was established before 1942 (EPA, 1994).

3.7 GROUNDWATER USE

Residents near Site 8 rely entirely on groundwater sources for their water supply. Approximately 15 domestic wells are located within 1,000 feet of Area C and one municipal well (WMA No. 13) for the Warminster Municipal Authority (WMA) is within 1,500 feet north of Site 8. The majority of these people are served by municipal water authorities, and the remainder utilize private domestic wells.

Well No. 13 is a 10-inch-diameter well that is 601 feet deep. It is cased to a depth of 80 feet below the ground surface and pumps at an average rate of 85 gallons per minute (gpm). The average daily withdrawal rate is 68,000 gallons. The intermittent, unnamed tributary of Little Neshaminy Creek is located between Site 8 and Well No. 13. This creek is not expected to act as a buffer between the base and this well, given the stream's small size and the well's depth and pumping rate.

Most of the domestic wells immediately north of Site 8 were decommissioned when public water connections were made along Kirk Road and Newtown Road as part of the OU-2 removal action. There are approximately 35 domestic wells and one municipal well within 3,200 feet of Area C at this time. The nearest well currently providing domestic well water is about 1,900 feet north of Site 8.

The wetlands assessment concluded that the stream and wetlands near Site 8 appear to be fairly healthy. No evidence of pollution, fish kills, or stressed vegetation was observed. Urban trash and litter (tires, boards, bottles, cans, paper, plastic) were common.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

The nature and extent of environmental contamination at Site 8 are discussed in this section. The discussion summarizes the distribution and concentration of contaminants detected in site soils before and after the February 1999 removal action, as well as in nearby surface water and sediment. The validated data generated during the RI work and subsequent investigations provide the basis for this information. The complete analytical database is included within Appendix A.

4.2 GEOPHYSICAL SURVEY RESULTS

An electromagnetic (EM) geophysical survey of the Site 8 area was conducted during the Phase I RI. The survey revealed a large positive anomaly, 60 umho/m above background (Figure 4-1). There were no indications of large buried metallic objects in the Site 8 survey area. The magnitude of the positive anomaly found at this site was unusual in the absence of metallic objects. This area was originally suspected to contain either disseminated metal, which would probably be highly oxidized, or a bedrock pinnacle.

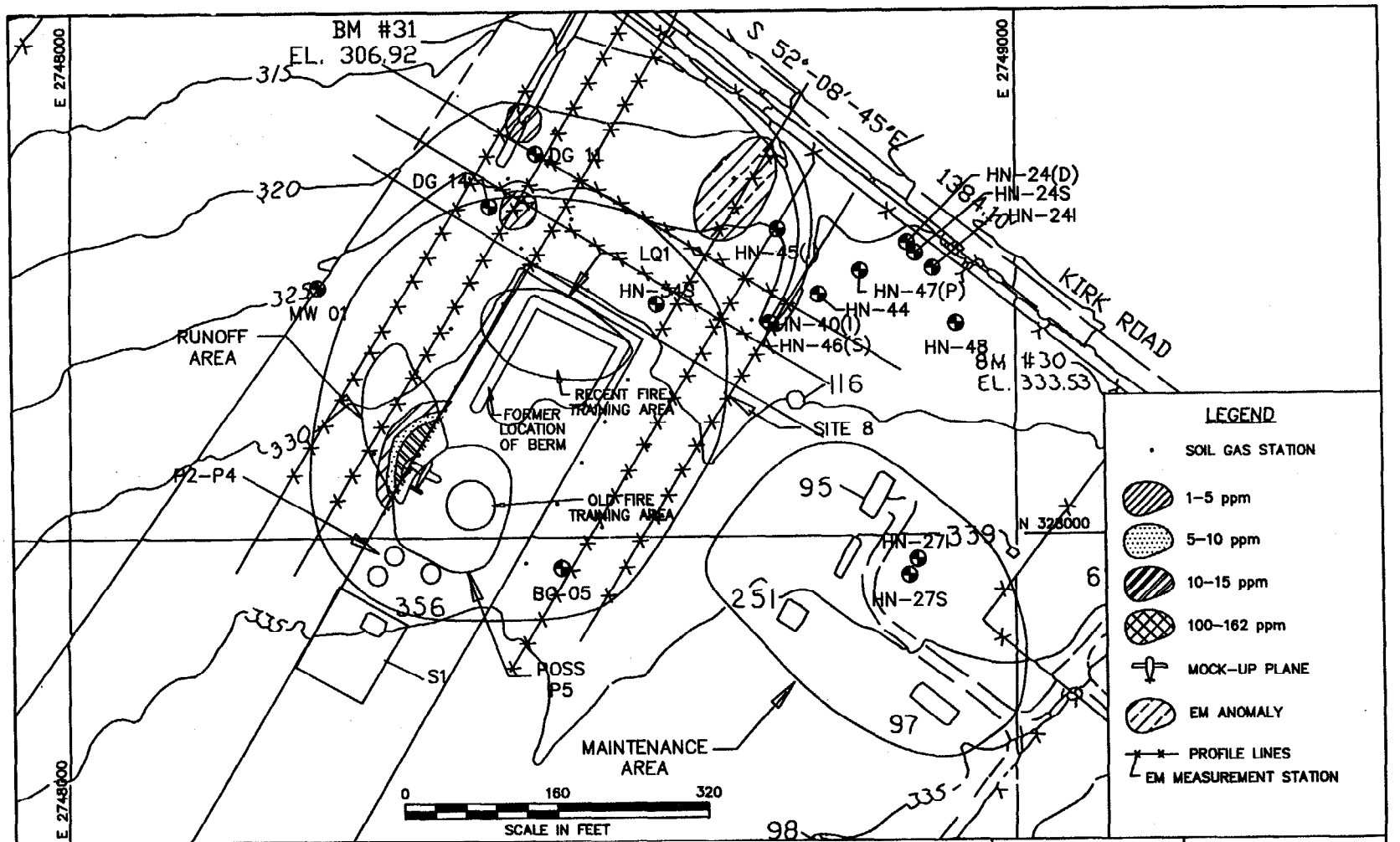
The station spacing and profile line spacing used during the Phase I RI EM survey of Site 8 were too large to resolve anomalies on a scale of approximately 25 to 50 feet or less. However, the nature of the problem at the site did not warrant the use of a smaller scale

4.3 SOIL GAS SURVEY RESULTS

Soil gas surveys were performed as part of Phase I and Phase III RI work. The Phase I soil gas survey results for Site 8 are shown on Figure 4-1. The soil gas survey indicated VOC concentrations of 52 and 162 mg/l or ppm at two survey points immediately adjacent to the mock-up airplane used for fire-fighting training. Slightly elevated VOC levels (2 ppm) were detected in the soil gas along the routes of surface drainage leading from the training area to the stormwater culvert located north of the abandoned runway.

The Phase I soil gas survey indicated that VOCs were present at levels less than 1 ppm along all three sides of the abandoned runway. The source of these VOCs may have been the former berm soils that were regraded around the edges of the runway or runoff containing residual fuel.

During the Phase III soil gas survey (Figures 4-2, 4-3, and 4-4), no clear pattern of subsurface contamination was identified based on the soil gas results. The Phase III soil gas survey results are presented in Appendix B. Most soil gas samples contained non-detects. A few scattered positive soil gas



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CHECKED BY DATE	PHASE 1 SOIL GAS AND EM SURVEY RESULTS SITE 8 NAWC WARMINSTER, PA	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE 1" = 100'		DRAWING NO. FIGURE 4-1	REV.

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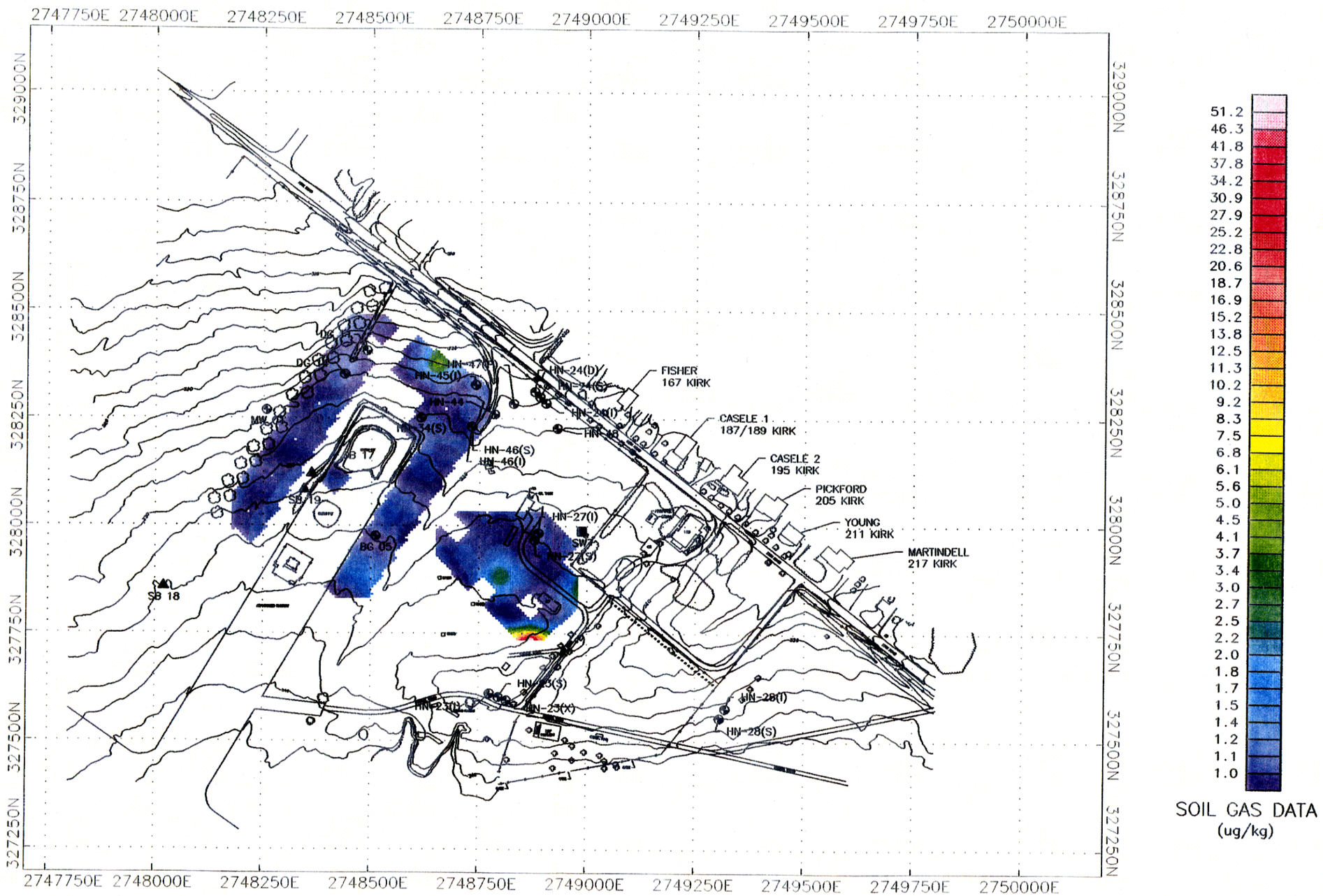
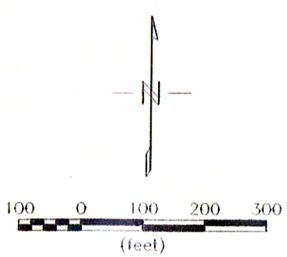


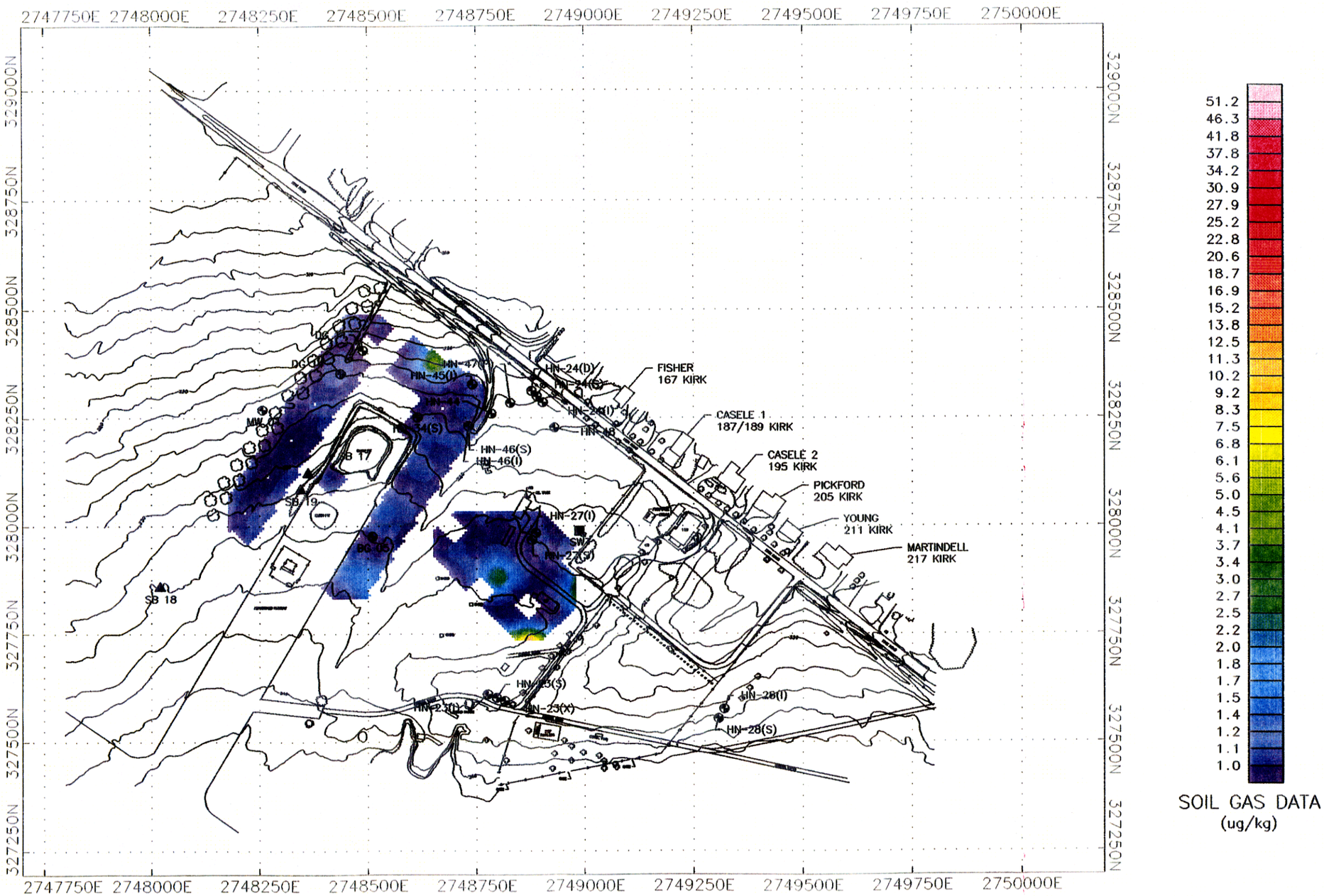


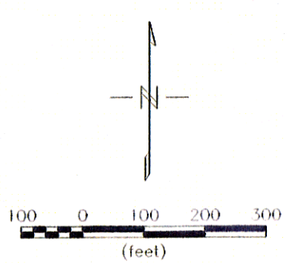
AREA C SOIL GAS RESULTS

MAP SHOWING COLOR CONTOURS OF VOC SOIL GAS RESULTS

FIGURE 4-2

Tetra Tech NUS, Inc.





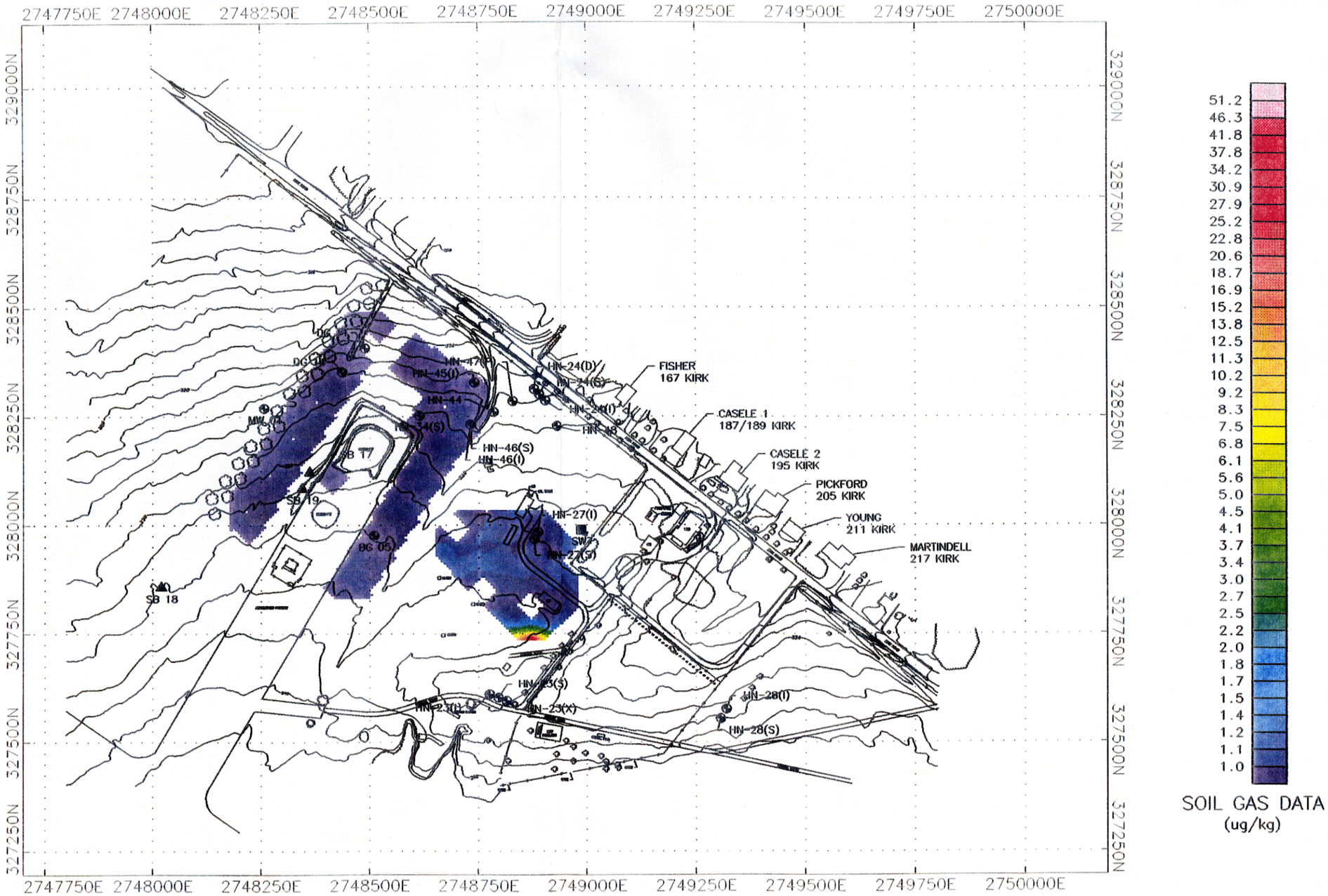
AREA C SOIL GAS RESULTS

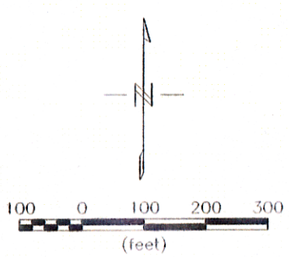
MAP SHOWING COLOR CONTOURS

OF BTEX SOIL GAS RESULTS

FIGURE 4-3

Tetra Tech NUS, Inc.





AREA C SOIL GAS RESULTS

MAP SHOWING COLOR CONTOURS OF HALOGENATED ORGANICS SOIL GAS RESULTS

FIGURE 4-4

Tetra Tech NUS, Inc.

detections were found, including BTEX (benzene, toluene, ethyl benzene, and xylene) compounds and 2-butanone, which were found at three soil gas locations at concentrations ranging from 1.2 to 4.6 ug/l or ppb. Two of these locations were located east of the former runway area. No samples showed the presence of PCE, which is the primary chemical found in Area C groundwater.

4.4 SURFACE SOIL RESULTS

Following the majority of Phase III RI work at Site 8, additional surface and subsurface soil sampling and analysis were conducted west and east of the runway extension to better delineate an area of elevated lead concentrations. This sampling led to a removal action for the site. The nature and extent of surface soil contamination at Site 8 are discussed in two parts. Surface soils were defined as those generally within 2 feet of the ground surface. The average depth of the Site 8 surface soil samples was between 6 and 30 inches, after accounting for the topsoil layer. The pre-removal results describe the occurrence and distribution of contaminants before the removal action was conducted; the post-removal results reflect the current nature and extent of contamination at the site. Appendix A-2 displays the Site 8 surface soil results for organics and inorganics.

4.4.1 Pre-Removal Results

A total of 30 surface soil samples (including four duplicate samples) were collected in the vicinity of Site 8 during Phases II and III of the RI (Figure 2-3). Twenty-six additional surface soil samples (including three duplicates) were collected during subsequent investigations. Three VOCs, methylene chloride, PCE, and toluene, were detected in these samples. Methylene chloride was detected at 7J ug/kg in two samples on the western side of the runway adjacent to EPIC features P2, P3, and P4. Toluene was found in five samples at low levels (2 to 3 ug/kg). Four of these samples were adjacent to or downgradient of P2 through P5 on the western side of the runway, and the other sample was collected in the northeastern corner of the runway. PCE was detected at 3J ug/kg in the sample collected at the northeastern corner of the runway. VOC levels at this sample location could be attributable to past contamination from the standing liquid area located at the end of the runway or to past fuel spills located in this area.

Several semivolatile organics, including, PAHs, phthalates, 1,4-dichlorobenzene, and pentachlorophenol (PCP), were detected in surface soil samples collected at Site 8. The PAHs were detected in a majority of the samples on the western side of the runway in a line beginning adjacent to structure S1 and running north along the abandoned runway to samples collected downgradient of EPIC feature P5. PAHs were also found at all the sampling locations on the eastern side of the runway at equal or lower levels than samples collected on the western. PAHs are generally associated with incomplete combustion of materials or runoff from asphalt. PAHs present in surface soil samples at Site 8 are generally downgradient of the historic burn pits and may have migrated to these locations via overland flow.

Phthalates, including bis(2-ethylhexyl)-, butyl benzyl-, and di-n-butyl-, were detected in a sample adjacent to EPIC features P2, P3, and P4 on the western side of the runway and di-n-butyl phthalate was detected in the sample adjacent to P2, P3, and P4 on the eastern side. The phthalate concentrations ranged from 50 to 1,750 ug/kg. 1,4-Dichlorobenzene was detected once on the western side of the runway downgradient from P2 through P5. PCP was detected in one surface soil sample collected on the eastern side of the runway. These semivolatile organics may be present due to combustion of materials in the historic burn pits or from the leakage of materials from the building structure (S1).

Aroclor 1254 was detected in five samples at Site 8, four on the western side of runway and one on the eastern side. The four samples on the western side had concentrations ranging from 13 J to 120 ug/kg. The higher concentrations were more than two times the background concentration of Aroclor 1254. Several pesticides, including aldrin, alpha-chlordane, dieldrin, endrin, endrin ketone, and gamma-chlordane, were detected on the western and eastern sides of the runway but not in background samples. PCBs may be present downgradient of the building and burn pits as a result of historical storage or burning practices at the site. Pesticides may be present via past applications of pesticides around Site 8 or historical practices of storage or burning at Site 8.

Two dioxins and three furans were detected in surface soil samples collected in the vicinity of the site. At least one dioxin or furan was detected in all 13 samples analyzed. OCDD and 1,2,3,4,6,7,8-HPCDD were the congeners detected at the highest concentrations, 22J and 3.4J ug/kg, respectively (samples SS-08-10/SS-08-11), located on the eastern side of the runway. Other dioxins and furans were detected at locations downgradient of the building structure and at EPIC features P1 through P5. Dioxins and furans may be related to impurities associated with pesticides or PCBs, which were also detected in the vicinity of Site 8.

Among the surface soil inorganic results, arsenic, beryllium, cadmium, copper, lead, manganese, mercury, selenium, and zinc results were elevated above background levels. The highest inorganic results were collected at sample locations SS-08-12 and SS-08-18, which are on the western side of the runway, and at sample location SS-08-10/11, which is on the eastern side. The highest lead concentrations were detected in samples SS-08-12 (1000 ug/kg), SS-08-13 (759 ug/kg), SS-08-21 (3130 ug/kg), SS-08-22 (1560 ug/kg), and SS-08-23/27 (2020 ug/kg). These sample locations are all in a narrow strip on the western side of the runway. These samples also contained the highest arsenic concentrations, up to 33.4 ug/kg (SS-08-12). The source of the elevated metals is unknown; however, they may be associated with the past storage, handling, or burning of materials in this area.

Two surface soil samples were analyzed for total petroleum hydrocarbons (TPHs) during Phase II. Concentrations of 60 and 200 mg/kg were found in these samples.

Two surface soil samples, SS-08-28/29 and SS-08-30, were collected from the drainage pathway that starts approximately 100 feet north of the end of the abandoned runway and leads off-base. These samples were analyzed for TAL metals. No metals were detected at concentrations exceeding background concentrations.

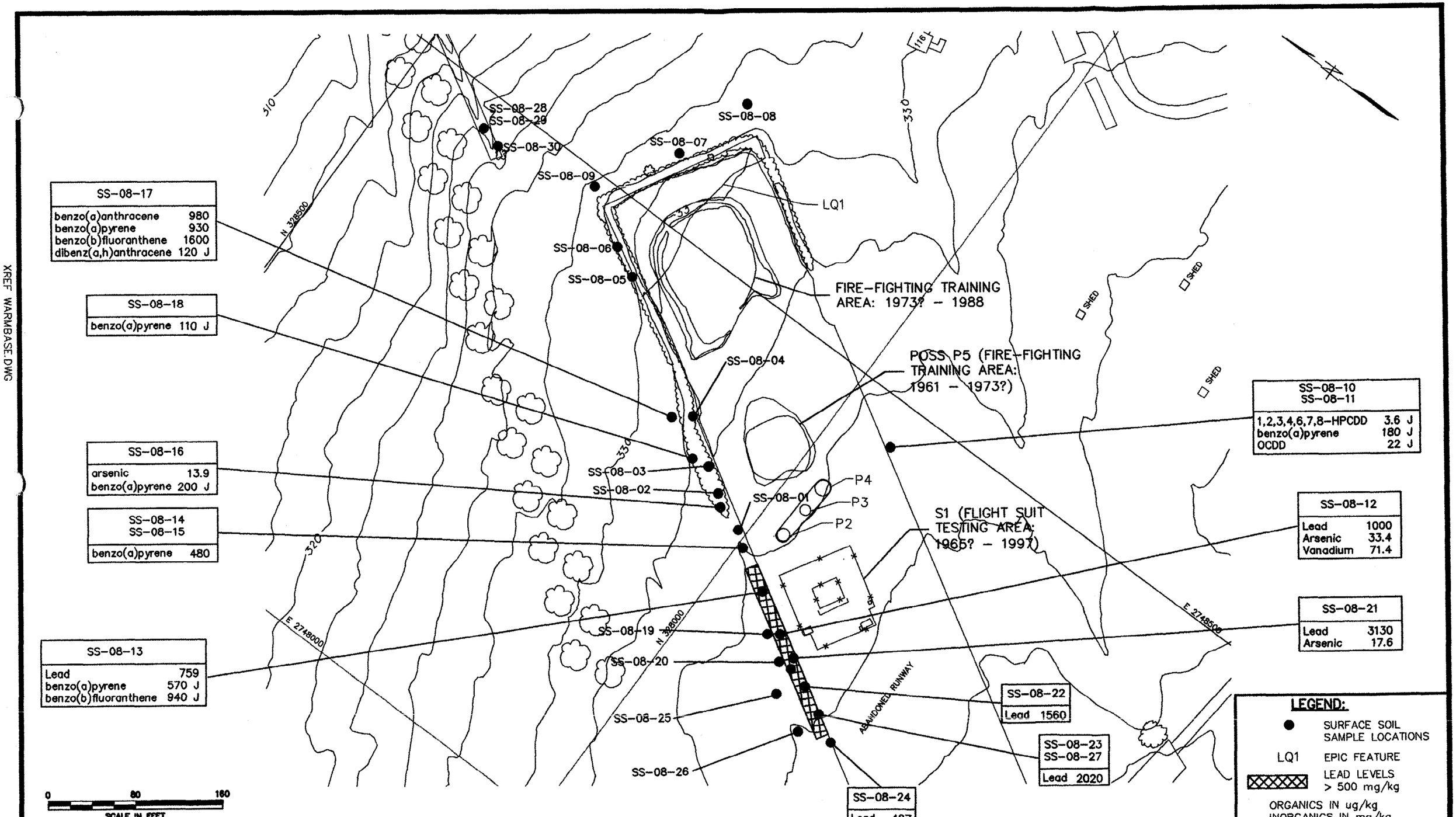
Figure 4-5 shows those contaminant concentrations that exceeded both the highest background concentration for that contaminant and any one of the screening criteria shown in Table 4-1. Table 4-2 summarizes the occurrence and distribution of Site 8 contaminants before the removal action was performed. Lead concentrations exceeded screening criteria in six samples. These samples were all collected from a narrow strip off the western edge of the runway. Two other metals, arsenic and vanadium, exceeded screening criteria. Arsenic exceeded the criteria in samples SS-08-12, SS-08-16, and SS-08-21; vanadium exceeded the criteria in sample SS-08-12. These samples were collected off the western edge of the runway. Low levels of dioxins/furans exceeding screening criteria were detected on the eastern side of Site 8 (sample SS-08-10/SS-08-11). The only other organic compounds found at concentrations above screening levels were benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene. The highest PAH concentrations were along the drainage pathway on the western side of the site and near structure S1.

Based on the use of petroleum-related products at the site, tentatively identified compounds (TICs) associated with both volatile and semivolatile organic compounds were reported during laboratory analyses. The TIC data for surface soils are included in Appendix F. These data demonstrate the presence of aliphatic hydrocarbons and alkenes in surface soils, primarily in the SVOC fraction. However, the levels of TICs detected are not indicative of significant contamination by petroleum-derived products.

4.4.2 Post-Removal Results

In February 1999, approximately 675 tons of contaminated surface soils were removed from an area along the western side of the runway extension in which lead and arsenic concentrations were encountered above screening criteria. The excavation measured 131 feet in length, 20 feet in width, and 2 to 2.5 feet in depth. This area encompassed sample locations SS-08-12, SS-08-13, SS-08-21, SS-08-22, and SS-08-23/27. The lead concentrations in these samples ranged from 759 mg/kg to 3139 mg/kg; the arsenic concentrations ranged from 10.6 mg/kg to 33.4 mg/kg.

Seventeen verification samples (including two duplicates) were collected from the bottoms and sides of the removal excavation and analyzed for lead and arsenic. Lead was the only contaminant for which a clean-up



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COST/SCHED.-AREA
SCALE 1" = 80'

TETRA TECH NUS, INC.

CONCENTRATIONS EXCEEDING SCREENING CRITERIA-PRE-REMOVAL
SURFACE SOIL SAMPLES - SITE 8
FORMER NAWC, WARMINSTER, PA

4-9

CONTRACT NO. N63472-90-D-1298
OWNER NO. 1412
APPROVED BY N. TEAMERSON
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TABLE 4-2
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 8 SURFACE SOIL (PRE-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

	Background Data				Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Exposure Point Concentration
1,2,3,4,6,7,8-HpCDD	0/0	-			7/13	0.0073 J	3.6 J	0.365	SS-08-10-D	3.6
1,2,3,4,6,7,8-HpCDF	0/0	-			2/7	0.1731 J	0.1755 J	0.236	SS-08-02	0.176
1,2,3,4,7,8-HxCDF	0/0	-			3/13	0.0048 J	0.007 J	0.0231	SS-08-03	0.007
OCDD	0/0	-			13/13	0.067 J	22 J	2.77	SS-08-10	13.9
OCDF	0/0	-			1/5	0.0379 J		0.491	SS-08-06	0.0379
Aluminum	29/29	4780	18100	BG-12	18/18	9000	16300	11900	SS-08-28-D	12700
Arsenic	25/29	0.28	12.1 J	BG-11	42/42	2	33.4	7.2	SS-08-12	8.08
Barium	25/27	34.1	225	BG-28	18/18	42.3	124	71.3	SS-08-17	81.5
Beryllium	25/29	0.31	1.7 K	BG-23-D	14/14	0.54	1.1	0.757	SS-08-07	0.83
Cadmium	0/29	-			10/17	0.53 L	12.9	2.82	SS-08-12	10.5
Calcium	23/27	240	1910	BG-24	17/17	776	45500	9440	SS-08-12	29900
Chromium	29/29	7.9 J	35.3 JK	BG-12	18/18	11.8 L	46.1	21.2	SS-08-14	24.9
Cobalt	25/28	1.6	22.1	BG-23-D	16/16	5.4	12.3	8.33	SS-08-28-D	9.31
Copper	27/29	3.6 K	30.6	BG-29	18/18	4.3	92.8 J	24.2	SS-08-10	42.1
Iron	29/29	6980	410500	BG-30	18/18	13000	25800	17300	SS-08-28-D	18800
Lead	29/29	1.6 J	96.5 J	BG-13	46/46	9.4	3130 N	290	SS-08-21	568
Magnesium	25/29	518	4960	BG-24	17/17	1840	28400	7140	SS-08-12	11700
Manganese	29/29	30.9	2010	BG-28	18/18	247	722 J	428	SS-08-18	492
Mercury	1/27	0.37		BG-23	4/16	0.06 L	0.15 L	0.0503	SS-08-12	0.0676
Nickel	18/25	4.1 J	21.7 J	BG-23-D	13/13	9.1	25.9	12.4	SS-08-12	14.4
Potassium	25/27	89.1	3050	BG-24	17/17	436	1840	802	SS-08-17	989
Selenium	0/20	-			4/18	0.7 K	1 K	0.468	SS-08-12	0.542
Sodium	4/18	55.2	86.7	BG-25	7/7	61.1	1110 J	330	SS-08-18	1110
Vanadium	29/29	15.4	45	BG-12	22/22	19.3	71.4	32.4	SS-08-12	36.2
Zinc	25/27	9	60	BG-13	18/18	24.9	1790	229	SS-08-12	536
4,4'-DDD	1/20	16 JP		BG-12	3/16	4.7 P	27 J	4.47	SS-08-12	6.28
4,4'-DDE	1/20	820		BG-12	2/16	12 J	25 J	4.01	SS-08-13	5.42
4,4'-DDT	1/20	1440 JP		BG-12	5/16	5 J	120 J	16.6	SS-08-13	41
Aldrin	0/20	-			1/16	3.2 J		0.979	SS-08-14-D	1.3
Alpha-Chlordane	0/20	-			2/14	0.9 J	4 J	1.21	SS-08-12	1.44
ıclor-1254	1/20	51		BG-13	5/16	13 J	120 J	35.3	SS-08-13	50.8
ıldrin	0/20	-			2/16	3.5 J	7.6 J	2.39	SS-08-12	2.81
Endrin	0/20	-			3/16	6.7 P	16 J	3.65	SS-08-12	5.04
Endrin Ketone	0/20	-			1/16	1.5 J		1.83	SS-08-13	1.5
Gamma-Chlordane	0/20	-			2/16	1.4 J	3.7 J	1.2	SS-08-12	1.38
1,4-Dichlorobenzene	1/11	43 J		BG-11	1/15	43		307	SS-08-18	43
2-Methylnaphthalene	0/11	-			1/19	130 J		254	SS-08-10	130
Anthracene	0/11	-			1/19	590		328	SS-08-17	418
Benz(a)anthracene	0/11	-			11/19	80 J	980	225	SS-08-17	286
Benzo(a)pyrene	0/11	-			11/19	79 J	930	246	SS-08-17	316
Benzo(b)fluoranthene	1/11	58 J		BG-13	11/19	120 J	1600	344	SS-08-17	463
Benzo(g,h,i)perylene	0/11	-			8/19	61 J	410	217	SS-08-17	294
Benzo(k)fluoranthene	1/11	46 J		BG-13	10/19	58 J	470 J	173	SS-08-13	219
Bis(2-ethylhexyl)phthalate	0/0	-			1/10	1700 J		350	SS-08-14-D	554
Butylbenzylphthalate	0/0	-			1/2	400 J		350	SS-08-14	600
Carbazole	0/11	-			1/19	310 J		313	SS-08-17	310
Chrysene	1/11	51 J		BG-13	11/19	77 J	980	284	SS-08-17	394
Di-n-butylphthalate	0/0	-			2/6	50 J	54 J	297	SS-08-10	54
Dibenz(a,h)anthracene	0/11	-			3/19	45 J	120 J	287	SS-08-17	120
Fluoranthene	1/11	92 J		BG-13	11/19	150 J	2000	383	SS-08-17	510
Fluorene	0/11	-			1/19	540		325	SS-08-17	413
Indeno(1,2,3-cd)pyrene	0/11	-			7/19	59 J	410	233	SS-08-17	323
Naphthalene	0/11	-			2/19	48 J	56 J	243	SS-08-10	56
Pentachlorophenol	0/11	-			1/15	43 J		592	SS-08-10	43
Phenanthrene	1/11	51 J		BG-13	11/19	72 J	2100	284	SS-08-17	368
Pyrene	1/11	100 J		BG-13	11/19	130 J	1600	347	SS-08-17	455
Methylene Chloride	0/13	-			2/6	7 J	7 J	6.25	SS-08-14-D	6.8
Tetrachloroethene	0/19	-			1/15	3 J		5.93	SS-08-08	3
Toluene	3/19	2 J		BG-17	5/15	2 J	3 J	5	SS-08-05	3

Notes:
* - Minimum and maximum detected site-related concentrations are based on duplicate samples.
Units are mg/kg for inorganics, ug/kg for organics.
ˢlumber of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
ean of all data includes positive detections and non-detected results. Detection limits are divided by two.
e determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separate table.
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.

goal (500 mg/kg) was established. One sample, SS-08-38, contained a lead concentration (733 mg/kg) greater than the clean-up goal. This sample was collected from the eastern wall of the excavation, adjacent to the runway, and consisted of a mixture of soil, crushed asphalt, gravel, and stone. Difficulty was encountered obtaining representative soil samples from the eastern wall of the excavation because this wall largely consisted of the exposed under bedding of the runway.

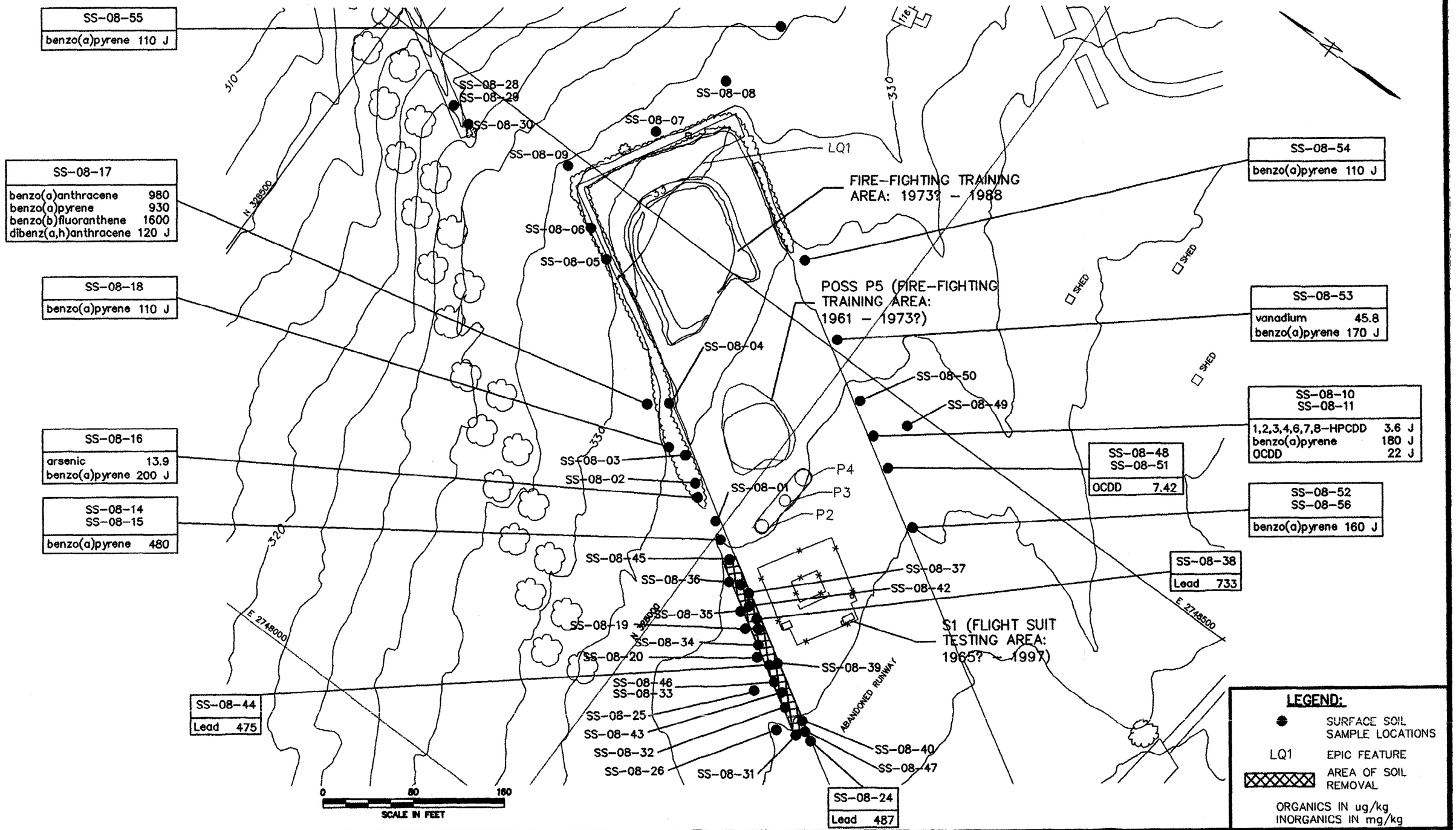
Seven additional surface soil samples were collected east of the runway to better characterize the extent of contamination in this area. Three of the samples, SS-08-48/51, SS-08-49, and SS-08-50, were collected at locations surrounding sample SS-08-10/11, in which dioxin had been detected. These three samples contained concentrations of OCDD ranging from 0.656 ug/kg to 7.942 ug/kg and concentrations of 1,2,3,4,6,7,8 - HPCDD ranging from ND to 0.925 ug/kg. Samples SS-08-52/56, SS-08-53, and SS-08-54 were collected off the eastern edge of the runway and were analyzed for arsenic, lead, vanadium, and PAHs. Low levels of several PAHs, including benzo(a)pyrene, were detected in these samples. Lead was the only inorganic detected above background levels. This occurred in samples SS-08-52/56 (157 mg/kg) and SS-08-53 (128 mg/kg). Sample SS-08-55 was collected at the start of the drainage pathway located approximately 120 feet east of the end of the runway. This sample contained low concentrations of several PAHs. No metals were detected above background levels.

Figure 4-6 shows the contaminant concentrations exceeding screening criteria that remained following the removal action. Table 4-3 provides the occurrence and distribution of organics and inorganics in background and site-related surface soils following the removal action. Two verification samples, SS-08-38 and SS-08-44, contained lead concentrations above the screening criteria. These concentrations were 733 mg/kg and 475 mg/kg, respectively. Sample SS-08-24, located outside the southern boundary of the excavation area, also contained lead slightly above the screening criteria. The excavation was backfilled with clean fill.

Benzo(a)pyrene was detected above screening criteria in four of the samples collected east of the runway (SS-08-52/56, SS-08-53, SS-08-54, and SS-08-55). Sample SS-08-53 also contained vanadium above screening criteria. OCDD was detected at a concentration (7.42 ug/kg) above screening criteria. OCDD was detected at a concentration (7.42 ug/kg) above screening criteria in sample SS-08-48/51.

4.5 SUBSURFACE SOIL RESULTS

The nature and extent of subsurface soil contamination at Site 8 are discussed in this section. Subsurface soils were defined as those at depths generally greater than 2 feet from the ground surface. All subsurface soil samples were collected at depths between 5.5 and 9 feet below the ground surface. Additional



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TETRA TECH NUS, INC.

CONCENTRATIONS EXCEEDING SCREENING CRITERIA–POST–REMOVAL
SURFACE SOIL SAMPLES – SITE 8
FORMER NAWC, WARMINSTER, PA

4-14

CONTRACT NO. N63472-90-D-1298
OWNER NO. 1412
APPROVED BY N. TEAMERSON DATE
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DRAWING NO. FIGURE 4-6
REV. 1

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TABLE 4-3
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 8 SURFACE SOIL (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

	Background Data				Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Exposure Point Concentration
1,2,3,4,6,7,8-HpCDD	0/0	-			7/13	0.0073 J	3.6 J	0.365	SS-08-10-D	3.6
1,2,3,4,6,7,8-HpCDF	0/0	-			2/7	0.1731 J	0.1755 J	0.236	SS-08-02	0.176
1,2,3,4,7,8-HxCDF	0/0	-			3/13	0.0048 J	0.007 J	0.0231	SS-08-03	0.007
OCDD	0/0	-			13/13	0.067 J	22 J	2.77	SS-08-10	13.9
OCDF	0/0	-			1/5	0.0379 J		0.491	SS-08-06	0.0379
Aluminum	29/29	4780	18100	BG-12	16/16	9940	16300	12300	SS-08-28-D	13000
Arsenic	25/29	0.28	12.1 J	BG-11	38/38	2	13.9	6.05	SS-08-16	6.7
Barium	25/27	34.1	225	BG-28	16/16	42.3	124	73	SS-08-17	84.9
Beryllium	25/29	0.31	1.7 K	BG-23-D	12/12	0.62	1.1	0.788	SS-08-07	0.858
Cadmium	0/29	-			8/15	0.53 L	6.3	1.65	SS-08-10	4.59
Calcium	23/27	240	1910	BG-24	15/15	776	19500	4770	SS-08-14	10500
Chromium	29/29	7.9 J	35.3 JK	BG-12	16/16	11.8 L	46.1	19.7	SS-08-14	23.1
Cobalt	25/28	1.6	22.1	BG-23-D	14/14	5.4	12.3	8.64	SS-08-28-D	9.66
Copper	27/29	3.6 K	30.6	BG-29	16/16	4.3	92.8 J	22.6	SS-08-10	40.5
Iron	29/29	6980	410500	BG-30	16/16	13000	25800	17700	SS-08-28-D	19300
Lead	29/29	1.6 J	96.5 J	BG-13	41/41	9.4	732 K	119	SS-08-38	214
Magnesium	25/29	518	4960	BG-24	15/15	1840	12100	4390	SS-08-14	6100
Manganese	29/29	30.9	2010	BG-28	16/16	247	722 J	433	SS-08-18	508
Mercury	1/27	0.37		BG-23	2/14	0.06 L	0.1	0.0425	SS-08-06	0.0552
Nickel	18/25	4.1 J	21.7 J	BG-23-D	11/11	9.1	15.7	11	SS-08-28-D	12
Potassium	25/27	89.1	3050	BG-24	15/15	436	1840	846	SS-08-17	1060
Selenium	0/20	-			2/16	0.7 K	0.72 K	0.417	SS-08-14-D	0.463
Sodium	4/18	55.2	86.7	BG-25	5/5	61.1	1110 J	418	SS-08-18	887
Vanadium	29/29	15.4	45	BG-12	20/20	19.3	45.8 J	29.9	SS-08-53	32.8
Zinc	25/27	9	60	BG-13	16/16	24.9	455	92.3	SS-08-14	165
4,4'-DDD	1/20	16 JP		BG-12	1/14	4.7 P		2.03	SS-08-10	2.2
4,4'-DDT	1/20	1440 JP		BG-12	3/14	5 J	23 J	3.92	SS-08-14-D	5.71
Aldrin	0/20	-			1/14	3.2 J		1.08	SS-08-14-D	1.19
Aroclor-1254	1/20	51		BG-13	3/14	13 J	83	24.6	SS-08-10	31
Endrin	0/20	-			1/14	6.7 P		2.11	SS-08-10	2.35
Dichlorobenzene	1/11	43 J		BG-11	1/14	43		251	SS-08-18	43
Ethylnaphthalene	0/11	-			1/18	130 J		207	SS-08-10	130
Anthracene	0/11	-			1/18	590		285	SS-08-17	348
Benz(a)anthracene	0/11	-			10/18	80 J	980	215	SS-08-17	271
Benzo(a)pyrene	0/11	-			10/18	79 J	930	228	SS-08-17	287
Benzo(b)fluoranthene	1/11	58 J		BG-13	10/18	120 J	1600	311	SS-08-17	402
Benzo(g,h,i)perylene	0/11	-			8/18	61 J	410	167	SS-08-17	218
Benzo(k)fluoranthene	1/11	46 J		BG-13	9/18	58 J	270 J	156	SS-08-14	193
Bis(2-ethylhexyl)phthalate*	0/0	-			1/10	1700 J	1800 J	350	SS-08-14-D	554
Butylbenzylphthalate*	0/0	-			1/2	400 J	600	350	SS-08-14	600
Carbazole	0/11	-			1/18	310 J		270	SS-08-17	310
Chrysene	1/11	51 J		BG-13	10/18	77 J	980	250	SS-08-17	331
Di-n-butylphthalate	0/0	-			2/5	50 J	54 J	137	SS-08-10	54
Dibenz(a,h)anthracene	0/11	-			3/18	45 J	120 J	242	SS-08-17	120
Fluoranthene	1/11	92 J		BG-13	10/18	150 J	2000	338	SS-08-17	426
Fluorene	0/11	-			1/18	540		282	SS-08-17	342
Indeno(1,2,3-cd)pyrene	0/11	-			7/18	59 J	410	165	SS-08-17	245
Naphthalene	0/11	-			2/18	48 J	56 J	195	SS-08-10	56
Pentachlorophenol	0/11	-			1/14	43 J		442	SS-08-10	43
Phenanthrene	1/11	51 J		BG-13	10/18	72 J	2100	275	SS-08-17	351
Pyrene	1/11	100 J		BG-13	10/18	130 J	1600	314	SS-08-17	397
Methylene Chloride	0/13	-			2/6	7 J	7 J	6.25	SS-08-14-D	6.8
Tetrachloroethene	0/19	-			1/13	3 J		5.77	SS-08-08	3
Toluene	3/19	2 J		BG-17	5/13	2 J	3 J	4.69	SS-08-05	3

Notes:
* - Minimum and maximum detected site-related concentrations are based on duplicate samples.
Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
Mean of all data includes positive detections and non-detected results. Detection limits are divided by two.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separate table.
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.

subsurface soil sampling was conducted north, west, and east of the runway extension to better delineate the nature and extent of contamination. Since the removal action for the site was limited to surface soils only, the analytical results for Site 8 subsurface soils did not change as a result of the removal action.

A total of 24 soil borings and two test pits were drilled or excavated at Site 8 during Phase III. No waste materials were encountered and no PID readings were recorded above background. The test pit excavations north of the runway, however, revealed a deactivated, lead-encased electric line 1 foot below the ground surface. These excavations were dug to investigate the Phase I EM anomaly.

During construction of the OU-3 groundwater remedy, soils west and north of the Site 8 runway extension were excavated to emplace groundwater conveyance piping. The trench excavation was approximately 4 feet wide by 5 feet deep. Samples were not collected along the length of this excavation. While the excavation plan called for stained soils, soils with a fuel type odor, or soils with elevated field screening measurements to be segregated and disposed off-base, no such soils were encountered near Site 8. The excavated soils were either used as trench backfill or relocated and graded north of the runway extension.

Appendices C and D provide test pit and soil boring logs for work done at Site 8.

4.5.1 Pre- and Post-Removal Results

A total of 29 subsurface soil samples (including one duplicate sample) were collected in the vicinity of Site 8 during RI work. The subsurface soil samples were collected at depths between 5.5 feet and 9 feet. Appendix A-3 displays the subsurface soil sample results for this site.

No VOCs were detected in subsurface soil samples collected at Site 8. A pesticide, endosulfan I, was detected in sample SB-08-08, which was just west of the S1 building. γ-Chlordane, another pesticide, was also detected along the western side of the runway. These pesticides were detected at low levels and may be present at Site 8 as a result of past application or storage practices. One dioxin, OCDD, was detected in the burn pit areas P2, P3, and P4 in sample SB-08-04. Dioxins may be present as impurities in PCBs or pesticides that have also been detected in samples collected at Site 8. PAHs were detected at relatively low concentrations (94 to 320 ug/kg) in one sample, SB-08-18, which was located in the same area as sample SS-08-03 and downgradient of S1 and P2 through P5. In P5, three semivolatile organics, 2-nitrophenol, 4-nitrophenol, and phenol, were detected at sample location SB-08-02. The nature of these phenols is unknown; they may be present as products of combustion or materials burned in the pits. No PAHs were detected in the four additional samples collected east of the runway (SS-08-21, SS-08-22, SS-08-23, and SS-08-24).

Antimony, beryllium, cobalt, copper, manganese, thallium, and vanadium results were elevated above background levels. However, antimony (14.9 mg/kg) and thallium (9.1 mg/kg) were only detected once in sample SB-08-19, which was located on the western side of the runway. Copper was detected at a concentration of 354J mg/kg in the same sample. The highest manganese and cobalt concentrations were detected in Test Pit No. 1 and the highest beryllium concentration was detected in Test Pit No. 2. Vanadium concentrations above background were detected at three locations east of the runway: SS-08-21, SS-08-22, and SS-08-23. The highest metal concentrations did not follow any apparent spatial pattern, and the nature of these metals at Site 8 is unknown.

During Phase II, toxicity characteristics leachate procedure (TCLP) and water leachate tests were conducted on one subsurface soil sample from Site 8. These tests are designed to determine the amount of leachable contaminants in solid material. The TCLP is used under RCRA to determine whether waste is characterized as "toxic" (and therefore "hazardous") by comparison with regulatory limits. Only leachable barium and lead were found for the Site 8 sample; these results exceeded background levels but fell well below the RCRA levels. No organic compounds were positively detected in this sample.

Leachable aluminum, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, potassium, sodium, vanadium, and zinc were detected in the water leachate test sample from Site 8; these concentrations exceeded the concentrations found in background test sample. No organic compounds were detected.

Also during Phase II, two subsurface samples were analyzed for BTEX and TPH. Among the BTEX and TPH results, no positive detections were noted. These results agreed with the TCL organic analysis results, which found no BTEX compounds.

Table 4-4 presents the occurrence and distribution of inorganic compounds and organics in background and site-related subsurface soil samples for Site 8. This table also includes a comparison of site-related concentrations to applicable soil criteria. Figure 4-7 shows those chemical concentrations that exceeded soil screening criteria. Thallium exceeded screening criteria at sample SB-08-19. Beryllium was greater than screening criteria from a test pit sample collected north of Site 8. Vanadium exceeded screening criteria in samples SS-08-21, SS-08-22, and SS-08-23. The concentrations of these metals were only slightly higher than corresponding background concentrations.

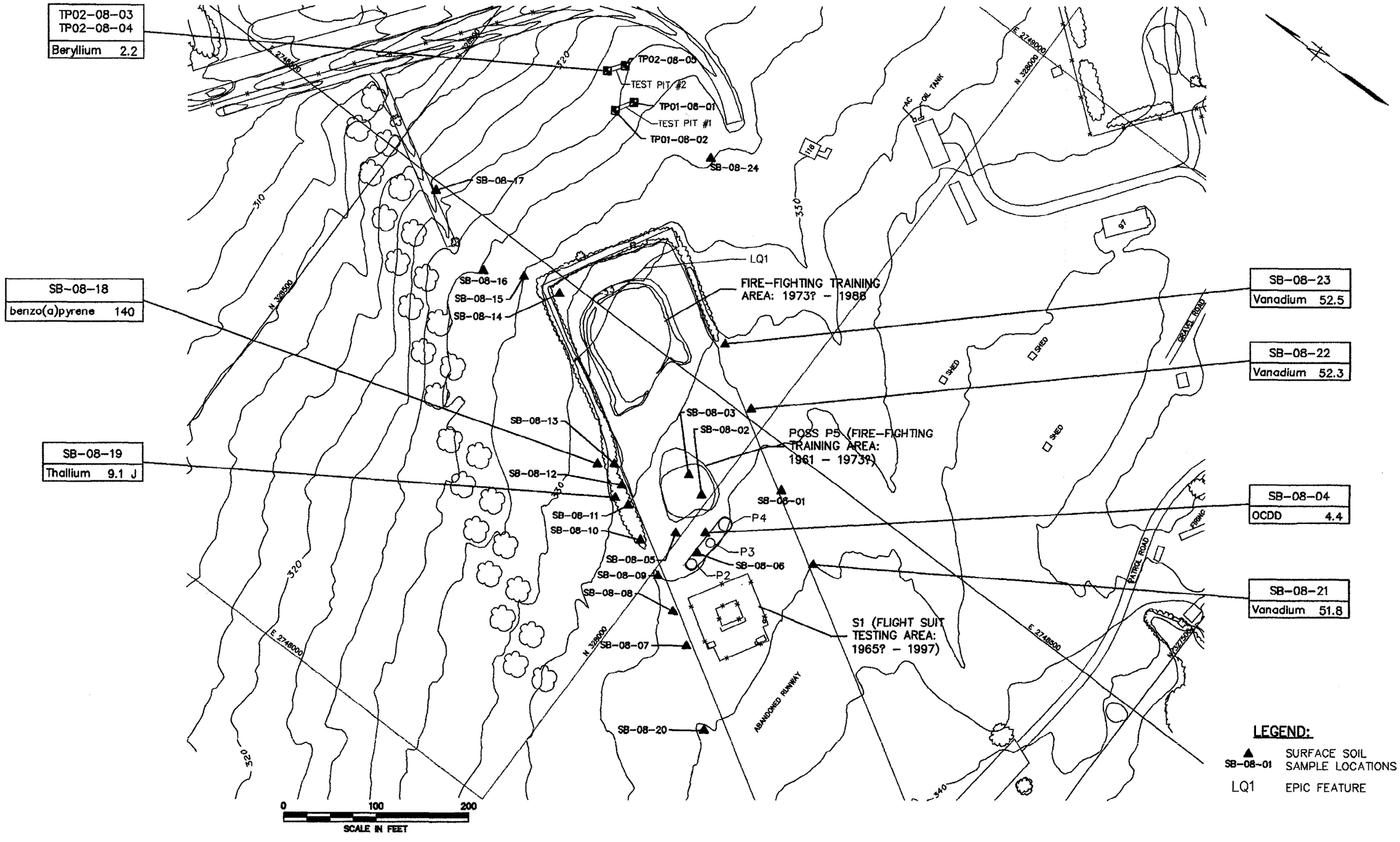
Two organic compounds [OCDD and benzo(a)pyrene (BAP)] exceeded screening levels in two separate samples. The OCDD concentration was from the boring sample near EPIC feature P3, and the BAP concentration was from a boring sample taken along the western side of Site 8. The remaining boring

TABLE 4-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 8 SUBSURFACE SOIL (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

	Background Data				Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Exposure Concentration
OCDD		-			1/4	4.4 J		2.71	SB-08-04	4.23
Aluminum	29/29	4780	18100	BG-12	23/23	6020	18000	11200	TP01-08-02	13100
Antimony	1/21	13.6 J		BG-16	1/17	14.9 J		4.72	SB-08-19	5.4
Arsenic	25/29	0.28	12.1 J	BG-11	22/22	0.61	6.6	3.1	SB-08-22	4.49
Barium	25/27	34.1	225	BG-28	23/23	16.1	113	43.8	TP01-08-02	56.6
Beryllium	25/29	0.31	1.7 K	BG-23-D	21/21	0.29	2.2	0.684	TP02-08-03	0.849
Calcium	23/27	240	1910	BG-24	22/22	492	10110	1260	SB-08-19	1440
Chromium	29/29	7.9 J	35.3 JK	BG-12	23/23	7.1	26.1 J	14.8	SB-08-10	16.9
Cobalt	25/28	1.6	22.1	BG-23-D	23/23	4.6	22.6	9.71	TP01-08-02	11.5
Copper	27/29	3.6 K	30.6	BG-29	22/22	5.8 L	353.65 J	30.6	SB-08-19	34.8
Iron	29/29	6980	410500	BG-30	22/23	7080	27450	14800	SB-08-19	17300
Lead	29/29	1.6 J	96.5 J	BG-13	28/28	1.9	26.7 J	7.52	SB-08-18	10
Magnesium	25/29	518	4960	BG-24	22/22	832	6975	2140	SB-08-19	2640
Manganese	29/29	30.9	2010	BG-28	23/23	143	1230	533	TP01-08-02	676
Mercury	1/27	0.37		BG-23	1/23	0.1 L		0.0301	SB-08-02	0.034
Nickel	18/25	4.1 J	21.7 J	BG-23-D	10/10	5.8	17.1	10.9	TP02-08-03-D	13
Potassium	25/27	89.1	3050	BG-24	21/22	145	2270	583	TP02-08-03	793
Selenium	0/20	-			1/23	0.63 K		0.32	SB-08-10	0.35
Sodium	4/18	55.2	86.7	BG-25	14/14	71.5	1470	186	SB-08-19	240
Thallium	3/29	0.37	0.42	BG-23-D	2/22	0.43	9.1 J	0.691	SB-08-19	0.639
Vanadium	29/29	15.4	45	BG-12	27/27	9.8	52.5	26.1	SB-08-23	31.7
Zinc	25/27	9	60	BG-13	22/22	5.1	47.6	18.7	SB-08-18	25.2
Endosulfan I	0/20	-			1/7	0.71 J		0.722	SB-08-08	0.71
Gamma-Chlordane	0/20	-			1/7	2		0.801	SB-08-18	2
2-Nitrophenol	0/11	-			1/19	42 J		181	SB-08-02	42
4-Nitrophenol	0/11	-			1/19	38 J		435	SB-08-02	38
Benz(a)anthracene	0/11	-			1/23	120 J		188	SB-08-18	120
Benzo(a)pyrene	0/11	-			1/23	140 J		188	SB-08-18	140
Benzo(b)fluoranthene	1/11	58 J		BG-13	1/23	190 J		191	SB-08-18	190
Benzo(g,h,i)perylene	0/11	-			1/23	80 J		186	SB-08-18	80
Benzo(k)fluoranthene	1/11	46 J		BG-13	1/23	110 J		187	SB-08-18	[illegible]
Chrysene	1/11	51 J		BG-13	1/23	170 J		190	SB-08-18	[illegible]
Fluoranthene	1/11	92 J		BG-13	1/23	320 J		196	SB-08-18	[illegible]
Indeno(1,2,3-cd)pyrene	0/11	-			1/23	94 J		186	SB-08-18	94
Phenanthrene	1/11	51 J		BG-13	1/23	180 J		190	SB-08-18	180
Phenol	0/11	-			1/19	920		227	SB-08-02	258
Pyrene	1/11	100 J		BG-13	1/23	290 J		195	SB-08-18	202

Notes:

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
Mean of all data includes positive detections and non-detected results. Detection limits are divided by two.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separate table.
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.



NO.	DATE	REVISIONS	BY	CHK'D	APP'D	REFERENCES
1	8/9/99	ADDRESSED DRAFT REPORT COMMENTS	EEH			

DRAWN BY EEH DATE 4/7/99
CHECKED BY N. TEAMERSON
COST/SCHED.-AREA
SCALE 1" = 100'

TETRA TECH NUS, INC.

CONCENTRATIONS EXCEEDING CRITERIA
TEST PIT AND SOIL BORING
AREA C - NEAR SITE 8
FORMER NAWC, WARMINSTER, PA 4-19

CONTRACT NO. N63472-90-D-1298
OWNER NO. 1412
APPROVED BY N. TEAMERSON DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4-7
REV. 1

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samples drilled beneath the runway did not contain contaminants at concentrations that were greater than screening criteria. In general, the Site 8 subsurface soil samples revealed that soil contamination at this site was limited to surface soils.

The highest levels of petroleum hydrocarbons potentially indicative of jet fuel constituents were contained in sample SB-08-17 at a depth of 6 feet. This boring sample was taken adjacent to the concrete swale which collected runoff from the western edge of the runway extension. The total concentration of TIC aliphatic hydrocarbons was about 8 mg/kg, which is below PADEP action levels.

TICs associated with both organic and semivolatile organic compounds were reported during laboratory analyses. The TIC data for subsurface soils are included in Appendix F. These data demonstrate trace levels of aliphatic hydrocarbons and alkenes in Site 8 subsurface soils, primarily in the SVOC fraction. However, the levels of TICs detected are not indicative of significant contamination by petroleum-derived products.

4.6 SURFACE WATER RESULTS

Surface water samples were collected for analysis during all three RI phases. The Site 8 surface water sample locations are shown on Figure 2-2. During Phase I, one surface water sample (C10) was collected, and two surface water samples (C12 and C13) were obtained during Phase II. During Phase III, one surface water sample (C8) was taken. The designated background surface water samples (C8, C10, and C13) were collected farther downstream from Site 8 along a tributary of Little Neshaminy Creek. These three background samples were in the same watershed as Area C and showed lower chemical concentrations than other Area C samples. Also, these samples were collected in a non-urban area around Area C and were considered to be more representative of undisturbed surface water and sediment conditions. All other samples collected near Area C were considered to be potentially impacted by NAWC Warminster. Samples C11 and C12 are considered the farthest downstream samples. No "true" upstream samples could be collected in the vicinity of Site 8.

Appendix A-4 provides the Site 8 surface water sample results. Tables 4-5 and 4-6 present the occurrence and distribution of total and dissolved inorganics in the Site 8 surface water samples, respectively. Generally, low levels of both total and dissolved metals were detected in the background samples, including barium and manganese. The background total barium concentrations ranged from 53 to 60 ug/l, and total manganese concentrations ranged from 25 to 83 ug/l. In both cases, total metal concentrations were lower than dissolved concentrations. Higher concentrations of these metals were detected in the surface water sample (C12) collected closer to Area C and downgradient of Site 8. Concentrations of total barium (93

TABLE 4-5

OCCURRENCE AND DISTRIBUTION OF TOTAL INORGANICS IN SURFACE WATER AT SITE 8

WARMINSTER, PENNSYLVANIA

(ug/L)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BARIUM	60	1 / 1	93	NONPARAMETRIC DIST	93
CALCIUM	18300	1 / 1	42800	NONPARAMETRIC DIST	42800
IRON	630	1 / 1	186	NONPARAMETRIC DIST	186
MAGNESIUM	7240	1 / 1	13700	NONPARAMETRIC DIST	13700
MANGANESE	83	1 / 1	159	NONPARAMETRIC DIST	159
POTASSIUM	1700	1 / 1	2150	NONPARAMETRIC DIST	2150
SODIUM	9960	1 / 1	42900	NONPARAMETRIC DIST	42900

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE 2-3

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TA[illegible]4-6

OCCURRENCE AND DISTRIBUTION OF DISSOLVED INORGANICS IN SURFACE WATER AT SITE 8

WARMINSTER, PENNSYLVANIA

(ug/L)

SUBSTANCE	BACKGROUND	SITE-RELATED			
	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BARIUM	59.4	1 / 1	122	NONPARAMETRIC DIST	122
CALCIUM	19100	1 / 1	48100	NONPARAMETRIC DIST	48100
MAGNESIUM	7610	1 / 1	15900	NONPARAMETRIC DIST	15900
MANGANESE	73	1 / 1	162	NONPARAMETRIC DIST	162
POTASSIUM	1310	1 / 1	2320	NONPARAMETRIC DIST	2320
SODIUM	9530	1 / 1	45600	NONPARAMETRIC DIST	45600

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE 2-4

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

ug/l) and manganese (159 ug/l) were detected at this location; the dissolved concentrations were 122 ug/l and 162 ug/l, respectively. For other metals, the dissolved concentrations were generally higher than total concentrations. No organic compounds were detected in the surface water samples.

In summary, only metals were detected in surface water samples collected downstream of Site 8. For both barium and manganese, the surface water concentrations near Site 8 were slightly greater than background levels for both total and dissolved samples.

4.7 SEDIMENT RESULTS

Sediment samples were taken for analysis during all three RI phases. Sediment sample locations near Site 8 are shown on Figure 2-2. During Phase I, two sediment samples (C10 and C11) were collected near Area A, and two samples (C12 and C13) were taken from these same locations during Phase II. During Phase III, two sediment samples (C6 and C8) were also obtained. The designated background sediment samples (C8, C10, and C13) were collected farther downstream from Site 8 along a tributary of Little Neshaminy Creek. The background samples showed lower chemical concentrations than other Site 8 samples. All other samples (C6, C11, and C12) were considered to be potentially impacted by Site 8.

Appendix A-5 summarizes the Site 8 sediment analytical results. Tables 4-7 and 4-8 present the occurrence and distribution of inorganics and organics in Site 8 sediment results, respectively. No VOCs, pesticides, or PCBs were detected in these samples. Several semivolatile organics, including PAHs and phthalates, were detected in both background and other Site 8 samples during Phases I and II. No phthalates were detected in the background Phase III RI Site 8 sediment samples.

In summary, only semivolatile organics and metals were detected in Site 8 sediment samples. The semivolatile organics may be related to runoff from Kirk Road. For metals, no analyte exceeded background levels by a factor of 3. Metal concentrations were found in most sediment samples, including all background samples.

4.8 SUMMARY AND CONCLUSIONS

Significant conclusions regarding the nature and extent of contamination at Site 8 include the following:

- The surface and subsurface soil data suggest that the site is not a source of PCE or other VOC groundwater contamination.

- The removal action has reduced the lead, arsenic, and PAH levels in surface soils west of the runway extension.

TABLE 4-7

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 8

WARMINSTER, PENNSYLVANIA

(mg/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
ALUMINUM	4000	3 / 3	3700 - 6750	NONPARAMETRIC DIST	6750
ARSENIC	2.8	2 / 2	3.4 - 4.2	NONPARAMETRIC DIST	4.20
BARIUM	40.6	2 / 3	49.8 - 74.6	NONPARAMETRIC DIST	74.6
BERYLLIUM	0.62	2 / 2	0.65 - 0.95	NONPARAMETRIC DIST	0.95
CADMIUM	-	1 / 1	0.2	NONPARAMETRIC DIST	0.2
CALCIUM	1290	2 / 2	3430 - 20300	NONPARAMETRIC DIST	20300
CHROMIUM	11.7	3 / 3	14 - 20.5	NONPARAMETRIC DIST	20.5
COBALT	4.4	3 / 3	6 - 9.3	NONPARAMETRIC DIST	9.3
COPPER	7.5	2 / 2	19.5 - 34.6	NONPARAMETRIC DIST	34.6
IRON	11200	3 / 3	16200 - 25400	NORMAL OVER LOGNORMAL	25400
LEAD	24.6	3 / 3	20.4 - 38.5	NONPARAMETRIC DIST	38.5
MAGNESIUM	1320	2 / 2	3290 - 12700	NONPARAMETRIC DIST	12700
MANGANESE	220	3 / 3	307 - 848	NONPARAMETRIC DIST	848
NICKEL	6	2 / 2	10 - 10.6	NONPARAMETRIC DIST	10.6
POTASSIUM	421	2 / 2	924 - 982	NONPARAMETRIC DIST	982
SODIUM	340	1 / 1	732	NONPARAMETRIC DIST	732
VANADIUM	13.6	3 / 3	18 - 34.2	NONPARAMETRIC DIST	34.2
ZINC	57.2	3 / 3	59 - 78.5	NONPARAMETRIC DIST	78.5

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE 2-5

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 4-8

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 8

WARMINSTER, PENNSYLVANIA

(ug/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
ACENAPHTHENE	-	1 / 2	120	NONPARAMETRIC DIST	120
ACENAPHTHYLENE	-	1 / 2	60	NONPARAMETRIC DIST	60
ANTHRACENE	97	2 / 2	72 - 290	NONPARAMETRIC DIST	290
BENZ(A)ANTHRACENE	280	2 / 2	280 - 720	NONPARAMETRIC DIST	720
BENZO(A)PYRENE	260	2 / 2	270 - 650	NONPARAMETRIC DIST	650
BENZO(B)FLUORANTHENE	320	2 / 2	230 - 820	NONPARAMETRIC DIST	820
BENZO(G,H,I)PERYLENE	150	1 / 2	320	NONPARAMETRIC DIST	320
BENZO(K)FLUORANTHENE	200	2 / 2	350 - 370	NONPARAMETRIC DIST	370
BIS(2-ETHYLHEXYL)PHTHALAT	200	1 / 1	93	NONPARAMETRIC DIST	93
CARBAZOLE	-	2 / 2	490 - 1100	NONPARAMETRIC DIST	1100
CHRYSENE	340	2 / 2	340 - 740	NONPARAMETRIC DIST	740
DI-N-OCTYLPHTHALATE	-	1 / 2	94	NONPARAMETRIC DIST	94
DIBENZ(A,H)ANTHRACENE	53	1 / 2	140	NONPARAMETRIC DIST	140
DIBENZOFURAN	-	1 / 2	72	NONPARAMETRIC DIST	72
FLUORANTHENE	550	2 / 2	670 - 1200	NONPARAMETRIC DIST	1200
FLUORENE	-	1 / 2	140	NONPARAMETRIC DIST	140
PYRENE	590	2 / 2	540 - 1400	NONPARAMETRIC DIST	1400

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE 2-6

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

- Subsurface soils in the vicinity of the site are not significantly impacted.

- Surface water and sediment samples collected from the tributary near Site 8 show contaminant concentrations only slightly higher than the respective background levels.

5.0 CONTAMINANT FATE AND TRANSPORT

Various aspects of contaminant fate and transport at Site 8 are discussed in this section. Chemical and physical properties affecting contaminant migration are discussed in Section 5.1. Potential contaminant migration routes are identified and discussed in Section 5.2. Section 5.3 presents a brief discussion of contaminant persistence.

5.1 PHYSICAL AND CHEMICAL PROPERTIES

This section discusses the physical and chemical properties of the contaminants found at Site 8. These properties, to the extent available, are presented in Table 5-1. These parameters may be used to assess the behavior of a contaminant in the environment.

Empirically determined literature values of water solubility, octanol-water partitioning coefficient (Kow), organic carbon/chemical partitioning coefficient (Koc), vapor pressure, Henry's Law constant, bioconcentration factor (BCF), and specific gravity are presented for organic chemicals, as available. Many of these parameters are not applicable to inorganic chemicals. For inorganics, specific gravity and BCFs have been presented, along with qualitative descriptions of important environmental fate properties. Calculated values, which were obtained using approximation methods, are presented when literature values are unavailable. A discussion of the environmental significance of each of these parameters follows.

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is a function of its water solubility. More soluble chemicals are expected to enter water much more readily and rapidly than less soluble chemicals. The water solubilities presented in Table 5-1 indicate that the VOCs are several orders of magnitude more water soluble than SVOCs (including phthalates and PAHs) or pesticides. This conclusion is reinforced by the fact that VOCs are typically discovered more frequently and at greater concentrations in groundwater than less soluble chemicals. (Volatilization of VOCs from surface media is also an important factor in the observed distribution of these chemicals.)

Although PAHs were detected in soil, such compounds have not been detected in groundwater. This is a manifestation of their limited water solubility and tendency to adsorb onto soil/sediment particles.

The Kow is a measure of the equilibrium partitioning of a chemical between octanol and water. The Kow is also used to estimate BCFs in aquatic organisms. A linear relationship between the Kow and the uptake of chemicals by fatty tissues of animal and human receptors has been determined (Lyman et al., 1990).

TABLE 5-1 (PAGE 1 OF 3)
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS
SITEWIDE - SURFACE WATER, SEDIMENT, SURFACE SOIL, AND SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	BIOCONCENTRATION FACTOR (ug/kg/ug/L)	SPECIFIC GRAVITY	Koc
VOLATILES								
1,1,1-TRICHLOROETHANE	133.41	720	2.47	1.23E2 (25C)	3.00E-02	8.10E+01	1.35	1.52E+01
1,1,2,2-TETRACHLOROETHANE	167.86	3.10E+03	-	6.80E-03	3.70E-04	-	-	7.94E+01
1,1-DICHLORETHANE	98.96	5500	1.79	1.80E+02	4.26E-03	1.90E+01	1.174	3.00E+01
1,1-DICHLOROETHENE	96.94	400	1.48	5.91E+02	1.90E-01	5.30E+01	1.218	6.50E+01
1,2-DICHLOROETHENE (TOTAL)	96.94	800 (20C)	-	200 (25C)	4.08E-03	4.80E+01	1.28	5.90E+01
TRANS-1,3-DICHLOROPROPENE	110.97	2.80E+03	-	3.80E-02	1.50E-03	-	-	-
ACETONE	58.08	6.80E+05	-0.24	2.70E+02	3.43E-05	3.00E-01	0.791	9.20E+00
2-BUTANONE	72.1	35300	0.26	7.80E+01	2.08E-05	6.00E-01	0.805	1.70E+01
BENZENE	78.12	1780	2.13	95.2 (25C)	5.50E-03	7.84E+00	-	6.50E+01
BROMOMETHANE	94.95	1.40E+04	-	2.2	1.40E-02	-	-	1.70E+02
CARBON DISULFIDE	76.14	2300	1.84	2.60E+02	1.13E-02	1.10E+01	1.263	1.42E+02
CARBON TETRACHLORIDE	153.82	785	2.64	9.00E+01	2.30E-02	2.11E+02	1.59	4.39E+02
CHLOROBENZENE	113	4.10E+02	-	1.60E-02	4.47E-03	-	-	2.04E+02
CHLOROETHANE	64.52	5740	1.54	1.00E+03	4.00E-02	-	0.879	4.17E+01
CHLOROMETHANE	50.94	6450	0.95	3.76E+03	4.00E-02	3.20E+00	0.991	4.30E+00
CHLOROFORM	119.38	8200	1.97 (20C)	1.50E+02	2.88E-03	5.56E+00	1.489	4.40E+01
ETHYLBENZENE	106.16	152	3.15	7.00E+00	6.60E-03	6.68E+01	0.867	1.10E+03
METHYLENE CHLORIDE	84.93	1.70E+04	-	4.90E-01	2.40E-03	-	-	1.58E+01
TETRACHLOROETHENE	165.83	200	2.6 (20C)	1.40E+01	1.53E-02	2.52E+02	1.626	3.64E+02
TOLUENE	92.13	534.8 (25C)	2.69 (20C)	2.87E+01	6.66E-03	2.50E+01	0.867	3.00E+02
TRICHLOROETHENE	131.39	1100	2.53	5.79E+01	9.10E-03	9.70E+01	1.46	1.26E+02
XYLENE (TOTAL)	106.16	187	2.77-3.2	6.50E+00	4.33E-63	1.50E-02	0.86-0.88	2.48E+02
SEMIVOLATILES								
1,4-DICHLOROBENZENE	147.01	73	-	1.40E-03	2.80E-03	-	-	5.13E+02
2-METHYLNAPHTHALENE	142.19	26-28 (25C)	4.26	0.087 (25C)	6.00E-04	1.00E+03	0.994	5.80E+03
2-NITROPHENOL	139.11	2.10E+03	-	1.30E-03	8.70E-05	-	-	3.72E+01
3,3'-DICHLOROBENZIDINE	253.13	3.5	-	2.90E-10	2.10E-08	-	-	2.24E+04
4-METHYL-2-PENTANONE	100.2	2.00E+04	-	2.50E-02	1.20E-04	-	-	1.74E+01
4-METHYLPHENOL	108.1	4400	1.92/1.94	4.00E-02	1.29E-06	1.10E+01	1.0347	2.43E+01
4-NITROPHENOL	139.11	1.60E+04	-	2.90E-03	2.50E-05	-	-	2.34E+02
ACENAPHTHENE	154.2	3.42 (25C)	3.92	1.55E-3 (25C)	9.10E-05	1.80E+03	1.0242	4.60E+03
ACENAPHTHYLENE	152.2	3.93 (25C)	3.72	2.90E-02	1.45E-03	1.00E+03	-	2.50E+03
ANTHRACENE	178.2	0.045 (25C)	4.45	1.7E-5 (25C)	8.60E-05	4.70E+03	1.283	1.40E+04
BENZO(A)ANTHRACENE	228.28	0.0057	5.61	2.20E-08	1.00E-06	5.30E+04	-	2.00E+05
BENZO(A)PYRENE	252	0.0038 (25C)	5.98	5.60E-09	4.90E-07	1.09E+04	-	5.50E+06
BENZO(B)FLUORANTHENE	252.3	0.0014 (25C)	6.57	5.00E-07	1.22E-05	1.40E+05	-	5.50E+05
BENZO(G,H,I)PERYLENE	276	0.00026 (25C)	7.23	1.03E-10 (25C)	1.44E-07	3.50E+05	-	1.60E+06
BENZO(K)FLUORANTHENE	252.3	0.0043 (25C)	6.84	5.00E-07	3.87E-05	1.40E+05	-	5.50E+05
BIS(2-ETHYLHEXYL)PHTHALATE	390.62	0.4 (25C)	5.3	2.00E-07	3.00E-07	2.30E+08	0.99	2.00E+09
BUTYLBENZYLPHTHALATE	312	2.9	4.78	6.00E-05	8.30E-06	4.70E+04	1.1 (25C)	1.70E+05
CARBAZOLE	167.21	-	3.29	400 (323C)	-	-	1.1	1.20E+03
CHRYSENE	228.3	0.0018 (25C)	5.61	6.3E-9 (25C)	1.05E-06	5.30E+04	1.274	2.00E+05
DI-N-BUTYLPHTHALATE	278.35	4.00E+02	5.20E+00	1.00E-01	2.80E-07	8.90E+01	1	5.23E+00
DI-N-OCTYLPHTHALATE	391	3 (25C)	9.2	1.40E-04	1.70E-05	3.90E+08	0.99	3.60E+09
DIBENZ(A,H)ANTHRACENE	278.4	0.005 (25C)	5.97	1.00E-10	7.30E-08	6.90E+05	-	3.30E+06

- = Physical or chemical properties not available for this chemical in this classification

TABLE 5-1 (PAGE 2 OF 3)
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS
SITEWIDE - SURFACE WATER, SEDIMENT, SURFACE SOIL, AND SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	BIOCONCENTRATION FACTOR (ug/kg/ug/L)	SPECIFIC GRAVITY	Koc
SEMIVOLATILES (CONTINUED)								
DIBENZOFURAN	168.2	10	4.12	-	-	-	-	8.13E+03
DIETHYLPHTHALATE	222.2	210	2.47	3.5E-3 (25C)	1.20E-06	1.07E+02	1.12	1.42E+02
FLUORANTHENE	202.3	0.26 (25C)	5.33	5E-6 (25C)	6.50E-06	1.20E+04	1.252	3.80E+04
FLUORENE	116.2	1.69 (25C)	4.18	7.10E-04	6.40E-05	3.80E+03	1.203	7.30E+03
HEXACHLOROETHANE	236.76	4.10E+01	-	6.20E-04	3.60E-03	-	-	2.19E+03
INDENO(1,2,3-CD)PYRENE	276.3	0.00053 (25C)	7.66	1.00E-10	6.95E-08	3.50E+05	-	1.60E+06
N-NITROSODIPHENYLAMINE (1)	198.23	3.50E+01	2.79E+00	1.00E-01	3.10E+00	1.40E+02	-	2.81E+00
NAPHTHALENE	128.2	31.7 (25C)	3.01/3.45	8.7E-3 (25C)	4.60E-04	4.20E+02	1.152	9.40E+02
PENTACHLOROPHENOL	266	1.30E+01	-	7.10E-07	1.40E-05	-	-	2.00E+04
PYRENE	202.3	0.13 (25C)	5.18	2.5E-6(25C)	5.10E-06	1.20E+04	-	3.80E+04
PESTICIDES/PCBs								
4,4'-DDD	320.1	0.09 (25C)	1.60E+06	1.2E-7 (25C)	2.20E-08	1.80E+05	-	7.70E+05
4,4'-DDE	318	0.04 (20C)	4.28	6.50E-06	6.80E-05	8.00E+06	-	4.40E+06
4,4'-DDT	354.5	0.0055 (25C)	6.19 (20C)	1.9E-7 (25C)	1.58E-05	8.00E+06	-	3.90E+06
ALDRIN	364.91	1.70E-02	5.11E+00	2.30E-06	5.00E-04	4.70E+03	1.7	4.98E+00
ALPHA-CHLORDANE	409.8	5.60E-02	2.78E+00	1.00E-05	3.70E-05	1.40E+03	1.11	5.15E+00
AROCLOR-1242	254	8.00E-02	-	1.00E-07	4.10E-04	-	-	4.79E+04
AROCLOR-1248	299.5	0.054	5.75	4.9E-4 (25C)	3.60E-03	-	-	2.50E+05
AROCLOR-1254	325.1	3.10E-02	6.04E+00	7.70E-05	2.60E-03	3.10E+04	-	5.72E+00
AROCLOR-1260	375.7	0.08 (24C)	7.15	4E-5 (25C)	0.74	1.00E+05	-	6.70E+06
BETA-BHC	290.85	0.54	-	6.50E-10	3.50E-07	-	-	2.29E+03
DELTA-BHC	290.85	2.10E+01	4.14E+00	2.00E-02	2.50E-07	1.30E+02	1.9	3.58E+00
DIELDRIN	380.91	1.90E-01	4.09E+00	1.80E-07	5.80E-05	4.70E+03	1.8	3.23E+00
ENDOSULFAN I	406.95	3.20E-01	-	1.30E-08	1.70E-05	-	-	2.04E+03
ENDOSULFAN II	406.95	3.30E-01	3.62E+00	1.00E-05	1.91E-05	2.70E+02	1.7 (20/20C)	2.30E+00
ENDOSULFAN SULFATE	422.92	2.20E-01	3.66E+00	NA	2.60E-05	-	-	1.62E+00
ENDRIN	380.92	2.60E-01	5.60E+00	2.00E-07	4.00E-07	4.00E+03	1.7	3.23E+00
ENDRIN ALDEHYDE	380.92	2.60E-01	5.60E+00	2.00E-07	3.90E-07	4.00E+03	-	2.83E+00
ENDRIN KETONE	380.92	-	-	-	4.00E-07	7.10E-02	-	-
GAMMA-CHLORDANE	409.8	5.60E-02	2.78E+00	1.00E-05	3.70E-05	1.40E+03	1.11	5.15E+00
GAMMA-BHC	290.85	4.20E+00	-	4.90E-08	3.40E-06	-	-	1.38E+03
HEPTACHLOR	373.35	2.70E-01	-	4.30E-07	5.80E-04	-	-	6.76E+03
HEPTACHLOR EPOXIDE	389.2	2.70E-01	-	5.70E-09	8.30E-06	-	-	2.09E+04
METHOXYCHLOR	345.65	4.00E-02	4.68E+00	-	3.00E-05	8.30E+03	1.4	4.90E+00
DIOXINS/FURANS								
2,3,7,8-TCDD**	322	0.000019	-	9.70E-13	9.20E-06	-	-	4.27E+06

- = Physical or chemical properties not available for this chemical in this classification

** 2,3,7,8-TCDD was not detected at NAWC Warminster, but the physical/chemical properties listed here are presented as an indication of the properties of other dioxin/furan congeners

TABLE 5-1 (PAGE 3 OF 3)
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS
SITEWIDE - SURFACE WATER, SEDIMENT, SURFACE SOIL, AND SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	BIOCONCENTRATION FACTOR (ug/kg/ug/L)	SPECIFIC GRAVITY	Koc
INORGANICS								
ALUMINUM	26.98	INSOLUBLE	-	0	-	-	2.708	-
ANTIMONY	121.75	-	-	1 (886C)	-	1.00E+00	6.684	-
ARSENIC	74.92	-	-	1 (372C)	-	4.40E+01	5.72	-
BARIUM	137.34	DECOMPOSE	-		-	1.00E+00	3.5	-
BERYLLIUM	9.01	-	-	1 (1520C)	-	1.90E+01	1.85	-
CADMIUM	112.4	INSOLUBLE	-	1 (1284C)	-	6.40E+01	8.642	-
CALCIUM	40.08	DECOMPOSE	-		-	-	1.57	-
CHROMIUM	52	INSOLUBLE	-	0	-	1.60E+01	7.2	-
COBALT	58.93	INSOLUBLE	-	0	-	1.00E+00	8.9	-
COPPER	63.54	INSOLUBLE	-	1 (1628C); 10 (1870C)	-	3.60E+01	8.92	-
IRON	55.85	INSOLUBLE	-	0	-	-	7.86	-
LEAD	207.19	INSOLUBLE	-	1 (980C)	-	1.00E+00	11.35	-
MAGNESIUM	24.312	-	-	-	-	-	1.738	-
MANGANESE	54.94	DECOMPOSE	-	1 (1292C)	-	1.00E+00	7.2	-
MERCURY	200.59	5.6E-03g/100cc	-	2E-03 (25C)	-	1.00E+00	13.5939	-
NICKEL	58.71	INSOLUBLE	-	1 (1810C)	-	4.70E+01	8.902	-
POTASSIUM	39.1	DECOMPOSE	-	-	-	-	0.862	-
SELENIUM	78.96	INSOLUBLE	-	0	-	1.00E+00	4.26-4.81	-
SILVER	107.87	INSOLUBLE	-	0	-	5.00E-01	10.5	-
SODIUM	22.9898	DECOMPOSE	-	-	-	-	0.97	-
THALLIUM	204.37	-	-	-	-	-	11.85	-
VANADIUM	50.94	-	-	-	-	1.00E+00	5.96	-
ZINC	65.37	-	-	1 (487C)	-	4.70E+01	7.133	-
CYANIDE	27	SOLUBLE	-	657.8 (21.9C)	-	-	0.699	-

- = Physical or chemical properties not available for this chemical in this classification

PAHs, phthalates, and chlorinated pesticides are several orders of magnitude more likely to partition to fatty tissues than the more water-soluble VOCs. The Kow is also useful in characterizing the sorption of compounds by organic soils when experimental values are not available.

The Koc is related to the water solubility and the Kow. This parameter indicates the tendency of a chemical to bind to soil particles containing organic carbon. Chemicals with high Koc generally have low water solubilities and vice versa. Chemicals such as phthalates, PAHs, and pesticides are relatively immobile in the subsurface environment and are preferentially bound to the soil phase. These compounds are not subject to groundwater transport to the same extent as compounds with high water solubilities.

Koc may be used to infer the relative rates at which the more mobile chemicals are transported in the groundwater. The Koc and the fractional organic carbon content of the soil (FOC) may be used to estimate an equilibrium distribution coefficient (Kd) for the solid and aqueous matrices using the following relationship:

$$Kd = Koc \times FOC$$

where: Kd = Distribution coefficient
FOC = Soil organic carbon content
Koc = Organic carbon partition coefficient

Total organic carbon (TOC) results may be used to calculate FOC for soils. One subsurface soil taken at Site 8 was analyzed for TOC, and the result was 3,700 mg/kg. Thus

$$FOC = (3{,}700 \text{ mg/kg})\ (1E\text{-}6 \text{ kg/mg})$$
$$= 0.0037 \text{ kg organic carbon/kg soil}$$

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary significance in instances where environmental interfaces such as surface soil/air and surface water/air are important, rather than in evaluation of groundwater and subsurface soils. Vapor pressures for VOCs are generally many times higher than vapor pressures for phthalate esters and PAHs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures.

Both vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies. The Henry's Law constant is the equilibrium vapor pressure of a chemical above a solution divided by its concentration in the solution (for dilute systems). The Henry's Law constant may also be used to calculate the equilibrium contaminant concentrations in the vapor versus liquid phases for dilute solutions

commonly encountered in environmental settings. The Henry's Law constant is also useful for mass transfer applications for air-stripping column design.

BCFs represent the ratio of aquatic-organism tissue concentration to water concentration. The ratio is both contaminant and species specific, as well as tissue specific. When site-specific values are not measured, literature values may be used or the BCF may be derived from the Kow. Phthalate esters, PAHs, and pesticides will bioconcentrate at orders of magnitude greater than those concentrations found in the water where the exposed species reside.

Specific gravity is the ratio of the mass of a given volume of pure chemical at a specified temperature to the mass of the same volume of water at a given temperature. It primary use is to determine whether immiscible compounds or very high concentrations of a pure contaminant will float or sink in water. As shown in Table 5-1, most of the chemicals detected in this study area were denser than water.

According to EPA's Soil Screening Guidance (EPA, 1996a), most of the inorganic chemicals have a strong tendency to adsorb onto sediment particles, a factor that greatly reduces their mobility. For some metals, such as lead, bioaccumulation also plays an important role in environmental fate. While the metals themselves are insoluble in water, soluble species of some metals, such as chromium and antimony, can increase contaminant mobility.

5.2 POTENTIAL MIGRATION ROUTES

In general, numerous potential migration routes exist in areas contaminated with hazardous materials. Such migration routes include, but are not limited to, atmospheric migration via particulates or volatile/semivolatile emissions, overland migration of dissolved or adsorbed contaminants, surface water transport, and groundwater transport.

The first possible route for contaminant migration from Site 8 through the air is the volatilization of compounds from surface soil, surface water, or subsurface soil (especially if exposed through excavation, erosion, etc.). This can be effectively ruled out, because no VOCs were detected in surface soil, subsurface soil, or surface water at or downgradient of Site 8.

Another possible scenario for contaminant migration is the generation of contaminant dusts from the subsurface soil (sediments are covered by water). This would be potentially important for metals and would depend upon the subsurface material being exposed in some way. Potential future risks to estimated dust emissions are assessed in Section 6.0.

Chemicals found in soil, especially subsurface soil, can leach into groundwater. This is especially likely to

happen with soluble, low-Koc compounds such as the VOCs. Leaching of organic compounds was not estimated in this report, due to the absence of VOCs in subsurface soil samples.

One possible migration route is from groundwater at Site 8 into the downgradient stream located north of Werner Park. Surface water and sediment were sampled downstream of this study area, and the results were presented in Sections 4.6 and 4.7.

Another possible route of groundwater migration is from the areas immediately beneath Site 8 into the deeper portions of the bedrock aquifer. The third possible route of groundwater migration is from the site to off-site areas including those across the unnamed tributary in Werner Park. These groundwater migration routes were not addressed as part of this report.

The primary migration route for stream contaminants in the surface water and sediment is via downstream flow. Contaminants may, to some degree, migrate from sediment to surface water and vice versa. However, chemicals, such as metals, and compounds with high organic carbon partition coefficient (Koc), such as PAHs and phthalates, tend to bind strongly to sediment and migrate slowly (Versar, 1979).

5.3 CONTAMINANT PERSISTENCE

Several transformation processes are believed to affect the persistence of organic chemicals in the environment. The primary processes affecting contaminant fate in the environment include microbial, photolytic, and chemical degradation.

Photolytic degradation is considered to be insignificant for phthalates and of unknown significance for PAHs (Versar, 1979). Generally, organic molecules are subject to several chemical reactions under environmental conditions. Such reaction mechanisms include acid/base reaction, addition, elimination, and hydrolysis. However, monocyclic aromatics are not particularly amenable to the majority of these degradation mechanisms. Hydrolysis is considered to be negligible for PAHs and halogenated hydrocarbon pesticides. Phthalates can be more susceptible (Versar, 1979; EPA, 1982; Lyman et al., 1990). Hydrolysis reactions can occur under acidic, basic, or neutral conditions. Bacterial degradation is a potential environmental fate mechanism. Biodegradation is not significant for the chemicals detected at Site 8 (EPA, 1982; Verschueren, 1983).

6.0 BASELINE RISK ASSESSMENT

This section provides a description of the risk assessment methods employed for Site 8, as well as a summary of the risk assessment results. The general objectives of the risk assessment were to estimate the actual or potential risks to human health and the environment resulting from the presence of contamination in surface soil, subsurface soil, surface water, and sediment and to provide the basis for determining appropriate remedial measures for these media as part of the FS report (Section 7.0). Sections 6.1 through 6.7 discuss the human health risk assessment (HHRA). Section 6.8 addresses the ecological risk assessment (ERA). The risk assessment was based on the nature and extent of contamination present at OU-5 after the surface soil removal action was taken into consideration.

6.1 HUMAN HEALTH RISK ASSESSMENT

The specific objectives of the HHRA were as follows:

- To estimate the actual or potential risks to human health resulting from the presence of contamination in surface and subsurface soils after remedial actions.
- To estimate the actual or potential risks to human health resulting from the presence of contamination in off-site surface water and sediment.
- To provide a basis for attainment of concentrations that are protective of potential human receptors under industrial, casual user, and hypothetical residential exposure scenarios.
- To determine the need for remedial measures (if applicable) for any unacceptable human health risks.

Three major aspects of chemical contamination must be considered when assessing public health risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist either at the source or via migration pathways if exposure occurs at a remote location other than the source; and (3) human or environmental receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without any one of the three factors listed above, there is no risk.

In order to estimate the potential for human health risk attributable to post remediation surface and subsurface soil, information regarding the toxicity of the compounds detected in the various media, the distribution of contamination, potential migration pathways, and a site-specific estimate of chemical intake

via assumed exposure routes were combined. The risk assessment processes were performed in accordance with current EPA risk assessment guidance.

The future anticipated land use at Site 8 is expected to be light industrial. Likely potential receptors include light industrial workers and casual use visitors from surrounding neighborhoods. Residential land use is not anticipated for this site. Risks estimated assuming residential land use provide a baseline to which all receptor risks can be compared, however, residential risks are purely hypothetical in nature. If the land use designation were to change in the future, quantitative risks estimated in this section should be re-evaluated.

The post-remedial HHRA for Site 8 was divided into Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization, Uncertainty Analysis, and Conclusions. Each section is briefly discussed below.

Data Evaluation (Section 6.2) is primarily concerned with data quality assessment, background comparison tests, identification of chemicals of potential concern (COPCs), distributional analysis of the data, and calculation of exposure point concentrations. The site-specific background and site data are analyzed and COPCs are selected that are representative of the environmental contaminants present at the site. Distributional analysis of the data is the basis for calculating an exposure point concentration, which provides the chemical input into each of the exposure pathways.

Exposure Assessment (Section 6.3) identifies potential human exposure, including a characterization of the site setting, selection of potential receptors, selection of exposure routes by medium, a presentation of a site-conceptual model, derivation of exposure estimates for each pathway, and a special explanation of the methodology used to evaluate lead concentrations in environmental media. This section identifies potential pathways of COPC migration, selected potential receptors, and the estimated intakes of COPCs for the identified receptors.

Toxicity Assessment (Section 6.4) presents available reference doses, cancer slope factors, EPA weight of evidence, adjustment of the dose-response parameters, relative potencies for polycyclic aromatic hydrocarbons (PAHs), and toxicity criteria for chromium. Quantitative toxicity indices, where available, are presented in this section, including any applicable regulatory standards and criteria.

Risk Characterization (Section 6.5) presents the approaches for determining carcinogenic risks, noncarcinogenic risks, and risks associated with exposure to lead concentrations in environmental media. The risk characterization evaluates the potential for adverse health effects from exposure to COPC concentrations in environmental media by integrating information developed during the toxicity and exposure assessments.

Uncertainty Analysis (Section 6.6) is a discussion of the general and site-specific uncertainties associated with the HHRA.

Conclusions (Section 6.7) presents major conclusions of the HHRA.

6.2 DATA EVALUATION

This section presents the approaches for data quality assessment, background comparison tests, identification of contaminants of potential concern (COPCs), distributional analysis of the data, and the calculation of exposure point concentrations. Four environmental media were sampled at Site 8: on-site surface soil, on-site subsurface soil, off-site sediment, and off-site surface water. Surface water was sampled for both total and dissolved inorganics and organics, however, no organic chemicals were positively detected in surface water samples.

6.2.1 Data Quality Assessment

Data quality was assessed using Data Useability Worksheets that are consistent with Risk Assessment Guidance for Superfunds (RAGs) - Part A (EPA, 1989a) and Data Quality Assessment guidance (EPA, 1996a). These data useability worksheets act as a summary of important data quality issues and potential impacts of the issues on the quantitative HHRA. The data useability worksheets were divided into four main sections: (1) Field Sampling, (2) Analytical Techniques, (3) Data Quality Objectives, and (4) Data Validation and Interpretation; and are provided for surface soil, subsurface soil, sediment, surface water (total inorganics), and surface water (dissolved inorganics) in Appendix G, Part I. The results of the data useability worksheets for surface soil, subsurface soil, sediment, and surface water (both total and dissolved inorganics) show that no major data quality assessment issues were present for Site 8, therefore, no impact on the quantitative HHRA was expected.

6.2.2 Background Comparison Tests

An array of statistical tests were performed to determine if results of samples from surface soil and subsurface soil were elevated relative to background sample results. Sediment and surface water (both total and dissolved inorganics) data sets were not compared to background sediment and surface water data because of the low number of data sampling locations in both background and site-related data sets. The name of each test, the statistical question answered by the test, the assumptions required to run the test, and the criterion used by each test to judge whether site data are greater than background are delineated in the headings and footnotes to background comparison tables for surface and subsurface soil presented in Appendix G, Part II. These statistical procedures include three quantitative tests that evaluate overall differences between the entire populations of site and background data values; four quantitative tests that essentially look for hot spots; and two qualitative tests that examine only the frequency of detection

(proportion of detected versus non-detected values in site versus background) but not the magnitude of values.

Each statistical test was performed using a decision-making probability level (P-level) of 0.05, which means that, in situations where the test conclusion states that site-related results are greater than background, the chance of the test yielding a false conclusion caused by random variations in the data set is five percent or less. The overall conclusion (whether site results are greater than background) was assumed to be "yes" if any one of the quantitative tests concluded that site data are elevated above background. If no conclusion could be reached for any of the quantitative tests (e.g., if the assumptions necessary to run each of the various tests were not valid), then the overall decision was based on the conclusions of the qualitative tests alone. Further information regarding each statistical test is presented below:

- The means of the two data sets were compared if the same type of distribution (normal or lognormal) was determined for both site and background data set. If the site and background data exhibited equal standard deviations (based upon Bartlett's test for equal variances), then the student's t-test was applied; otherwise, Satterthwaite's t-test was performed to determine if the site mean is greater than the background mean. The t-test is valid only if at least 85 percent of site data and 85 percent of background data are positive detects, there are at least three sampling points in each data set, and the pooled standard deviation is not zero.

- Nonparametric statistical tests, which do not require underlying assumptions regarding equal data distributions, were also applied in each case. The Mann-Whitney U-test was used to determine whether the site and background data are from populations with identical medians and rank distributions. The Mann-Whitney test involves combining the two data sets, ranking results from smallest to largest, and evaluating whether the two sites have a similar distribution of data within the range of low to high ranks. If more than 40 percent nondetected results are present in either the site or the background data set or when multiple levels of detection limits are present, a different statistically valid test, Gehan's test, was substituted because recent guidance (EPA, 1992b) indicates that the Mann-Whitney test is not valid in the aforementioned situations. (Gehan's test is statistically equivalent to the Mann-Whitney Test if all results are positive.) For either of these tests to work, not all data points can be tied and there must be at least two background data points. The Mann-Whitney U test and the Gehan's test statistics were computed using appropriate score adjustments for tied values and a normal approximation when sufficient data points were available; whereas, an exact computation of probabilities was used in the situations where there were very few (for example, less than eight) data points.

- A 95 percent upper tolerance limit (UTL) test was applied to determine whether the maximum concentration detected in an area of interest was a hot spot of a magnitude exceeding 95 percent of the background population. The 95 percent UTL is defined as the calculated upper limit that, on the average, is expected to include 95 percent of the background population. If the background data were determined to match the shape of a normal or lognormal population, then the limit was calculated using the t-distribution and the appropriate normal or log-transformed mean and standard deviation from the background data set. For this test to be valid, the background data set was required to be comprised of at least 85 percent detects and at least three data points.

- A substitute procedure for the 95 percent UTL, called the 95 percent quantile test, was employed to test for hot spots if the background data were not determined to be normally or log-normally distributed. For the quantile test to be valid, at least 19 background data points were required, no detection limit could be greater than the UTL, and at least 10 percent of the data points must be detects in the background data set.

- The upper ranks test (EPA, 1992b, 1996a) is another hot spot test. This test combines the site and background data into one set and determines whether the major portion of a subset of the largest detected results is comprised chiefly of site data rather than an equal mixture of site and background. In this procedure, the probability is calculated that k or more samples from the largest r data points in the combined data set are comprised of site data, assuming that the site and background populations are equal. In the event that there is less than a five percent chance that this could happen if the populations are indeed the same, then the test concludes that there is a hot spot comprised of k samples from the area of interest.

- In the event that none of the above quantitative statistical tests yielded a definite "yes" or "no" decision, a test of proportions was used to determine if the percentage of positively detected results was greater in the site data versus the background data. When only a very small portion of results are positive detections (less than 10 percent), this test is recommended (EPA, 1996a, 1989b). The test is routinely applied using a normal distribution approximation to the probability that site is above background but is not considered valid when fewer than five positive detections are reported in either site or background. This limitation for the routine test of proportions precluded any comparison of site to background for nearly all volatile organic compounds (VOCs) in surface water, although most were not detected at all in background. To reach a confident decision regarding VOCs in surface water, a generalized version of the test of proportions, called the Fisher Exact Test, was required (Brownlee, 1965). This test can be applied to all

situations because it calculates the exact probability for all combinations of possible outcomes and gives a probability level for the condition where the observed frequency of site detects is greater than background, given the number of samples involved.

- As recommended (EPA, 1996a, 1992a, 1989b), quantitative statistical tests were preceded by data analysis to evaluate the distributional shape for both positive and nondetected data, of which quantile plots or tables are one recommended (and efficient) approach. This data analysis is required because multiple detection limits bias or invalidate the conclusions of common statistical tests. For each chemical in each risk group, a quantile (percentile) range evaluation was required to compare the number and magnitude of site and background nondetects. In particular, some of the above tests do not tolerate any non-detects above a certain magnitude or portion of the total. In the case of the Mann-Whitney test, careful quantitative evaluation was used to determine if the site and background populations exhibited the same distributional spread of non-detected results and to determine if the Gehan's test, a more robust test, should be used.

6.2.3 Identification of COPCs

The selection of COPCs was based on various aspects of chemical concentration, occurrence, distribution, and toxicity. COPCs were selected to represent site contamination and to provide the framework for the quantitative HHRA. The COPC selection protocols are defined in Table 6-1.

Four media (surface soil, subsurface soil, off-site sediment, and off-site surface water) were evaluated for Site 8 human health risks. The results of the analysis of Site 8 samples are summarized in the occurrence and distribution tables for (1) background soil [Section 2.0 - soils that were collected from various locations at NAWC Warminster (Figure 2-6) that are considered unaffected by past site-related activities; all surface and subsurface background samples were pooled together and used as background for any site-specific surface or subsurface data set]; (2) background sediment and surface water (3) surface soil (4) subsurface soil; (5) off-site sediment; and (6) off-site surface water. These tables contain statistics including frequency of detection, range of positive detection, and location of maximum detection.

Subsets of the surface soil, subsurface soil, sediment, and surface water (both total and dissolved inorganics) databases were evaluated in this HHRA by including only those chemicals detected at least once in each media at a suspected source concern. Concentrations of inorganic and/or organic constituents detected in surface soil, subsurface soil, sediment, surface water (total inorganics), and surface water (dissolved inorganics) and results of background analysis are presented in Tables 6-2 through 6-6, respectively

SUMMARY OF COPC SELECTION CRITERIA, SITE 8 SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT, AND SURFACE WATER
NAWC WARMINSTER, PENNSYLVANIA

COPC Selection Protocol	Definition	Decision Result #1	Decision Result #2	Notes
Essential Nutrients	Eliminate essential nutrients (calcium, chloride, magnesium, potassium, and sodium) as COPCs.	Eliminate essential nutrients as COPCs.	Eliminate essential nutrients as COPCs.	Essential nutrients that are present at elevated concentrations will be noted in the qualitative HHRA.
Background Screening (Applicable for Surface and Subsurface Soil Only)	Compare inorganic contaminants in surface and subsurface soil to background data set.	If a surface and/or subsurface soil inorganic contaminant is within the range of background, eliminate the chemical as COPC.	If statistical tests show surface and/or subsurface inorganic contaminant levels exceed background check Frequency of Detection.	Background screening is only applicable for surface and subsurface soil inorganic contaminants. Organic contaminants are subject to a check for Frequency of Detection.
Frequency of Detection	Compare frequency of positive detections relative to total number of usable results to determine if a substance was detected in greater than 5 percent of samples [Applicable only if the number of samples collected in each media of consideration was >= 20].	If frequency of detection is less than 5 percent and the number of samples collected was >=20, eliminate the chemical as a COPC.	If frequency of detection is greater than 5 percent, do a Toxicity Screen.	Frequency of detection screening applies to all organic and inorganic contaminants. Contaminants detected in less than 5 percent of samples are eliminated from consideration. This screen could miss potential "Hot Spots", however, any potential "Hot Spots" were eliminated during the removal actions at the site.
Toxicity Screen vs. RBC	Compare maximum concentrations of inorganic substances (only those that exceed background) and organic contaminants in surface and subsurface soil to Risk Based Screening Levels (RBCs).* Compare maximum concentrations of inorganic and organic substances substances in sediment and surface water to Risk Based Screening Levels (RBCs).**	If maximum concentration of contaminant is less than the applicable RBC; eliminate the contaminat as a COPC.	If the maximum concentration of a contaminant exceeds the applicable RBC, the contaminant is selected as a COPC	Chemicals that are selected as a COPCs will be evaluated quantitatively in this HHRA. NOTE: The RBC for hexavalent chromium (Cr VI) is used in this HHRA because speciation data (Cr VI vs. Cr III) were not available for soil samples collected at Site 6.
Lead	Compare maximum concentrations of lead in surface and subsurface soil and sediment to a value of 400 mg/kg (EPA, 1994).*** Compare maximum concentrations of lead in surface water to a value of 15 ug/L (EPA, 1996d).****	If maximum concentration of lead in soil or sediment is less than 400 mg/kg and/or lead in surface water is less than 15 ug/L eliminate lead as a COPC.	If maximum concentration of lead in soil or sediment exceeds 400 mg/kg and/or lead in surface water exceeds 15 ug/L select lead as a COPC.	If lead is selected as a COPC, then risks are evaluated using the Integrated Exposure Uptake Biokinetic model to assess potential blood lead levels in exposed children.

* Risk-Based Concentrations (RBCs; EPA 1999b) are chemical-specific benchmark criteria, prepared by EPA Region III, which represent the concentration of a substance that is estimated to yield a lifetime cancer risk of 1E-06 or a noncarcinogenic hazard quotient (HQ) of 1. RBCs are calculated assuming default exposure assumptions for soil ingestion for a lifetime resident (child plus adult exposure). Those RBCs which are based on non-cancer toxicity are first divided by 10 before being used for screening. (This step adds a safety factor in case more than one contaminant is present that might cause an additive risk of adverse effects.)

** Risk-Based Concentrations (RBCs; EPA 1999b) are chemical-specific benchmark criteria, prepared by EPA Region III, which represent the concentration of a substance that is estimated to yield a lifetime cancer risk of 1E-06 or a noncarcinogenic hazard quotient (HQ) of 1. RBCs are calculated assuming default exposure assumptions for soil ingestion (for sediment screening) and drinking water ingestion (for surface water ingestion) for a lifetime resident (child plus adult exposure). Those RBCs which are based on non-cancer toxicity toxicity are first divided by 10 before being used for screening. (This step adds a safety factor in case more than one contaminant is present that might cause an additive risk of adverse effects.)

*** The lead screening value was developed by the EPA (1994a) Office of Solid Waste and Emergency Response (OSWER). It is not an automatic cleanup goal but rather a level above which there is sufficient concern to merit additional site-specific evaluation of risks.

**** The lead screening value was developed by the EPA (1996d). It is not an automatic cleanup goal but rather a drinking water action level above which there is sufficient concern to merit additional site-specific evaluation of risks.

6.2.3.1 Surface Soil COPC Selection

Section 4.4 discusses the results of sampling surface soils at Site 8. COPCs in surface soil for all potential receptors (using the protocols established in Table 6-1) are shown on Table 6-2 and listed below:

- 1,2,3,4,6,7,8-HpCDD
- OCDD
- Arsenic
- Chromium
- Lead
- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene

For lead, the Integrated Exposure and Uptake Biokinetic (IEUBK) Model (Version 0.99) was used to evaluate this contaminant as a COPC.

The maximum detections, arithmetic means, and exposure point concentrations (EPCs) (discussed in Section 6.2.5) for OCDD, arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene exceeded their respective RBCs. Notable trends for each of these COPCs were as follows:

- OCDD was evenly distributed across the site at concentrations less than 2 ug/kg (12 detects). A maximum concentration of 22 J ug/kg was detected at sample location SS-08-10. The maximum detected concentration, arithmetic mean, and EPC reported for OCDD exceeded the RBC presented in Table 6-2.

- Arsenic was detected in all 38 surface soil samples analyzed and concentrations were evenly distributed across the site.

- Benzo(a)pyrene was detected in 10 of 18 samples with seven of the 10 positive detections reported at concentrations of less than 400 ug/kg and three of the positive detects reported at concentrations equal to or exceeding 400 ug/kg [sample locations SS-08-14 (480 ug/kg), SS-08-15 (400 J ug/kg), and SS-08-17 (930 J ug/kg)].

TABLE 6-2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN , SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil, Industrial Adult*

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
35822-46-9	1,2,3,4,6,7,8-HpCDD	0.0073	J	3.6	J	ug/kg	SS-08-10-D	7/13	0.0024-0.193	3.6	NA	0.43 C	Y	ASL
67562-39-4	1,2,3,4,6,7,8-HpCDF	0.1731	J	0.1755	J	ug/kg	SS-08-02	2/7	0.0158-2.2	0.1755	NA	0.43 C	N	BSL
70648-26-9	1,2,3,4,7,8-HxCDF	0.0048	J	0.007	J	ug/kg	SS-08-03	3/13	0.0009-0.28	0.007	NA	0.043 C	N	BSL
3268-87-9	OCDD	0.067	J	22	J	ug/kg	SS-08-10	13/13	21-21	22	NA	4.3 C	Y	ASL
39001-02-0	OCDF	0.0379	J	0.0379	J	ug/kg	SS-08-06	1/5	0.321-4	0.0379	NA	4.3 C	N	BSL
7429-90-5	Aluminum	9940		16300		mg/kg	SS-08-28-D	16/16	N/A	16300	N	7800 N	N	BKG
7440-38-2	Arsenic	2		13.9		mg/kg	SS-08-16	38/38	N/A	13.9	Y	0.43 C	Y	ASL
7440-39-3	Barium	42.3		124		mg/kg	SS-08-17	16/16	N/A	124	Y	550 N	N	BKG
7440-41-7	Beryllium	0.62		1.1		mg/kg	SS-08-07	12/12	N/A	1.1	N	16 N	N	BKG
7440-43-9	Cadmium	0.53	L	6.3		mg/kg	SS-08-10	8/15	0.51-0.98	6.3	N	7.8 N	N	BKG
7440-70-2	Calcium	776		19500		mg/kg	SS-08-14	15/15	N/A	19500	Y	0 N	N	NUT
7440-47-3	Chromium	11.8	L	46.1		mg/kg	SS-08-14	16/16	N/A	46.1	Y	23 N	Y	ASL
7440-48-4	Cobalt	5.4		12.3		mg/kg	SS-08-28-D	14/14	N/A	12.3	N	470 N	N	BKG
7440-50-8	Copper	4.3		92.8	J	mg/kg	SS-08-10	16/16	N/A	92.8	Y	310 N	N	BKG
7439-89-6	Iron	13000		25800		mg/kg	SS-08-28-D	16/16	N/A	25800	N	2300 N	N	BKG
7439-92-1	Lead	9.4		732	K	mg/kg	SS-08-38	41/41	N/A	732	Y	400 C	Y	ASL
7439-95-4	Magnesium	1840		12100		mg/kg	SS-08-14	15/15	N/A	12100	Y	0 N	N	NUT
7439-96-5	Manganese	247		722	J	mg/kg	SS-08-18	16/16	N/A	722	N	160 N	N	BKG
7439-97-6	Mercury	0.06	L	0.1		mg/kg	SS-08-06	2/14	0.05-0.11	0.1	N	0.78 N	N	BKG
7440-02-0	Nickel	9.1		15.7		mg/kg	SS-08-28-D	11/11	N/A	15.7	N	160 N	N	BKG
7440-09-7	Potassium	436		1840		mg/kg	SS-08-17	15/15	N/A	1840	Y	0 N	N	NUT
7782-49-2	Selenium	0.7	K	0.72	K	mg/kg	SS-08-14-D	2/16	0.63-1.2	0.72	NA	39 N	N	BKG
7440-23-5	Sodium	61.1		1110	J	mg/kg	SS-08-18	5/5	N/A	1110	Y	0 N	N	NUT
7440-62-2	Vanadium	19.3		45.8		mg/kg	SS-08-53	20/20	N/A	45.8	Y	55 N	N	BKG
7440-66-6	Zinc	24.9		455		mg/kg	SS-08-14	16/16	N/A	455	Y	2300 N	N	BKG
72-54-8	4,4'-DDD	4.7	P	4.7	P	ug/kg	SS-08-10	1/14	3.5-4.1	4.7	NA	2700 C	N	BSL
50-29-3	4,4'-DDT	5	J	23	J	ug/kg	SS-08-14-D	3/14	3.5-4	23	NA	1900 C	N	BSL
309-00-2	Aldrin	3.2	J	3.2	J	ug/kg	SS-08-14-D	1/14	1.8-2.2	3.2	NA	38 C	N	BSL
11097-69-1	Aroclor-1254	13	J	83		ug/kg	SS-08-10	3/14	35-40	83	NA	320 C	N	BSL
72-20-8	Endrin	6.7	P	6.7	P	ug/kg	SS-08-10	1/14	3.5-4.1	6.7	NA	2300 N	N	BSL
106-46-7	1,4-Dichlorobenzene	43		43		ug/kg	SS-08-18	1/14	360-4100	43	NA	27000 C	N	BSL
91-57-6	2-Methylnaphthalene	130	J	130	J	ug/kg	SS-08-10	1/18	360-4100	130	NA	160000 N	N	BSL
120-12-7	Anthracene	590		590		ug/kg	SS-08-17	1/18	370-4100	590	NA	2300000 N	N	BSL
56-55-3	Benz(a)anthracene	80	J	980		ug/kg	SS-08-17	10/18	370-4100	980	NA	870 C	Y	ASL
50-32-8	Benzo(a)pyrene	79	J	930		ug/kg	SS-08-17	10/18	370-4100	930	NA	87 C	Y	ASL
205-99-2	Benzo(b)fluoranthene	120	J	1600		ug/kg	SS-08-17	10/18	370-4100	1600	NA	870 C	Y	ASL
191-24-2	Benzo(g,h,i)perylene	61	J	410		ug/kg	SS-08-17	8/18	370-4100	410	NA	0 N	N	NTX
207-08-9	Benzo(k)fluoranthene	58	J	270	J	ug/kg	SS-08-14	9/18	360-4100	270	NA	8700 C	N	BSL
117-81-7	Bis(2-ethylhexyl)phthalat	1700	J	1800	J	ug/kg	SS-08-14-D	1/10	370-400	1800	NA	46000 C	N	BSL

TABLE 6-2

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NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil, Industrial Adult*

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value		COPC Flag	Rationale for (4) Contaminant Deletion or Selection
85-68-7	Butylbenzylphthalate	400	J	600		ug/kg	SS-08-14	1/2	400-400	600	NA	1600000	N	N	BSL
86-74-8	Carbazole	310	J	310	J	ug/kg	SS-08-17	1/18	370-4100	310	NA	32000	C	N	BSL
218-01-9	Chrysene	77	J	980		ug/kg	SS-08-17	10/18	370-4100	980	NA	87000	C	N	BSL
84-74-2	Di-n-butylphthalate	50	J	54	J	ug/kg	SS-08-10	2/5	360-4100	54	NA	780000	N	N	BSL
53-70-3	Dibenz(a,h)anthracene	45	J	120	J	ug/kg	SS-08-17	3/18	370-4100	120	NA	87	C	Y	ASL
206-44-0	Fluoranthene	150	J	2000		ug/kg	SS-08-17	10/18	370-4100	2000	NA	310000	N	N	BSL
86-73-7	Fluorene	540		540		ug/kg	SS-08-17	1/18	370-4100	540	NA	310000	N	N	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	59	J	410		ug/kg	SS-08-17	7/18	370-4100	410	NA	870	C	N	BSL
91-20-3	Naphthalene	48	J	56	J	ug/kg	SS-08-10	2/18	370-4100	56	NA	160000	N	N	BSL
87-86-5	Pentachlorophenol	43	J	43	J	ug/kg	SS-08-10	1/14	880-10000	43	NA	5300	C	N	BSL
85-01-8	Phenanthrene	72	J	2100		ug/kg	SS-08-17	10/18	370-4100	2100	NA	0	N	N	NTX
129-00-0	Pyrene	130	J	1600		ug/kg	SS-08-17	10/18	370-4100	1600	NA	230000	N	N	BSL
75-09-2	Methylene Chloride	7	J	7	J	ug/kg	SS-08-14-D	2/6	11-12	7	NA	85000	C	N	BSL
127-18-4	Tetrachloroethene	3	J	3	J	ug/kg	SS-08-08	1/13	11-13	3	NA	12000	C	N	BSL
108-88-3	Toluene	2	J	3	J	ug/kg	SS-08-05	5/13	11-13	3	NA	1600000	N	N	BSL

* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Industrial Adult.
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Child (Age 1-6).
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Child (Age 1-6).
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Pre-Adolescent/Adolescent (Age 7-16).
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Pre-Adolescent/Adolescent (Age 7-16).
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Adult.
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Adult.
* This screening is also valid for Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Residential Child.
* This screening is also valid for Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Residential Child.
* This screening is also valid for Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Residential Adult.
* This screening is also valid for Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Residential Adult.

(1) Minimum/maximum detected concentration.
(2) Refer to supporting information for background discussion.
Y - Site (>) Background; N - Site (not >) Background; NA - Not Applicable (inorganics - insufficient site or back info; organics).
(3) EPA Region III Risk Based Concentration Screening Values [Residential Land Use] (EPA, 1999b), Office of Solid Waste and Emergency Response (OSWER) [for lead only] (EPA, 1994a).
(4) Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST)
Frequent Detection (FD)
Toxicity Information Available (TX)
Above Screening Levels (ASL)
Deletion Reason: Infrequent Detection (IFD)
Background Levels (BKG)
No Toxicity Information, discussed in uncertainty section of HHRA (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions:
N/A = Not Applicable
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR = Applicable or Relevant and Appropriate Require
TBC - To Be Considered.
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

- Dibenz(a,h)anthracene was detected in three of 18 samples with a maximum concentration of 120 J ug/kg (sample SS-08-17). The maximum detected concentration, arithmetic mean, and EPC reported for this contaminant exceeded the RBC.

The maximum detections and EPCs for 1,2,3,4,6,7,8-HpCDD and chromium exceeded their respective RBCs, however, the arithmetic means calculated for these contaminants did not. Notable trends for these COPCs are as follows:

- 1,2,3,4,6,7,8-HpCDD was evenly distributed across the site at concentrations less than 0.03 ug/kg (5 detects). Maximum concentrations of 1,2,3,4,6,7,8-HpCDD were 3.2 J ug/kg (sample SS-08-10) and 3.6 J ug/kg (sample SS-08-11).

- Chromium was detected in all 16 surface soil samples analyzed and concentrations were evenly distributed across the site.

The maximum detects of lead, benz(a)anthracene, and benzo(b)fluoranthene exceeded their respective RBCs, however, the arithmetic means and EPCs calculated for these contaminants did not. Notable trends for these COPCs were as follows:

- Lead was detected in 38 surface soil samples at concentrations less than 341 mg/kg. Concentrations exceeding 341 mg/kg included 475 mg/kg (sample SS-08-44), 487 mg/kg (sample SS-08-24), and 732 mg/kg (sample SS-08-38).

- Benz(a)anthracene was detected in 10 of 18 samples with most detections occurring at concentrations of less than 300 ug/kg. An exception was reported for sample SS-08-17 (980 ug/kg).

- Benzo(b)fluoranthene was detected in 10 of 18 samples with most detections occurring at concentrations of less than 350 ug/kg. An exception was reported for samples SS-08-14 (820 ug/kg) and SS-08-17 (1,600 ug/kg).

6.2.3.2 Subsurface Soil COPC Selection

Section 4.5 discusses the results of sampling subsurface soils at Site 8. COPCs in subsurface soil for all potential receptors (using residential soil RBC screening criteria set at cancer risk levels of 1×10^{-6} and HQs of 0.1) are shown on Table 6-3 and listed below:

TABLE 6-3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN , SITE 8 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Subsurface Soil, Industrial Adult*

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
3268-87-9	OCDD	4.4	J	4.4	J	ug/kg	SB-08-04	1/4	2.5-5.2	4.4	NA	4.3 C	Y	ASL
7429-90-5	Aluminum	6020		18000		mg/kg	TP01-08-02	23/23	N/A	18000	N	7800 N	N	BKG
7440-36-0	Antimony	14.9	J	14.9	J	mg/kg	SB-08-19	1/17	7.1-10.4	14.9	N	3.1 N	N	BKG
7440-38-2	Arsenic	0.61		6.6		mg/kg	SB-08-22	22/22	N/A	6.6	N	0.43 C	N	BKG
7440-39-3	Barium	16.1		113		mg/kg	TP01-08-02	23/23	N/A	113	N	550 N	N	BKG
7440-41-7	Beryllium	0.29		2.2		mg/kg	TP02-08-03	21/21	N/A	2.2	Y	16 N	N	BKG
7440-70-2	Calcium	492		10110		mg/kg	SB-08-19	22/22	N/A	10110	Y	0 N	N	NUT
7440-47-3	Chromium	7.1		26.1	J	mg/kg	SB-08-10	23/23	N/A	26.1	N	23 N	N	BKG
7440-48-4	Cobalt	4.6		22.6		mg/kg	TP01-08-02	23/23	N/A	22.6	Y	470 N	N	BKG
7440-50-8	Copper	5.8	L	353.65	J	mg/kg	SB-08-19	22/22	N/A	353.65	Y	310 N	Y	ASL
7439-89-6	Iron	7080		27450		mg/kg	SB-08-19	22/23	20200-20200	27450	N	2300 N	N	BKG
7439-92-1	Lead	1.9		26.7	J	mg/kg	SB-08-18	28/28	N/A	26.7	N	400 C	N	BKG
7439-95-4	Magnesium	832		6975		mg/kg	SB-08-19	22/22	N/A	6975	Y	0 N	N	NUT
7439-96-5	Manganese	143		1230		mg/kg	TP01-08-02	23/23	N/A	1230	N	160 N	N	BKG
7439-97-6	Mercury	0.1	L	0.1	L	mg/kg	SB-08-02	1/23	0.04-0.1	0.1	N	0.78 N	N	IFD
7440-02-0	Nickel	5.8		17.1		mg/kg	TP02-08-03-D	10/10	N/A	17.1	N	160 N	N	BKG
7440-09-7	Potassium	145		2270		mg/kg	TP02-08-03	21/22	877-877	2270	Y	0 N	N	NUT
7782-49-2	Selenium	0.63	K	0.63	K	mg/kg	SB-08-10	1/23	0.51-1.1	0.63	NA	39 N	N	IFD
7440-23-5	Sodium	71.5		1470		mg/kg	SB-08-19	14/14	N/A	1470	Y	0 N	N	NUT
7440-28-0	Thallium	0.43		9.1	J	mg/kg	SB-08-19	2/22	0.51-0.65	9.1	N	0.55 N	N	BKG
7440-62-2	Vanadium	9.8		52.5		mg/kg	SB-08-23	27/27	N/A	52.5	Y	55 N	N	BKG
7440-66-6	Zinc	5.1		47.6		mg/kg	SB-08-18	22/22	N/A	47.6	N	2300 N	N	BKG
959-98-8	Endosulfan I	0.71	J	0.71	J	ug/kg	SB-08-08	1/7	0.49-2	0.71	NA	47000 N	N	BSL
5103-74-2	Gamma-Chlordane	2		2		ug/kg	SB-08-18	1/7	0.49-2	2	NA	1800 C	N	BSL
88-75-5	2-Nitrophenol	42	J	42	J	ug/kg	SB-08-02	1/19	350-410	42	NA	0 X	N	NTX
100-02-7	4-Nitrophenol	38	J	38	J	ug/kg	SB-08-02	1/19	850-990	38	NA	63000 N	N	BSL
56-55-3	Benz(a)anthracene	120	J	120	J	ug/kg	SB-08-18	1/23	350-420	120	NA	870 C	N	IFD
50-32-8	Benzo(a)pyrene	140	J	140	J	ug/kg	SB-08-18	1/23	350-420	140	NA	87 C	N	IFD
205-99-2	Benzo(b)fluoranthene	190	J	190	J	ug/kg	SB-08-18	1/23	350-420	190	NA	870 C	N	IFD
191-24-2	Benzo(g,h,i)perylene	80	J	80	J	ug/kg	SB-08-18	1/23	350-420	80	NA	0 N	N	IFD
207-08-9	Benzo(k)fluoranthene	110	J	110	J	ug/kg	SB-08-18	1/23	350-420	110	NA	8700 C	N	IFD
218-01-9	Chrysene	170	J	170	J	ug/kg	SB-08-18	1/23	350-420	170	NA	87000 C	N	IFD

TABLE 6-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN , SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Subsurface Soil, Industrial Adult*

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
206-44-0	Fluoranthene	320	J	320	J	ug/kg	SB-08-18	1/23	350-420	320	NA	310000 N	N	IFD
193-39-5	Indeno(1,2,3-cd)pyrene	94	J	94	J	ug/kg	SB-08-18	1/23	350-420	94	NA	870 C	N	IFD
85-01-8	Phenanthrene	180	J	180	J	ug/kg	SB-08-18	1/23	350-420	180	NA	0 N	N	IFD
108-95-2	Phenol	920		920		ug/kg	SB-08-02	1/19	350-410	920	NA	4700000 N	N	BSL
129-00-0	Pyrene	290	J	290	J	ug/kg	SB-08-18	1/23	350-420	290	NA	230000 N	N	IFD

* This screening is also valid for Current/Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Industrial Adult.
* This screening is also valid for Future/Subsurface Soil/Subsurface Soil/Contact (Ing. & Der.) with Subsurface Soil Residential Child.
* This screening is also valid for Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Residential Child.
* This screening is also valid for Future/Subsurface Soil/Subsurface Soil/Contact (Ing. & Der.) with Subsurface Soil Residential Adult.
* This screening is also valid for Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Residential Adult.

(1) Minimum/maximum detected concentration.
(2) Refer to supporting information for background discussion.
Y - Site (>) Background; N - Site (not >) Background; NA - Not Applicable (inorganics - insufficient site or back info; organics).
(3) EPA Region III Risk Based Concentration Screening Values [Residential Land Use] (EPA, 1999b), Office of Solid Waste and Emergency Response (OSWER) [for lead only] (EPA, 1994a).
(4) Rationale Codes Selection Reason:
Infrequent Detection but Associated Historically (HIST)
Frequent Detection (FD)
Toxicity Information Available (TX)
Above Screening Levels (ASL)
Deletion Reason:
Infrequent Detection (IFD)
Background Levels (BKG)
No Toxicity Information, discussed in uncertainty section of HHRA (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions:
N/A = Not Applicable
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR = Applicable or Relevant and Appropriate Require
TBC - To Be Considered.
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

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- OCDD
- Copper

The maximum detects of OCDD and copper exceeded their respective RBCs, however, their arithmetic means and EPCs were less than their respective RBCs. Notable trends for these COPCs included:

- OCDD was detected in 1 of 4 subsurface soil samples at a concentration of 4.4 J ug/kg (sample SB-08-04).

- Copper was detected in all 22 subsurface soil samples with all concentrations detected at levels less than 31 mg/kg with the exception of the maximum concentration of 353.65 J mg/kg (sample SB-08-19).

6.2.3.3 Sediment Soil COPC Selection

Section 4.7 discusses the results of sampling sediment at Site 8. COPCs in sediment for all potential receptors (using residential soil RBC screening criteria set at cancer risk levels of 1×10^{-6} and HQs of 0.1) are shown on Table 6-4 and listed below:

- Arsenic
- Iron
- Manganese
- Benzo(a)pyrene
- Dibenz(a,h)anthracene

Notable trends for these COPCs included:

- Arsenic was detected in 2 of 3 sediment samples with a maximum concentration of 4.2 mg/kg (sample C6). Both positively detected concentrations of arsenic exceeded the RBC.

- Iron was detected in 3 of 3 sediment samples with a maximum concentration of 25,400 mg/kg (sample C12). All 3 positively detected concentrations of iron exceeded the RBC.

- Manganese was detected in 3 of 3 sediment samples with a maximum concentration of 848 J mg/kg (sample C12). All 3 positively detected concentrations of manganese exceeded the RBC.

TABLE 6-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN , SITE 8 SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact (Ing. & Der.) with Sediment, Off-Site Recreational Pre-Adolescent (Age 7-12)

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
7429-90-5	Aluminum	3700		6750		mg/kg	C6	3/3	N/A	6750	NA	7800 N	N	BSL
7440-38-2	Arsenic	3.4		4.2		mg/kg	C6	2/3	3.1-3.1	4.2	NA	0.43 C	Y	ASL
7440-39-3	Barium	49.8		74.6		mg/kg	C12	2/3	50-50	74.6	NA	550 N	N	BSL
7440-41-7	Beryllium	0.65		0.95	L	mg/kg	C6	2/3	1.3-1.3	0.95	NA	16 N	N	BSL
7440-43-9	Cadmium	0.2		0.2		mg/kg	C11	1/3	1.9-3.1	0.2	NA	7.8 N	N	BSL
7440-70-2	Calcium	3430		20300	J	mg/kg	C12	2/2	N/A	20300	NA	0 N	N	NUT
7440-47-3	Chromium	14		20.5	J	mg/kg	C12	3/3	N/A	20.5	NA	23 N	N	BSL
7440-48-4	Cobalt	6		9.3	K	mg/kg	C12	3/3	N/A	9.3	NA	470 N	N	BSL
7440-50-8	Copper	19.5		34.6	J	mg/kg	C12	2/3	15.4-15.4	34.6	NA	310 N	N	BSL
7439-89-6	Iron	16200		25400		mg/kg	C12	3/3	N/A	25400	NA	2300 N	Y	ASL
7439-92-1	Lead	20.4	K	38.5		mg/kg	C6	3/3	N/A	38.5	NA	400 C	N	BSL
7439-95-4	Magnesium	3290		12700	K	mg/kg	C12	2/2	N/A	12700	NA	0 N	N	NUT
7439-96-5	Manganese	307		848	J	mg/kg	C12	3/3	N/A	848	NA	160 N	Y	ASL
7440-02-0	Nickel	10		10.6	L	mg/kg	C6	2/3	13.2-13.2	10.6	NA	160 N	N	BSL
7440-09-7	Potassium	924		982		mg/kg	C6	2/2	N/A	982	NA	0 N	N	NUT
7440-23-5	Sodium	732	J	732	J	mg/kg	C12	1/1	N/A	732	NA	0 N	N	NUT
7440-62-2	Vanadium	18	K	34.2	K	mg/kg	C12	3/3	N/A	34.2	NA	55 N	N	BSL
7440-66-6	Zinc	59		78.5		mg/kg	C6	3/3	N/A	78.5	NA	2300 N	N	BSL
83-32-9	Acenaphthene	120	J	120	J	ug/kg	C12	1/2	5000-5000	120	NA	470000 N	N	BSL
208-96-8	Acenaphthylene	60	J	60	J	ug/kg	C11	1/2	360-360	60	NA	0 N	N	NTX
120-12-7	Anthracene	72	J	290	J	ug/kg	C12	2/2	N/A	290	NA	2300000 N	N	BSL
56-55-3	Benz(a)anthracene	280	J	720		ug/kg	C12	2/2	N/A	720	NA	870 C	N	BSL
50-32-8	Benzo(a)pyrene	270	J	650		ug/kg	C12	2/2	N/A	650	NA	87 C	Y	ASL
205-99-2	Benzo(b)fluoranthene	230	J	820		ug/kg	C12	2/2	N/A	820	NA	870 C	N	BSL
191-24-2	Benzo(g,h,i)perylene	320	J	320	J	ug/kg	C12	1/2	5000-5000	320	NA	0 N	N	NTX
207-08-9	Benzo(k)fluoranthene	350	J	370	J	ug/kg	C11	2/2	N/A	370	NA	8700 C	N	BSL
117-81-7	Bis(2-ethylhexyl)phthalat	93	J	93	J	ug/kg	C11	1/2	280-280	93	NA	46000 C	N	BSL
86-74-8	Carbazole	490	J	490	J	ug/kg	C12	1/1	N/A	490	NA	32000 C	N	BSL
218-01-9	Chrysene	340	J	740		ug/kg	C12	2/2	N/A	740	NA	87000 C	N	BSL
117-84-0	Di-n-octylphthalate	94	J	94	J	ug/kg	C12	1/2	5000-5000	94	NA	160000 N	N	BSL
53-70-3	Dibenz(a,h)anthracene	140	J	140	J	ug/kg	C12	1/2	5000-5000	140	NA	87 C	Y	ASL
132-64-9	Dibenzofuran	72	J	72	J	ug/kg	C12	1/2	5000-5000	72	NA	31000 N	N	BSL
206-44-0	Fluoranthene	670	J	1200		ug/kg	C12	2/2	N/A	1200	NA	310000 N	N	BSL
86-73-7	Fluorene	140	J	140	J	ug/kg	C12	1/2	5000-5000	140	NA	310000 N	N	BSL
85-01-8	Phenanthrene	340	J	1200		ug/kg	C12	2/2	N/A	1200	NA	0 N	N	NTX
129-00-0	Pyrene	540	J	1400		ug/kg	C12	2/2	N/A	1400	NA	230000 N	N	BSL

(1) Minimum/maximum detected concentration.

(2) Refer to supporting information for background discussion.

Y - Site (>) Background; N - Site (not >) Background; NA - Not Applicable (inorganics - insufficient site or back info; organics).

(3) EPA Region III Risk Based Concentration Screening Values [Residential Land Use] (EPA, 1999b), Office of Solid Waste and Emergency Response (OSWER) [for lead only] (EPA, 1994a).

(4) Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST)
Frequent Detection (FD)

Definitions:
N/A = Not Applicable
SQL = Sample Quantitation Limit

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TABLE 6-4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN , SITE 8 SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact (Ing. & Der.) with Sediment, Off-Site Recreational Pre-Adolescent (Age 7-12)

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection

Deletion Reason:
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information, discussed in uncertainty section of HHRA (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR = Applicable or Relevant and Appropriate Require
TBC - To Be Considered.
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

TABLE 6-6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SITE 8 SURFACE WATER (DISSOLVED INORGANICS)
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Dissolved Inorganics)
Exposure Medium: Surface Water (Dissolved Inorganics)
Exposure Point: Contact (Ing. & Der.) with Surface Water (Dissolved Inorganics), Off-Site Recreational Pre-Adolescent (Age 7-12)

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Site Greater Than Background (2)	Screening (3) Toxicity Value	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
7440-39-3	Barium	122		122		ug/L	C12	1/1	N/A	122	NA	260 N	N	BSL
7440-70-2	Calcium	48100		48100		ug/L	C12	1/1	N/A	48100	NA	0 N	N	NUT
7439-95-4	Magnesium	15900		15900		ug/L	C12	1/1	N/A	15900	NA	0 N	N	NUT
7439-96-5	Manganese	162		162		ug/L	C12	1/1	N/A	162	NA	73 N	Y	ASL
7440-09-7	Potassium	2320		2320		ug/L	C12	1/1	N/A	2320	NA	0 N	N	NUT
7440-23-5	Sodium	45600		45600		ug/L	C12	1/1	N/A	45600	NA	0 N	N	NUT

(1) Minimum/maximum detected concentration.

(2) Refer to supporting information for background discussion.
Y - Site (>) Background; N - Site (not >) Background; NA - Not Applicable (inorganics - insufficient site or back info; organics).

(3) EPA Region III Risk Based Concentration Screening Values [Residential Land Use] (EPA, 1999b), Office of Solid Waste and Emergency Response (OSWER) [for lead only] (EPA, 1994a).

(4) Rationale Codes Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information, discussed in uncertainty section of HHRA (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
N/A = Not Applicable
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR = Applicable or Relevant and Appropriate Require
TBC - To Be Considered.
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

to the guidance referenced in several EPA and related publications (EPA, 1989a, 1989b, 1992a, 1992b, and 1996a). Before EPCs were estimated for each COPC, the underlying statistical distribution of data was determined. The Shapiro-Wilk W test or the Shapiro-Francia Test (EPA, 1992a) were performed to determine if the data set of chemical concentrations matched the shape of a normal or lognormal distribution. [The latter test is required if there are greater than 50 samples (EPA, 1992a, 1996a).] Normally distributed data exhibit a characteristic "bell-shape" curve that is symmetrical, whereas lognormal data have a skewed shape (a longer tail at the high-concentration tail). For each COPC, the W test was performed once using the original data and once after data were converted to their logarithms. A 5% level of significance was used to determine if the data deviated from either hypothesized distribution. If the W test indicated a normal distribution, then the estimation of the reasonable maximum exposure point concentration (using the upper 95th percentile confidence limit on the mean, as discussed in the next section) was based upon a normal distribution and standard deviation. If taking the logarithms of the data provided a better match than a normal distribution, a lognormal transformation of data was performed before the upper 95th percentile confidence limit on the mean concentrations was computed. If neither distribution matched the data set of interest, the default assumption of an underlying lognormal distribution was followed (EPA, 1989a).

The distributional analysis results for COPCs in surface soil, subsurface soil, sediment, surface water (total inorganics), and surface water (dissolved inorganics) are shown in Tables 6-7 through 6-11, respectively. As shown on Table 6-7, the COPCs in surface soil generally exhibited a lognormal or nonparametric (assumed lognormal) distribution better than a normal distribution, especially 1,2,3,4,6,7,8-HpCDD, OCDD, arsenic, and chromium. As shown on Table 6-8, OCDD exhibited a normal distribution, however, because of the low number of sampling locations, there is less confidence in the shape of the distribution. Copper exhibited a nonparametric (assumed lognormal) distribution. As shown on Tables 6-9, 6-10, and 6-11, the COPCs in sediment and surface water were associated with a particular distribution (normal, lognormal, nonparametric [assumed lognormal], or unknown [assumed lognormal]), however, because only three samples were collected in sediment and one sample was collected in surface water, there is very little confidence in the shapes of these distributions.

6.2.5 Exposure Point Concentrations

An EPC was calculated for each COPC selected for the various environmental media data sets. Post-remedial concentrations of detected chemicals at each medium were evaluated. Usability of results is discussed below. The EPC was calculated using the latest risk assessment guidance from EPA (1985, 1989a, 1991a, 1991b, 1998a) and Gilbert (1987).

TABLE 6-7

REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION - SITE 8 SURFACE SOIL (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for K_{95} (Lognorm.) or $T_{0.95}$ (Normal)	Sample Standard Deviation (Log Standard Deviation)	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration
				W-norm.	W-lognorm.	W-Table					
1,2,3,4,6,7,8-HpCDD	13	12	lognormal	0.4474	0.9156	0.866	5.739	2.44	0.365	27.4	3.6
1,2,3,4,6,7,8-HpCDF	7	6	lognormal	0.6169	0.9205	0.803	5.0251	1.45	0.236	6.02	0.1755
1,2,3,4,7,8-HxCDF	13	12	lognormal	0.6373	0.8707	0.866	5.0611	2.12	0.0231	0.867	0.007
OCDD	13	12	lognormal	0.5885	0.956	0.866	3.6174	1.42	2.77	13.9	22
OCDF	5	4	lognormal	0.6126	0.8907	0.762	7.003	1.47	0.491	92.8	0.0379
Aluminum	16	15	lognormal	0.9496	0.9597	0.887	1.7593	0.132	12300	13000	16300
Arsenic	38	37	lognormal	0.8951	0.9661	0.938	1.7991	0.337	6.05	6.7	13.9
Barium	16	15	lognormal	0.9177	0.9473	0.887	1.8756	0.306	73	84.9	124
Beryllium	12	11	lognormal	0.9142	0.956	0.859	1.81	0.154	0.788	0.858	1.1
Cadmium	15	14	nonparametric (assumed lognorm.)	0.7098	0.8249	0.881	3.1068	1.22	1.65	4.59	6.3
Calcium	15	14	nonparametric (assumed lognorm.)	0.6344	0.8395	0.881	2.9032	1.1	4770	10500	19500
Chromium	16	15	lognormal	0.8113	0.9365	0.887	1.8901	0.324	19.7	23.1	46.1
Cobalt	14	13	lognormal	0.961	0.9619	0.874	1.8295	0.216	8.64	9.66	12.3
Copper	16	15	lognormal	0.7967	0.9305	0.887	2.5234	0.879	22.6	40.5	92.8
Iron	16	15	lognormal	0.8916	0.9255	0.887	1.7907	0.185	17700	19300	25800
Lead	41	40	nonparametric (assumed lognorm.)	0.7077	0.9331	0.941	2.6333	1.24	119	214	732
Magnesium	15	14	nonparametric (assumed lognorm.)	0.6634	0.7908	0.881	2.1822	0.601	4390	6100	12100
Manganese	16	15	lognormal	0.9162	0.9631	0.887	1.8901	0.324	433	508	722
Mercury	14	13	nonparametric (assumed lognorm.)	0.787	0.8369	0.874	2.045	0.46	0.0425	0.0552	0.1
Nickel	11	10	lognormal	0.8937	0.9093	0.85	1.8207	0.149	11	12	15.7
Potassium	15	14	lognormal	0.8087	0.9112	0.881	1.998	0.431	846	1060	1840
Selenium	16	15	nonparametric (assumed lognorm.)	0.7737	0.8318	0.887	1.8164	0.225	0.417	0.463	0.72
Sodium	5	4	normal	0.7745	0.7665	0.762	2.1318	492	418	887	1110
Vanadium	20	19	lognormal	0.9718	0.9891	0.905	1.7855	0.217	29.9	32.8	45.8
Zinc	16	15	nonparametric (assumed lognorm.)	0.6775	0.8265	0.887	2.5931	0.927	92.3	165	455
4,4'-DDD	14	13	nonparametric (assumed lognorm.)	0.4954	0.5654	0.874	1.789	0.156	2.03	2.2	4.7
4,4'-DDT	14	13	nonparametric (assumed lognorm.)	0.4591	0.5943	0.874	2.3843	0.735	3.92	5.71	23
Aldrin	14	13	nonparametric (assumed lognorm.)	0.4238	0.4904	0.874	1.823	0.207	1.08	1.19	3.2
Aroclor-1254	14	13	nonparametric (assumed lognorm.)	0.5426	0.643	0.874	2.0277	0.444	24.6	31	83
Endrin	14	13	nonparametric (assumed lognorm.)	0.412	0.4807	0.874	1.8345	0.223	2.11	2.35	6.7
1,4-Dichlorobenzene	14	13	nonparametric (assumed lognorm.)	0.397	0.592	0.874	2.2611	0.644	251	365	43
2-Methylnaphthalene	18	17	nonparametric (assumed lognorm.)	0.525	0.6469	0.897	1.795	0.213	207	226	130
Anthracene	18	17	nonparametric (assumed lognorm.)	0.4648	0.5536	0.897	2.0104	0.489	285	348	590
Benz(a)anthracene	18	17	nonparametric (assumed lognorm.)	0.4817	0.8007	0.897	2.0616	0.541	215	271	980
Benzo(a)pyrene	18	17	nonparametric (assumed lognorm.)	0.5177	0.7741	0.897	2.0436	0.523	228	287	930
Benzo(b)fluoranthene	18	17	nonparametric (assumed lognorm.)	0.4996	0.7593	0.897	2.1584	0.631	311	402	1600
Benzo(g,h,i)perylene	18	17	nonparametric (assumed lognorm.)	0.804	0.8596	0.897	2.0249	0.504	167	218	410
Benzo(k)fluoranthene	18	17	nonparametric (assumed lognorm.)	0.8818	0.8182	0.897	1.9399	0.411	156	193	270
Bis(2-ethylhexyl)phthalate	10	9	nonparametric (assumed lognorm.)	0.3696	0.3948	0.842	2.5241	0.695	350	554	1800
Butylbenzylphthalate	2	1	unknown (assumed lognorm.)					0.648	350		600
Carbazole	18	17	nonparametric (assumed lognorm.)	0.3959	0.5198	0.897	1.9668	0.441	270	319	310
Chrysene	18	17	nonparametric (assumed lognorm.)	0.5657	0.8061	0.897	2.1478	0.622	250	331	980
Di-n-butylphthalate	5	4	nonparametric (assumed lognorm.)	0.7508	0.7366	0.762	3.7434	0.721	137	571	54
Dibenz(a,h)anthracene	18	17	nonparametric (assumed lognorm.)	0.4929	0.772	0.897	2.1824	0.652	242	335	120
Fluoranthene	18	17	nonparametric (assumed lognorm.)	0.429	0.648	0.897	2.1655	0.637	338	426	2000
Fluorene	18	17	nonparametric (assumed lognorm.)	0.456	0.553	0.897	2.0018	0.48	282	342	540
Indeno(1,2,3-cd)pyrene	18	17	nonparametric (assumed lognorm.)	0.806	0.8864	0.897	2.0567	0.536	185	245	410
Naphthalene	18	17	nonparametric (assumed lognorm.)	0.6645	0.6162	0.897	2.0073	0.486	195	255	56
Pentachlorophenol	14	13	nonparametric (assumed lognorm.)	0.4072	0.3358	0.874	2.2581	0.641	442	730	43
Phenanthrene	18	17	nonparametric (assumed lognorm.)	0.3724	0.752	0.897	2.2787	0.734	275	351	2100
Pyrene	18	17	nonparametric (assumed lognorm.)	0.4753	0.7174	0.897	2.1173	0.594	314	397	1600
Methylene Chloride	6	5	lognormal	0.827	0.8382	0.788	1.9385	0.0969	6.25	6.8	7
Tetrachloroethene	13	12	nonparametric (assumed lognorm.)	0.4671	0.4244	0.866	1.8265	0.195	5.77	6.42	3
Toluene	13	12	nonparametric (assumed lognorm.)	0.7672	0.7594	0.866	2.0585	0.453	4.69	6.26	3

Notes:
Bold Text indicates selected COPC for this media.
Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

TABLE 6-8
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION - SITE 8 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for Hoe (Lognorm) or Toe (Normal)	Standard Deviation of UCL / Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration
				W-norm.	W-lognorm	W-Table					
OCDD	4	3	normal	0.9341	0.9312	0.748	2.3534	1.29	2.71	4.23	4.4
Aluminum	23	22	lognormal	0.9087	0.9193	0.914	1.8741	0.376	11200	13100	18000
Antimony	17	16	nonparametric (assumed lognorm.)	0.3767	0.4935	0.892	1.881	0.326	4.72	5.4	14.9
Arsenic	22	21	lognormal	0.9057	0.9496	0.911	2.1836	0.705	3.1	4.49	6.6
Barium	23	22	lognormal	0.8017	0.9213	0.914	2.0604	0.595	43.8	56.6	113
Beryllium	21	20	lognormal	0.7531	0.9268	0.908	1.9982	0.51	0.684	0.849	2.2
Calcium	22	21	nonparametric (assumed lognorm.)	0.3422	0.654	0.911	2.1129	0.638	1260	1440	10110
Chromium	23	22	lognormal	0.9388	0.9768	0.914	1.845	0.335	14.8	16.9	26.1
Cobalt	23	22	lognormal	0.8764	0.9691	0.914	1.9008	0.412	9.71	11.5	22.8
Copper	22	21	nonparametric (assumed lognorm.)	0.305	0.7714	0.911	2.3519	0.849	30.6	34.8	353.65
Iron	23	22	lognormal	0.9477	0.9703	0.914	1.8769	0.38	14800	17300	27450
Lead	28	27	lognormal	0.827	0.9759	0.924	2.1108	0.689	7.52	10	26.7
Magnesium	22	21	lognormal	0.7571	0.9649	0.911	1.9877	0.508	2140	2640	6975
Manganese	23	22	lognormal	0.8945	0.977	0.914	2.005	0.536	533	676	1230
Mercury	23	22	nonparametric (assumed lognorm.)	0.4432	0.5553	0.914	1.8551	0.349	0.0301	0.034	0.1
Nickel	10	9	normal	0.9567	0.9371	0.842	1.8331	3.54	10.9	13	17.1
Potassium	22	21	lognormal	0.7428	0.9708	0.911	2.1344	0.659	583	793	2270
Selenium	23	22	nonparametric (assumed lognorm.)	0.5711	0.6333	0.914	1.7857	0.241	0.32	0.35	0.63
Sodium	14	13	nonparametric (assumed lognorm.)	0.3261	0.4762	0.874	2.444	0.776	186	240	1470
Thallium	22	21	nonparametric (assumed lognorm.)	0.2323	0.3174	0.911	2.226	0.743	0.691	0.639	9.1
Vanadium	27	26	lognormal	0.8839	0.9497	0.923	1.9475	0.5	26.1	31.7	52.5
Zinc	22	21	lognormal	0.9282	0.9628	0.911	2.0873	0.613	18.7	25.2	47.6
Endosulfan I	7	6	nonparametric (assumed lognorm.)	0.7731	0.7171	0.803	2.7704	0.643	0.722	1.59	0.71
Gamma-Chlordane	7	6	lognormal	0.8327	0.8358	0.803	3.2907	0.852	0.801	2.7	2
2-Nitrophenol	19	18	nonparametric (assumed lognorm.)	0.4329	0.3399	0.901	1.8788	0.346	181	216	42
4-Nitrophenol	19	18	nonparametric (assumed lognorm.)	0.4089	0.3035	0.901	2.0804	0.572	435	625	38
Benz(a)anthracene	23	22	nonparametric (assumed lognorm.)	0.728	0.6438	0.914	1.7192	0.108	188	195	120
Benzo(a)pyrene	23	22	nonparametric (assumed lognorm.)	0.8434	0.7929	0.914	1.7083	0.0803	188	194	140
Benzo(b)fluoranthene	23	22	lognormal	0.9271	0.9357	0.914	1.6967	0.0483	191	194	190
Benzo(g,h,i)perylene	23	22	nonparametric (assumed lognorm.)	0.5677	0.451	0.914	1.7563	0.187	186	200	80
Benzo(k)fluoranthene	23	22	nonparametric (assumed lognorm.)	0.6789	0.5833	0.914	1.7262	0.124	187	196	110
Chrysene	23	22	lognormal	0.9544	0.9601	0.914	1.6986	0.0538	190	194	170
Fluoranthene	23	22	nonparametric (assumed lognorm.)	0.5109	0.5936	0.914	1.7237	0.119	196	205	320
Indeno(1,2,3-cd)pyrene	23	22	nonparametric (assumed lognorm.)	0.6136	0.5049	0.914	1.7403	0.155	186	198	94
Phenanthrene	23	22	lognormal	0.9247	0.9333	0.914	1.6972	0.0497	190	194	180
Phenol	19	18	nonparametric (assumed lognorm.)	0.2806	0.3336	0.901	1.8935	0.366	227	258	920
Pyrene	23	22	nonparametric (assumed lognorm.)	0.5929	0.6671	0.914	1.716	0.1	195	202	290

Notes:
Bold Text indicates selected COPC for this media.
Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shap
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

TABLE 6-9

REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION - SITE 8 SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $t_{0.95}$ (Lognorm) or $t_{0.95}$ (Normal)	Standard Deviation of Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration
				W-norm.	W-lognorm	W-Table					
Aluminum	3	2	normal	1	0.9918	0.767	2.92	1530	5230	7800	6750
Arsenic	3	2	normal	0.9503	0.9004	0.767	2.92	1.36	3.05	5.34	4.2
Barium	3	2	normal	1	0.9779	0.767	2.92	24.8	49.8	91.6	74.6
Beryllium	3	2	nonparametric (assumed lognorm.)	0.75	0.75	0.767	3.4288	0.219	0.75	1.29	0.95
Cadmium	3	2	normal	0.9959	0.9168	0.767	2.92	0.676	0.9	2.04	0.2
Calcium	2	1	unknown (assumed lognorm.)					1.26	11900		20300
Chromium	3	2	lognormal	0.9119	0.9324	0.767	3.278	0.197	16.7	26.5	20.5
Cobalt	3	2	normal	0.9508	0.9284	0.767	2.92	1.69	7.87	10.7	9.3
Copper	3	2	normal	0.995	0.9817	0.767	2.92	13.5	20.6	43.3	34.6
Iron	3	2	nonparametric (assumed lognorm.)	0.7582	0.7603	0.767	3.7317	0.258	19300	38500	25400
Lead	3	2	normal	0.9988	0.9849	0.767	2.92	9.06	29.6	44.9	38.5
Magnesium	2	1	unknown (assumed lognorm.)					0.955	8000		12700
Manganese	3	2	lognormal	0.9734	0.9995	0.767	6.601	0.508	552	6180	848
Nickel	3	2	normal	0.8596	0.8407	0.767	2.92	2.16	9.07	12.7	10.6
Potassium	2	1	unknown (assumed lognorm.)					0.0431	953		982
Sodium	1		unknown (assumed lognorm.)						732		732
Vanadium	3	2	lognormal	0.9563	0.9837	0.767	4.349	0.324	25.1	69.1	34.2
Zinc	3	2	lognormal	0.8407	0.8524	0.767	3.0162	0.155	66.3	92.6	78.5
Acenaphthene	2	1	unknown (assumed lognorm.)					2.15	1310		120
Acenaphthylene	2	1	unknown (assumed lognorm.)					0.777	120		60
Anthracene	2	1	unknown (assumed lognorm.)					0.985	181		290
Benz(a)anthracene	2	1	unknown (assumed lognorm.)					0.668	500		720
Benzo(a)pyrene	2	1	unknown (assumed lognorm.)					0.621	460		650
Benzo(b)fluoranthene	2	1	unknown (assumed lognorm.)					0.899	525		820
Benzo(g,h,i)perylene	2	1	unknown (assumed lognorm.)					1.45	1410		320
Benzo(k)fluoranthene	2	1	unknown (assumed lognorm.)					0.0393	360		370
Bis(2-ethylhexyl)phthalate	2	1	unknown (assumed lognorm.)					0.289	117		93
Carbazole	1		unknown (assumed lognorm.)						490		490
Chrysene	2	1	unknown (assumed lognorm.)					0.55	540		740
Di-n-octylphthalate	2	1	unknown (assumed lognorm.)					2.32	1300		94
Dibenz(a,h)anthracene	2	1	unknown (assumed lognorm.)					2.04	1320		140
Dibenzofuran	2	1	unknown (assumed lognorm.)					2.51	1290		72
Fluoranthene	2	1	unknown (assumed lognorm.)					0.412	935		1200
Fluorene	2	1	unknown (assumed lognorm.)					2.04	1320		140
Phenanthrene	2	1	unknown (assumed lognorm.)					0.892	770		1200
Pyrene	2	1	unknown (assumed lognorm.)					0.674	970		1400

Notes:
Bold Text indicates selected COPC for this media.
Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shapiro test.
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data.
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

TABLE 6-10
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION - SITE 8 SURFACE WATER (TOTAL INORGANICS)
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for H_{95} (Lognorm.) or $T_{0.95}$ (Norm.)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration
				W-norm.	W-lognorm.	W-Table					
Barium	1		unknown (assumed lognorm.)						93		93
Calcium	1		unknown (assumed lognorm.)						42800		42800
Iron	1		unknown (assumed lognorm.)						186		186
Magnesium	1		unknown (assumed lognorm.)						13700		13700
Manganese	1		unknown (assumed lognorm.)						159		159
Potassium	1		unknown (assumed lognorm.)						2150		2150
Sodium	1		unknown (assumed lognorm.)						42900		42900

Notes:
Bold Text indicates selected COPC for this media.
Units are ug/L.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shapiro test.
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data.
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

TA[illegible] 6-11

REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION - SITE 8 SURFACE WATER (DISSOLVED INORGANICS)

NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $H_{95\%}$ (Lognorm.) or $T_{95\%}$ (Normal)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration
				W-norm.	W-lognorm.	W-Table					
Barium	1		unknown (assumed lognorm.)						122		122
Calcium	1		unknown (assumed lognorm.)						48100		48100
Magnesium	1		unknown (assumed lognorm.)						15900		15900
Manganese	1		unknown (assumed lognorm.)						162		162
Potassium	1		unknown (assumed lognorm.)						2320		2320
Sodium	1		unknown (assumed lognorm.)						45600		45600

Notes:

Bold Text indicates selected COPC for this media.

Units are ug/L.

Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.

Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.

A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.

A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shapiro test.

H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data.

Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).

The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

6.2.5.1 Calculation of Exposure Point Concentrations

Where available, validated data were used to calculate EPCs. The validated data for Site 8 were generated between 1991 and 1999 as part of RI fieldwork. For purposes of calculating the EPC, a value of one-half the sample quantitation limit was assumed for non-detect (U, UJ, and UL qualified) results. Estimated values (J qualified), biased values (L and K qualified), other qualified values (N and P qualified) were used as the reported value. Rejected (R and UR qualified) and Blank-Contamination (B and BJ qualified) values were eliminated from further consideration.

Duplicate samples were averaged together and considered as one result. For duplicates, where one result was positive and the other result was a non-detect, the problem of calculating an average result arose whenever half the detection limit exceeded the positive result. In these situations, the positive result was used to represent the duplicate pair.

The calculation of an EPC involves two steps. First, the distribution of the data was determined as discussed in the preceding section. Then, based on the distribution of the data, an EPC was either calculated or selected.

Several important assumptions were used to evaluate the distribution of the data (Section 6.2.4):

- The distribution of a data set was determined using a Shapiro-Wilk test.
- The distributions were classified as lognormal, normal, or unknown.
- By default, environmental data are generally determined to be lognormally distributed.
- If the data were not determined to be either a lognormal or normal distribution, they were classified as an unknown distribution and a lognormal distribution was assumed.

If the data were considered to be lognormally distributed, then the standard deviation of the log-transformed sample set was determined, as follows:

$$S = \sqrt{\sum\left(\frac{(X_i - \mu)^2}{n-1}\right)}$$

where:

S = Standard deviation of the log-transformed data

X_i	=	Individual sample value (log-transformed using the natural logarithm function)
μ	=	Arithmetic mean of the log-transformed n samples
n	=	Number of samples

The one-sided upper 95 percent confidence limit (UCL_{LOG}) was then calculated as follows:

$$UCL_{LOG} = e^{\left[\mu + 0.5s^2 + \left(\frac{sH}{\sqrt{n-1}}\right)\right]}$$

where:

e	=	constant (base of the natural log, equal to 2.718)
μ	=	Arithmetic mean of the log-transformed data
H	=	H-statistic (e.g., from table published in Gilbert, 1987)
S	=	Standard deviation of the log-transformed data
n	=	Number of samples

The EPC was then selected as the lesser value of the one-sided 95 percent UCL and the maximum positive value in the data set.

If the data were determined to be normally distributed, then the standard deviation of the sample set was used to calculate the one-sided 95 percent UCL, as follows:

First, the standard deviation of the sample set was determined:

$$S = \sqrt{\sum\left(\frac{(X_i - \mu)^2}{n-1}\right)}$$

where:

S	=	Standard deviation of the data
X_i	=	Individual sample value
μ	=	Arithmetic mean of the n samples
n	=	Number of samples

The one-sided upper 95 percent confidence limit (UCL_{NOR}) was calculated as follows:

$$UCL_{NOR} = \mu + \frac{(t * S)}{\sqrt{n}}$$

where:

S	=	Standard deviation of the data
t	=	One-sided t distribution factor
μ	=	Arithmetic mean of the n samples
n	=	Number of samples

The EPC was then selected as the lesser value of the one-sided 95 percent UCL and the maximum positive value in the data set.

For small sample sets or sample sets in which all positive results equal less than one-half the detection limit, the UCL can sometimes exceed the maximum detected concentration. In these cases, the maximum concentration was selected as the EPC.

6.2.5.2 Reasonable Maximum Exposure EPCs

Reasonable maximum exposure (RME) EPCs were considered for use in this HHRA. RME is the exposure that is expected to represent an upper-bound exposure in a given medium of interest. RME EPCs are selected from the maximum value, 95% upper confidence limit on the mean of normally distributed data (95% UCL-N), or the upper 95% upper confidence limit on log transformed data (95% UCL-T). As explained in Section 6.2.5.1, the RME EPC is the lower of the maximum value and the 95% UCL-N or 95% UCL-T (selected based on distribution of the data).

6.2.5.3 EPCs for Current/Future and Future Surface Soil Exposure Pathways

Surface soil EPCs for the current/future industrial adult, current/future casual user child (age 1 - 6), current/future casual user pre-adolescent/adolescent (age 7 - 16), current/future casual user adult, future residential child, and future residential adult are shown on Table 6-12. The maximum detected concentration was less than the calculated UCL-statistic for 1,2,3,4,6,7,8-HpCDD and dibenz(a,h)anthracene in surface soil therefore, the maximum detected concentrations were selected as the RME EPCs. The calculated UCL-statistic was less than the reported maximum for each of the remaining surface soil COPCs (OCDD, arsenic, chromium, lead, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene), therefore, RME EPCs for each of these contaminants was the 95% UCL-T statistic. The rationale for each 95% UCL-statistic was based on determination of the

TABLE 6-12
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY SITE 8 SURFACE SOIL (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil, Industrial Adult*

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
1,2,3,4,6,7,8-HpCDD	ug/kg	0.317	12.1	3.6	J	ug/kg	3.6	Max	Max < U95log
OCDD	ug/kg	2.04	6.83	22	J	ug/kg	13.9	95%UCL-T	Wlg>=Wt& Wno
Arsenic	mg/kg	6.08	6.73	13.9		mg/kg	6.73	95%UCL-T	Wlg>=Wt& Wno
Chromium	mg/kg	19.7	23.1	46.1		mg/kg	23.1	95%UCL-T	Wlg>=Wt& Wno
Lead	mg/kg	119	214	732	K	mg/kg	214	95%UCL-T	W<Wt;log def
Benz(a)anthracene	ug/kg	215	271	980		ug/kg	271	95%UCL-T	W<Wt;log def
Benzo(a)pyrene	ug/kg	228	287	930		ug/kg	287	95%UCL-T	W<Wt;log def
Benzo(b)fluoranthene	ug/kg	311	402	1600		ug/kg	402	95%UCL-T	W<Wt;log def
Dibenz(a,h)anthracene	ug/kg	242	335	120	J	ug/kg	120	Max	Max < U95log

* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Industrial Adult.
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Child (Age 1-6).
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Child (Age 1-6).
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Pre-Adolescent/Adolescent (Age 7-16).
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Pre-Adolescent/Adolescent (Age 7-16).
* This screening is also valid for Curent/Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Casual User Adult.
* This screening is also valid for Current/Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Casual User Adult.
* This screening is also valid for Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Residential Child.
* This screening is also valid for Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Residential Child.
* This screening is also valid for Future/Surface Soil/Surface Soil/Contact (Ing. & Der.) with Surface Soil Residential Adult.
* This screening is also valid for Future/Surface Soil/Particulates/Contact (Inhalation) with Surface Soil Residential Adult.

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).
J - Estimated Value.
K - Biased High Value.

data distributional shape (normal, lognormal, nonparametric [assumed lognormal) and statistical scores that were presented on Table 6-7.

6.2.5.4 EPCs for Current/Future and Future Subsurface Soil Exposure Pathways

Subsurface soil EPCs for the current/future industrial adult, future residential child, and future residential adult are shown on Table 6-13. The calculated UCL-statistic was less than the reported maximum for OCDD, therefore, the RME EPC was based on the 95% UCL-N statistic. The calculated UCL-statistic was less than the reported maximum for copper, therefore, the RME EPC was based on the 95% UCL-T statistic. The rationale for each 95% UCL-statistic was based on determination of the data distributional shape (normal, lognormal, nonparametric [assumed lognormal], and statistical scores that were presented on Table 6-8.

6.2.5.5 EPCs for Current/Future Sediment Exposure Pathways

Sediment EPCs for the current/future recreational pre-adolescent (age 7 - 12) are shown on Table 6-14. The maximum detected concentration was less than the calculated UCL-statistic for arsenic, iron, and manganese, therefore, the RME EPC in sediment for these COPCs were based on the maximum detected concentration. The UCL-statistic could not be calculated for benzo(a)pyrene and dibenz(a,h)anthracene because of the low number of data points, therefore, the RME EPC in sediment for these COPCs were based on the maximum detected concentration.

6.2.5.6 EPCs for Current/Future Surface Water (Total Inorganics) Exposure Pathways

Surface Water (total inorganics and organics) EPCs for the current/future recreational pre-adolescent (age 7 - 12) are shown on Table 6-15. The UCL-statistic could not be calculated for manganese because of the low number of data points, therefore, the RME EPC in surface water for total manganese was based on the maximum detected concentration.

6.2.5.7 EPCs for Current/Future Surface Water (Dissolved Inorganics) Exposure Pathways

Surface Water (dissolved inorganics and organics) EPCs for the current/future recreational pre-adolescent (age 7 - 12) are shown on Table 6-16. The UCL-statistic could not be calculated for manganese because of the low number of data points, therefore, the RME EPC in surface water for dissolved manganese was based on the maximum detected concentration.

TABLE 6-13
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY SITE 8 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Subsurface Soil, Industrial Adult*

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
OCDD	ug/kg	2.71	4.23	4.4	J	ug/kg	4.23	95%UCL-N	Wno>=Wt&>Wlg
Copper	mg/kg	30.6	34.8	353.65	J	mg/kg	34.8	95%UCL-T	W<Wt;log def

* This screening is also valid for Current/Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Industrial Adult.
* This screening is also valid for Future/Subsurface Soil/Subsurface Soil/Contact (Ing. & Der.) with Subsurface Soil Residential Child.
* This screening is also valid for Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Residential Child.
* This screening is also valid for Future/Subsurface Soil/Subsurface Soil/Contact (Ing. & Der.) with Subsurface Soil Residential Adult.
* This screening is also valid for Future/Subsurface Soil/Particulates/Contact (Inhalation) with Subsurface Soil Residential Adult.

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).
J - Estimated Value.

TABLE 6-14
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY SITE 8 SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact (Ing. & Der.) with Sediment, Off-Site Recreational Pre-Adolescent (Age 7-12)

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/kg	3.05	5.34	4.2		mg/kg	4.2	Max	Max < U95nor
Iron	mg/kg	19300	38500	25400		mg/kg	25400	Max	Max < U95log
Manganese	mg/kg	552	6180	848	J	mg/kg	848	Max	Max < U95log
Benzo(a)pyrene	ug/kg	460	(2)	650		ug/kg	650	Max	U95 undefined
Dibenz(a,h)anthracene	ug/kg	1320	(2)	140	J	ug/kg	140	Max	U95 undefined

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).
(2) Not estimated for a data set of 2 sampling locations.
J - Estimated Value.

TABLE 6-15
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY SITE 8 SURFACE WATER (TOTAL INORGANICS)
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Total Inorganics)
Exposure Medium: Surface Water (Total Inorganics)
Exposure Point: Contact (Ing. & Der.) with Surface Water (Total Inorganics), Off-Site Recreational Pre-Adolescent (Age 7-12)

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Manganese	ug/L	159	(2)	159		ug/L	159	Max	U95 undefined

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).
(2) Not estimated for a data set of 1 sampling location.

TABLE 6-16
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY SITE 8 SURFACE WATER (DISSOLVED INORGANICS)
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Dissolved Inorganics)
Exposure Medium: Surface Water (Dissolved Inorganics)
Exposure Point: Contact (Ing. & Der.) with Surface Water (Dissolved Inorganics), Off-Site Recreational Pre-Adolescent (Age 7-12)

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Manganese	ug/L	162	(2)	162		ug/L	162	Max	U95 undefined

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N).
(2) Not estimated for a data set of 1 sampling location.

6.3 EXPOSURE ASSESSMENT

The exposure assessment evaluates the potential for human exposure to the chemicals detected in the environmental media at Site 8. This section presents a characterization of the exposure setting, characterizes the exposed populations, identifies actual or potential exposure routes, and summarizes the methods used to generate exposure estimates. Figure 6-1 displays the conceptual site model for human health risks related to Site 8. The nature and extent of contamination for each media of interest for which exposures were based are presented in Section 4.0.

6.3.1 Characterization of the Exposure Setting

A characterization of the site setting (e.g. land use, hydrology, and soil characteristics) is presented in Section 3.0. The Site 8 area is comprised of media of interest at or surrounding the site including surface soil, subsurface soil, sediment, and surface water. Any media contamination occurring within the study area that was attributable to Site 8 would generally be present as the result of migration of contaminants away from the site via spills, infiltration, overland runoff, or fugitive dust emissions. Contaminant migration and accompanying receptor exposures within the study area would have to be associated with primary, secondary and tertiary release mechanisms and transport processes. Section 5.0 provides a more thorough discussion of these mechanisms and processes.

6.3.2 Potential Receptors

The potential receptors chosen for Site 8 are discussed in detail in this section. The on/off-base receptors were selected based on several criteria (i.e., current and anticipated future land use, accessibility to the site, and media of interest sampled) and are listed as follows:

6.3.2.1 Surface Soil Exposure

The surface soil exposure scenarios are presented below (a more detailed explanation of each exposure parameter selected for each potential receptor is provided in Section 6.3.3):

- Current/Future Industrial Adult - This receptor is an adult who uses Site 8 for work-related industrial purposes 250 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

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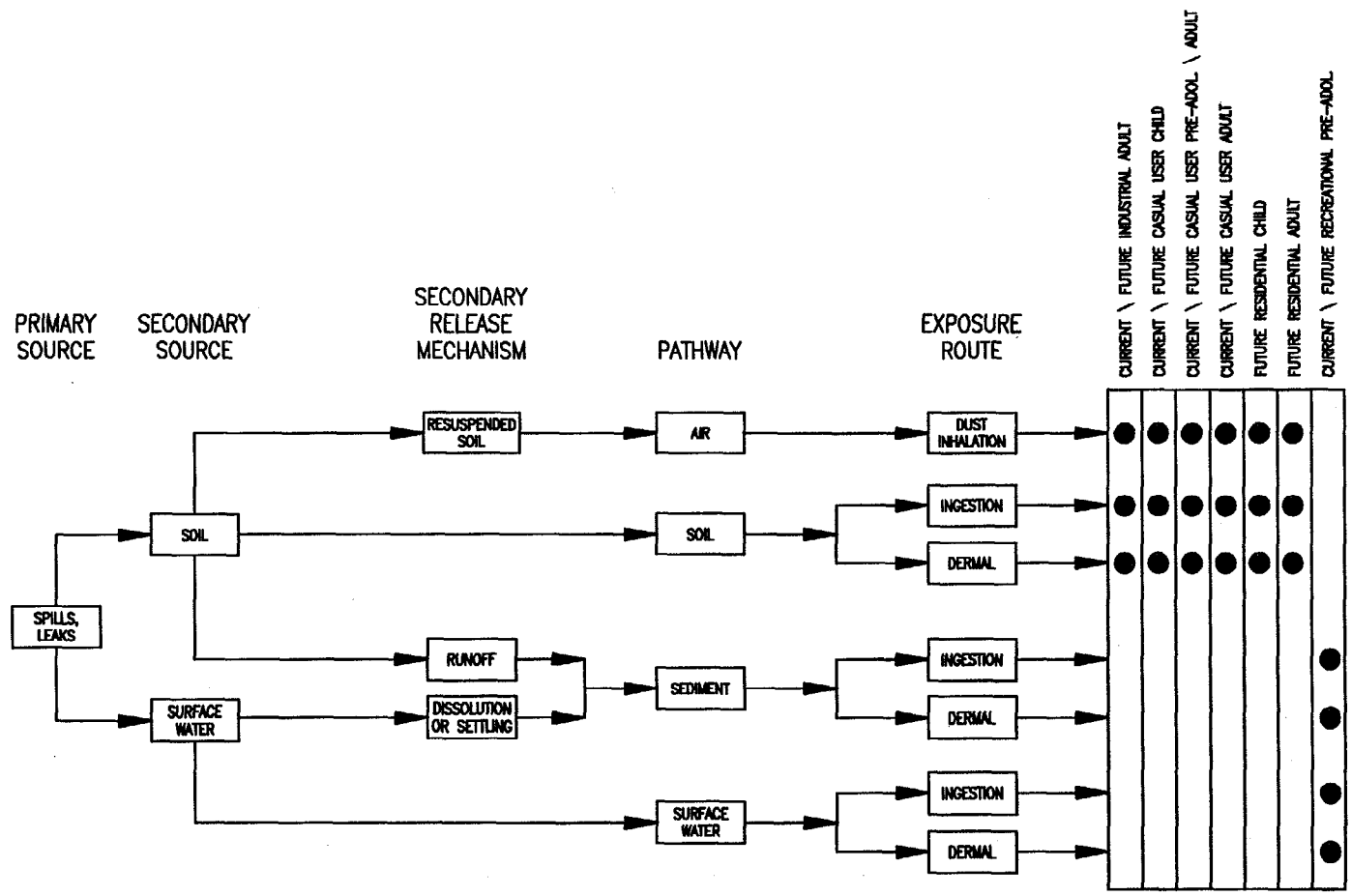

DRAWN BY LDL DATE 4/29/99	Tetra Tech NUS, Inc.	CONTRACT NO. 1412	OWNER NO. 4010
CHECKED BY DATE	SITE 8 CONCEPTUAL MODEL HUMAN HEALTH RISK ASSESSMENT NAWC WARMINSTER, PA	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE NONE		DRAWING NO. FIGURE 6-1	REV.

- Current/Future Casual User Child - This receptor is a child (age 1 - 6) who uses Site 8 for recreational purposes 24 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

- Current/Future Casual User Pre-Adolescent/Adolescent - This receptor is a pre-adolescent/adolescent (age 7 - 16) who uses Site 8 for recreational purposes 24 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

- Current/Future Casual User Adult - This receptor is an adult who accompanies the current/future casual user child (age 1 - 6) who uses Site 8 for recreational purposes 24 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

- Current/Future Lifetime Casual User - This receptor uses the area for recreational purposes (24 days per year) throughout a lifetime [casual user child (age 1 - 6), casual user pre-adolescent/adolescent (age 7 - 16), and a casual user adult]. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil. [This additive casual user exposure scenario is included to estimate the lifetime cancer risk under a casual visitor land use scenario].

- Future Residential Child - This receptor is an child (age 1 - 6) who resides at or near Site 8 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

- Future Residential Adult - This receptor is an adult who resides at or near Site 8 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil.

- Future Lifetime Resident - This receptor is exposed (350 days per year) as an adult and as a child [residential child (age 1 - 6) and residential adult]. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil. [This additive residential exposure scenario is included to estimate the lifetime cancer risk under a residential land use scenario].

6.3.2.2 Subsurface Soil Exposure

The subsurface soil exposure scenarios are presented below. A more detailed explanation of each exposure parameter selected for each potential receptor is provided in Section 6.3.3. The exposure scenarios for subsurface soils included:

- Current/Future Industrial Adult - This receptor is an adult who uses Site 8 for work-related industrial purposes 250 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in subsurface soil.
- Future Residential Child - This receptor is an child (age 1 - 6) who resides at or near Site 8 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in subsurface soil.
- Future Residential Adult - This receptor is an adult who resides at or near Site 8 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in subsurface soil.
- Future Lifetime Resident - This receptor is exposed as a residential child (age 1 - 6) and as a residential adult who resides at or near Site 8 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in subsurface soil. [This additive residential exposure scenario is included to estimate the lifetime cancer risk under a residential land use scenario].

6.3.2.3 Sediment Exposure

The sediment exposure scenario is presented below. A more detailed explanation of each exposure parameter selected for the potential receptor is provided in Section 6.3.3. The exposure scenario for sediment included:

- Current/Future Recreational Pre-Adolescent - This receptor is an pre-adolescent (age 7 - 12) who use off-site areas near Site 8 for recreational purposes 7 days/year. This receptor is potentially exposed via ingestion of and dermal contact with COPCs in sediment.

6.3.2.4 Surface Water (Total Inorganics) Exposure

The surface water (total inorganics) exposure scenario is presented below. A more detailed explanation of each exposure parameter selected for the potential receptor is provided in Section 6.3.3. The exposure scenario for surface water (total inorganics) included:

- Current/Future Recreational Pre-Adolescent - This receptor is an pre-adolescent (age 7 - 12) who use off-site areas near Site 8 for recreational purposes 7 days/year. This receptor is potentially exposed via ingestion of and dermal contact with COPCs in surface water (total inorganics).

6.3.2.5 Surface Water (Dissolved Inorganics) Exposure

The surface water (dissolved inorganics) exposure scenario is presented below. A more detailed explanation of each exposure parameter selected for the potential receptor is provided in Section 6.3.3. The exposure scenario for surface water (dissolved inorganics) included:

- Current/Future Recreational Pre-Adolescent - This receptor is an pre-adolescent (age 7 - 12) who use off-site areas near Site 8 for recreational purposes 7 days/year. This receptor is potentially exposed via ingestion of and dermal contact with COPCs in surface water (dissolved inorganics).

6.3.3 Exposure Estimates

The exposure routes, methods, and models presented in this section are consistent with current EPA risk assessment guidance (EPA, 1989a, 1991c, 1996b, and 1998b). Exposure estimates associated with each exposure route are presented below. All exposure scenarios incorporate RME EPCs in the estimation of intakes. There are four environmental media for Site 8 through which potential receptors (see previous section) can be either directly or indirectly exposed to site-related COPCs: surface soil, subsurface soil, sediment, and surface water.

Exposure doses for the evaluation of noncarcinogenic risks were estimated using the concept of an average annual exposure. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. This is used along with the "averaging time," which converts the daily exposure frequency and duration to an annual exposure by dividing by 365 days per year of exposure. Noncarcinogenic risks for some exposure routes (e.g., soil) are generally greater for children than for adults because of differences in body weight and intake. Carcinogenic risks, on the other hand, were calculated as an incremental lifetime risk and, therefore, the exposure dose for the evaluation of cancer risk incorporates terms to represent the exposure duration (years) over the course of a lifetime (70 years).

6.3.3.1 Surface and Subsurface Soil Exposure Estimates

Three potential exposure routes were associated with direct exposure to surface and subsurface soil at Site 8, including:

- Ingestion
- Dermal absorption
- Inhalation of fugitive dust

For surface soil, all three exposure routes were evaluated using the current/future industrial adult receptor, current/future casual user child (age 1 - 6) receptor, current/future casual user pre-adolescent/adolescent (age 7 - 16) receptor, current/future casual user adult receptor, current/future lifetime casual user receptor [cancer risks only], future residential child receptor, future residential adult receptor, and future lifetime residential receptor [cancer risks only]. These receptors were chosen because they are expected to be representative of typical industrial, recreational, or residential exposures at Site 8.

For subsurface soil, all three exposure routes were evaluated using the current/future industrial adult receptor, future residential child receptor, future residential adult receptor, and future lifetime residential receptor [cancer risks only]. These receptors were chosen because they are expected to be representative of typical industrial or residential exposures at Site 8.

Ingestion of and dermal contact with soil are expected to contribute to the majority of the risk under the soil exposure scenarios, whereas risks based on exposure to fugitive dust are expected to be low. For fugitive dust emissions under industrial, recreational, and residential exposure, the fraction of vegetative surface cover was assumed to be 50% of the surface area. Derivation of the soil particle emission factor is presented in EPA's Soil Screening Guidance (EPA, 1996c). Concentrations of VOCs in surface soil and subsurface soil did not exceed soil screening levels developed by EPA for the inhalation route of exposure (SSLs; EPA, 1996c), therefore, the "inhalation of volatiles" exposure pathway was not quantitatively evaluated in this HHRA.

Table 6-17 and Table 6-18 present the RME input parameters selected for the surface and subsurface exposure pathways for the current/future industrial adult. Table 6-19 and Table 6-20 present the RME input parameters selected for the surface soil exposure pathway for the current/future casual user child (age 1 - 6). Table 6-21 and Table 6-22 present the RME input parameters selected for the surface soil exposure pathway for the current/future casual user pre-adolescent/adolescent (age 6 - 17). Table 6-23 and Table 6-24 present the RME input parameters selected for surface soil exposure pathway for the current/future casual user adult. Table 6-25 and Table 6-26 present the RME input parameters selected

for the surface and subsurface exposure pathways for the current/future residential child. Table 6-27 and Table 6-28 present the RME input parameters selected for surface and subsurface exposure pathways for the future residential adult.

Rationale for each exposure surface and subsurface soil input parameter was presented in Tables 6-17 through 6-28. The only input values not shown on the exposure input tables are the chemical specific absorption factors for the dermal pathway. These values are provided by EPA Region III. For surface and subsurface soil COPCs, absorption factors are as follows (EPA, 1995a): 1,2,3,4,6,7,8-HpCDD (3%), OCDD (3%), arsenic (3%), chromium (1%), copper (1%), and lead (1%). Note: EPA (1989a) states that it is inappropriate to estimate the risks associated with dermal exposure to PAHs, which cause cancer through a direct action at the point of application. Derivation of the surface areas (used in all dermal exposure equations in this risk assessment) for each of the potential receptors was based upon the sum of the values for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix G, Part 3. This table also shows the input values used to derive the average body weights for the age-range categories including the casual user child (age 1 - 6), casual user pre-adolescent/adolescent (age 5 - 12), and residential adult (age 1 - 6). Sample calculations for ingestion, dermal absorption, and inhalation of fugitive dust of COPCs in surface and subsurface soil are provided in Appendix G, Part 4.

6.3.3.2 Sediment Soil Exposure Estimates

Two potential exposure routes (ingestion and dermal absorption) were associated with direct exposure to sediment at off-site areas near Site 8.

For sediment, both exposure routes were evaluated using the current/future recreational pre-adolescent (age 7 - 12) receptor. This receptor was chosen because it is expected to be representative of typical recreational exposures at off-site areas near Site 8.

Table 6-29 presents the RME input parameters (and rationale) selected for the sediment exposure pathways for the current/future recreational pre-adolescent. A soil-to-skin adherence factor of 0.2 mg/cm^2/event was used for sediment, since the nearby stream is often void of water and more closely resembles dry soil. The only input values not shown on the exposure input tables are the chemical specific absorption factors for the dermal pathway. These values are provided by EPA Region III. For sediment COPCs, absorption factors are as follows (EPA, 1995a): arsenic (3%), iron (1%), and manganese (1%). Note: EPA (1989a) states that it is inappropriate to estimate the risks associated with dermal exposure to PAHs, which cause cancer through a direct action at the point of application. Deviation of the surface areas (used in all dermal exposure equations in this

TABLE 6-17

VALUES USED FOR DAILY INTAKE CALCULATIONS - INDUSTRIAL ADULT CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface & Subsurface Soil
Exposure Medium: Surface & Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Surface & Subsurface Soil
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1991c	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	Prof Judge	
	EF	Exposure Frequency	days/year	250	EPA, 1997b	
	ED	Exposure Duration	years	25	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm2	4499	(2c)	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.2	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	250	EPA, 1997b	
	ED	Exposure Duration	years	25	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989a	

Sources:

(2c). EPA, 1985. *Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.*

(2c). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2c). Surface Area adjusted represents hands, lower legs and feet.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1991c. Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance).

TABLE 6-18

VALUES USED FOR DAILY INTAKE CALCULATIONS - INDUSTRIAL ADULT CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface & Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.5	EPA, 1997b	
	ET	Exposure Time	hours/day	8	(1b)	
	EF	Exposure Frequency	days/year	250	EPA, 1997b	
	ED	Exposure Duration	years	25	EPA, 1997b	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989a	

Sources:

(1b). Professional Judgment. 8 hours/day exposure based on an average workday.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-19

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	EPA, 1997b	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	0.5	(1a)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	16.6	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA-ADJ	Age-Adjusted Skin Surface Area/Body Wt. Ratio	cm2-years/kg	842	(2b)	CS x SA-ADJ x SSAF x DABS x EV x EF x CF3 x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.2	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(1a). Professional Judgment. 50% Fraction Ingested from Contaminated Source.

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(2b). EPA, 1985. Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, forearms, lower legs, feet, and face.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance).

TABLE 6-20

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.2	EPA, 1997b	
	ET	Exposure Time	hours/day	4	(1d)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997b	
	BW	Body Weight	kg	16.6	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(1d). Professional Judgment. 4 hours/day exposure time, 50% of expected time spent outdoors.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-21

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	150	(3b)	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	0.5	(1a)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	10	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	43.4	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	3650	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA-ADJ	Age-Adjusted Skin Surface Area/Body Wt. Ratio	cm2-years/kg	1035	(2b)	CS x SA-ADJ x SSAF x DABS x EV x EF x CF3 x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.2	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	10	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	3650	EPA, 1989a	

Sources:

(1a). Professional Judgment. 50% Fraction Ingested from Contaminated Source.

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(2b). EPA, 1985. Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, forearms, lower legs, feet, and face.

(3b). EPA, 1997b (100 mg/day) + Additional Exposure Based on Professional Judgment.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance).

TABLE 6-22

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.2	EPA, 1997b	
	ET	Exposure Time	hours/day	4	(1d)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	10	EPA, 1997b	
	BW	Body Weight	kg	43.4	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	3650	EPA, 1989a	

Sources:

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(1d). Professional Judgment. 4 hours/day exposure time, 50% of expected time spent outdoors.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-23

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER ADULT CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	50	EPA, 1997b	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	0.5	(1a)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	14	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	5110	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm2	6411	(2b)	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.07	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	*Event Frequency*	*events/day*	1	*Prof Judge*	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	14	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	5110	EPA, 1989a	

Sources:

(1a). Professional Judgment. 50% Fraction Ingested from Contaminated Source.

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(2b). EPA, 1985. Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, forearms, lower legs, feet, and face.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance).

TABLE 6-24

VALUES USED FOR DAILY INTAKE CALCULATIONS - CASUAL USER ADULT CONTACT WITH SITE 8 SURFACE SOIL (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997b	
	ET	Exposure Time	hours/day	4	(1d)	
	EF	Exposure Frequency	days/year	24	(1c)	
	ED	Exposure Duration	years	14	EPA, 1997b	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	5110	EPA, 1989a	

Sources:

(1c). Professional Judgment. 24 days/year = (2 days/week * 12 weeks/year; Months of June, July, and August).

(1d). Professional Judgment. 4 hours/day exposure time, 50% of expected time spent outdoors.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-25

VALUES USED FOR DAILY INTAKE CALCULATIONS - RESIDENTIAL CHILD CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface & Subsurface Soil
Exposure Medium: Surface & Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Surface & Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	EPA, 1997b	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	6	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	16.6	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA-ADJ	Age-Adjusted Skin Surface Area/Body Wt. Ratio	cm2-years/kg	842	(2b)	CS x SA-ADJ x SSAF x DABS x EV x EF x CF3 x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.2	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	6	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(2b). EPA, 1985. Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, forearms, lower legs, feet, and face.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance) Region I EPA.

TABLE 6-26

VALUES USED FOR DAILY INTAKE CALCULATIONS - RESIDENTIAL CHILD CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface & Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.2	EPA, 1997b	
	ET	Exposure Time	hours/day	24	Prof Judge	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	6	EPA, 1997b	
	BW	Body Weight	kg	16.6	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(1e). Professional Judgment. 24 hour/day exposure time based on an entire day at residence.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-27

VALUES USED FOR DAILY INTAKE CALCULATIONS - RESIDENTIAL ADULT CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface & Subsurface Soil
Exposure Medium: Surface & Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Surface & Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	50	EPA, 1997b	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	24	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989a	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA	Skin Surface Area Available for Contact	cm2	6411	(2b)	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.07	EPA, 1998b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	24	EPA, 1997b	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989a	

Sources:

(2b). EPA, 1985. Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, forearms, lower legs, feet, and face.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance).

TABLE 6-28

VALUES USED FOR DAILY INTAKE CALCULATIONS - RESIDENTIAL ADULT CONTACT WITH SITE 8 SURFACE (POST-REMOVAL) AND SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface & Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact (Inhalation) with Particulates
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+9	EPA, 1996c	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997b	
	ET	Exposure Time	hours/day	24	(1e)	
	EF	Exposure Frequency	days/year	350	EPA, 1997b	
	ED	Exposure Duration	years	24	EPA, 1997b	
	BW	Body Weight	kg	70	EPA, 1997b	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989a	

Sources:

(1e). Professional Judgment. 24 hour/day exposure time based on an entire day at residence.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1996c. Soil Screening Guidance, Users Guide. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency. Washington. April 1996. EPA/540/R-96/018.

EPA, 1997b. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

TABLE 6-29

VALUES USED FOR DAILY INTAKE CALCULATIONS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SITE 8 SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact (Ing. & Der.) with Sediment
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Sediment	mg/kg	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Sediment	mg/day	200	EPA, 1997a	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	Prof Judge	
	EF	Exposure Frequency	days/year	7	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997a	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	BW	Body Weight	kg	32.5	EPA, 1997a	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	
Dermal	CS	Chemical Concentration in Sediment	mg/kg	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA-ADJ	Age-Adjusted Skin Surface Area/Body Wt. Ratio	cm2-years/kg	253	(2b)	CS x SA-ADJ x SSAF x DABS x EV x EF x CF3 x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm2/event	0.2	EPA, 1997b	
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995a	
	EV	Event Frequency	events/day	1	Prof Judge	
	EF	Exposure Frequency	days/year	7	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997a	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(1c). Professional Judgement. 7 days/year = Matches national average for swimming (as listed in RAG for Superfund - EPA, 1989a).

(2b). Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997a. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands and feet (wading scenario).

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

EPA, 1997a. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

EPA, 1997b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance) Region I EPA.

risk assessment) for the potential receptor was based upon the sum of the values for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix G, Part 3. This table also shows the input values used to derive the average body weight for the recreational pre-adolescent (age 7 - 12). Sample calculations for ingestion and dermal absorption of COPCs in sediment are provided in Appendix G, Part 4.

6.3.3.3 Surface Water (Both Total and Dissolved Inorganics) Exposure Estimates

Two potential exposure routes were associated with direct exposure to surface water (for both total and dissolved inorganic exposure) at off-site areas near Site 8, including:

- Ingestion
- Dermal absorption

For surface water, both exposure routes were evaluated using the current/future recreational pre-adolescent (age 7 - 12) receptor. This receptor was chosen because it is expected to be representative of typical recreational exposures at off-site areas near Site 8.

Table 6-30 presents the RME input parameters (and rationale) selected for the surface water (for both total and dissolved inorganics) exposure pathways for the current/future recreational pre-adolescent. The only input values not shown on the exposure input tables are the chemical specific permeability constants for the dermal pathway. For the surface water COPC, manganese, the permeability constant is 1E-03 cm/hr (EPA, 1992e). Derivation of the surface areas (used in all dermal exposure equations in this risk assessment) for the potential receptor was based upon the sum of the values for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix G, Part 3. This table also shows the input values used to derive the average body weight for the recreational pre-adolescent (age 7 - 12). Sample calculations for ingestion and dermal absorption of COPCs in surface water are provided in Appendix G, Part 4.

6.3.4 Blood-Lead Modeling

As outlined in OSWER Directive 9355.4-12, EPA (1994a) has developed an approach to evaluating lead risks that recognizes the multimedia nature of lead exposures, incorporating absorption and pharmacokinetic information. Research has been conducted concerning lead intake and resultant blood-lead levels. Determinations of lead uptake from several sources (including soil and drinking water) were considered. Potential blood-lead level increases are estimated and are discussed, along with the potential implications of blood-lead results for residential children. The following discussion presents information that is useful in estimating lead exposure for surface soil exposure.

TABLE 6-30

VALUES USED FOR DAILY INTAKE CALCULATIONS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SITE 8 SURFACE WATER (TOTAL AND DISSOLVED INORGANICS)

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Total and Dissolved Inorganics)
Exposure Medium: Surface Water (Total and Dissolved Inorganics)
Exposure Point: Contact (Ing. & Der.) with Surface Water (Total and Dissolved Inorganics)
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Surface Water	ug/l	See Table 3	See Table 3	Intake (mg/kg-day) =
	IR-W	Ingestion Rate of Surface Water	liters/hour	0.2	EPA, 1997a	CWS x IR-W x FI x EF x ED x CF1 x 1/(BW x AT)
	FI	Fraction Ingested from Contaminated Source	--	1	Prof Judge	
	EF	Exposure Frequency	days/year	7	(1c)	
	ED	Exposure Duration	years	6	EPA, 1997a	
	CF1	Conversion Factor 1	mg/ug	0.001	--	
	BW	Body Weight	kg	32.5	EPA, 1997a	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	
Dermal	CW	Chemical Concentration in Surface Water	ug/l	See Table 3	See Table 3	Dermal Absorbed Dose (mg/kg-day) =
	SA-ADJ	Age-Adjusted Skin Surface Area/Body Wt. Ratio	cm2-years/kg	483	(2b)	CW x SA-ADJ x KP x Function(ET) x EV x EF x CF1 x
	KP	Permeability Constant (Dermal for Liquids)	cm/hr	Chemical-Specific	EPA, 1992e	CF2 x 1/AT
	ET	Exposure Time	hr/event	2.6	EPA, 1989a	Where: Function(ET) = ET for inorganics, or
	EV	Event Frequency	events/day	1	Prof Judge	(24 x Tau x ET / PI)^0.5 for organics where ET < T*, or
	EF	Exposure Frequency	days/year	7	(1c)	[ET/(1+B)] + Tau x (2+6B)/(1+B) for organics, ET > T*.
	ED	Exposure Duration	years	6	EPA, 1997a	See EPA, 1992e for chemical-specific constants Tau, B, T*
	CF1	Conversion Factor 1	mg/ug	0.001	--	
	CF2	Conversion Factor 2	l/cm3	0.001	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989a	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989a	

Sources:

(1c). Professional Judgement. 7 days/year = Matches national average for swimming (as listed in RAG for Superfund - EPA, 1989a).

(2b). Development of Statistical Distributions or Ranges of Standard Exposure Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.

(2b). EPA, 1997a. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2b). Surface Area adjusted represents hands, lower legs, and feet.

EPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

EPA, 1992e. Dermal Exposure Assessment: Principles and Applications. Interim Report. EPA 600/8-91/011/B. Office of Health and Environmental Assessment. Washington, DC. January.

EPA, 1997a. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

No threshold has been defined for effects related to blood-lead increases. Effects below blood-lead levels of 10 ug/dL are difficult to define. Inhibition of certain enzymes involved in red blood cell metabolism has been reported to occur at 10 to 15 ug/dL and possibly lower. Small increases in blood pressure have been observed in adults with blood-lead levels down to 7 ug/dL (EPA, 1994b). The most sensitive subpopulation to effects below 7 ug/dL, would be infants, whose early neurological development can be affected by blood-lead concentrations reportedly down to 5 ug/dL (EPA, 1994b). Lead is also a fairly common environmental contaminant and, for this reason, typical blood-lead levels in the population at large may already exceed the concentrations discussed here.

For drinking water exposure, children 0 through 6 months old are expected to experience blood lead increases at the rate of 0.26 ug/dL per ug/L lead in water up to 15 ug/L and at the rate of 0.04 ug/dL for every ug/L lead in water above 15 ug/L (EPA, 1994b). For older children, the ratio is 0.12 ug/dL blood lead per ug/L lead in water up to 15 ug/L and 0.06 ug/dL for every ug/L lead in water above 15 ug/L (EPA, 1994b). For adults, the ratio is approximately 0.06 ug/dL blood lead per ug/L in water (EPA, 1994b). Dietary intake of lead is assumed to produce increases of 0.02 to 0.04 ug/dL blood lead per ug/day ingested by adults and 0.16 ug/dL blood lead per ug/day ingested by infants (EPA, 1986a). Blood-lead levels are estimated to increase by 0.6 to 6.8 ug/dL per 1,000 mg/kg lead in soil (EPA, 1986a).

Blood-lead levels in residential children (age 1 - 6) were estimated using the Integrated Exposure and Uptake Biokinetic (IEUBK) Model (version 0.99) developed by EPA (EPA, 1994b). The model is applied using the average surface soil concentration at Site 8. As discussed in Section 6.1.3.1, lead was selected as a COPC in surface soil [the maximum detection of lead (732 mg/kg) in surface soil exceeds the 400 mg/kg OSWER Directive benchmark criterion]. Blood-lead levels in industrial or commercial workers were not estimated as part of the human health risk assessment since children were considered to be the most sensitive receptor to the effects related to blood-level increases.

For the assessment of ingestion of lead in surface soil by residential children, default values in the model are used to represent background lead concentrations in air, house dust, water, and the level of material contribution. Additionally, the model's default values are used to represent respiratory rate, soil and water ingestion rates, and the percent of lead absorption by the various exposure routes. The only site-specific factor entered into the IEUBK Model is the average lead concentration (119 mg/kg) in surface soil.

The output of the IEUBK Model is a histogram that presents the estimated percentage of residential children (age 0 through 6 years) with a blood-lead level above 10 ug/dL (considered to be the threshold significance level above which adverse effects cannot be ruled out). When the percentage of the population estimated to have blood-levels above 10 ug/dL is greater than five percent, then EPA considers the potential for adverse effects to be significant (EPA, 1994a). This histogram, along with input information particular to each run of the IEUBK model, is presented in Appendix G, Part 5. The estimated percentage of residential

children (age 0 through 6 years) with a blood-lead level above 10 ug/dL is also presented in Section 6.5.6. Uncertainties associated with the IEUBK model are discussed in Section 6.6.4.

6.4 DOSE-RESPONSE ASSESSMENT

Dose-Response Assessment identifies the potential health hazards associated with exposure to each of the COPCs. A toxicological evaluation characterizes the inherent toxicity of a compound. The literature indicates that the COPCs have the potential to cause carcinogenic and/or noncarcinogenic health effects in humans. Although the COPCs may cause adverse health effects, dose-response relationships and the potential for exposure must be evaluated before the risks to receptors can be determined. Dose-response relationships correlate the magnitude of the intake with the probability of toxic effects, as discussed below. Toxicity information for the COPCs in surface soil, subsurface soil, sediment, and surface water at Site 8 are presented in this section and Appendix G, Part 6 in the form of toxicological profiles.

An important component of the risk assessment process is the relationship between the intake of a compound (the amount of a chemical that is absorbed by a receptor) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts can be quantified. The published information of doses and responses is used in conjunction with information on the nature and magnitude of human exposure to develop an estimate of potential health risks.

Dose-response values [reference doses (RfDs) and slope factors (SFs)] have been developed by EPA and other sources for many organics and inorganics. This section provides a brief description of these parameters.

6.4.1 Reference Doses

The RfD is developed by EPA for chronic and/or subchronic human exposure to hazardous chemicals and is based solely on the noncarcinogenic effects of chemical substances. Subchronic RfDs are specifically developed to be protective for a portion of a lifetime exposure to a compound (as a Superfund program guideline, 2 weeks to 7 years). Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (as a Superfund program guideline, 7 years to lifetime). The RfD is usually expressed as a dose (mg) per unit body weight (kg) per unit time (day). It is generally derived by dividing a No-Observed-(Adverse)-Effect-Level (NOAEL or NOEL) or a Lowest-Observed-Adverse-Effect-Level (LOAEL) by an appropriate uncertainty factor. NOAELs, etc. are determined from laboratory or epidemiological toxicity studies. The uncertainty factor is based on the availability of toxicity data.

Uncertainty factors are generally applied as multiples of 10 to represent specific areas of uncertainty in the available data. A factor of 10 is used to account for variations in the general population (to protect sensitive subpopulations), when test results from animals are extrapolated to humans (to account for interspecies variability), when a NOAEL derived from a subchronic study (instead of a chronic study) is used to develop the RfD, and when a LOAEL is used instead of a NOAEL. In addition, EPA reserves the use of a modifying factor of up to 10 for professional judgment of uncertainties in the data base not already accounted for. The default value of the modifying factor is 1.

The RfD incorporates the surety of the evidence for chronic human health effects. Even if applicable human data exist, the RfD (as diminished by the uncertainty factor) still maintains a margin of safety so that chronic human health effects are not underestimated. Thus, the RfD is an acceptable guideline for evaluation of noncarcinogenic risk, although the associated uncertainties preclude its use for precise risk quantitation. Oral and dermal RfDs, primary target organs, uncertainty/modifying factors, and sources for selected COPCs in surface soil, subsurface soil, sediment, and surface water are provided in Table 6-31. Inhalation RfDs, primary target organs, uncertainty/modifying factors, and sources for selected COPCs in surface soil and subsurface soil are provided in Table 6-32.

Target organ data have been extracted from the Integrated Risk Information System (IRIS; EPA, 1999a), Health Effect Assessment Summary Tables (HEAST; EPA, 1997a), or other applicable sources. Only the target organs that are affected in the applicable study in which the RfD was derived have been included in Tables 6-31 and 6-32. When multiple target organs are cited in the applicable RfD-derivation study, only the primary target organ will be selected and used in this HHRA.

Noncarcinogenic risks for lead were not quantified and compared to RfDs, because EPA has implemented an approach to evaluating lead risks that does not provide a single-point estimate output. Instead, potential lead exposures are evaluated using a biokinetic model to estimate expected blood-lead increases. The blood-lead model is discussed in Section 6.3.4. A discussion of the results of the blood-lead model estimates is presented in Section 6.5.6.

6.4.2 Cancer Slope Factors (SFs)

SFs are applicable for estimating the lifetime probability (assumed 70-year lifespan) of human receptors developing cancer as a result of exposure to known or potential carcinogens. This factor is generally reported in units of 1/(mg/kg/day) and is derived through an assumed low-dosage linear relationship of extrapolation from high to low dose responses determined from animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit.

TABLE 6-31

NON-CANCER TOXICITY DATA -- ORAL/DERMAL EXPOSURE ROUTES, SITE 8 SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT, AND SURFACE WATER COPCS

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD Target Organ	Dates of RfD Target Organ
1,2,3,4,6,7,8-HpCDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OCDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	Chronic	3.00E-04	mg/kg-day	9.50E-01	2.85E-04	mg/kg-day	Skin	3	IRIS	04/15/99
Chromium	Chronic	3.00E-03	mg/kg-day	2.50E-02	7.50E-05	mg/kg-day	Kidney	900	IRIS	04/15/99
Copper	-	4.00E-02	mg/kg-day	6.00E-01	2.40E-02	mg/kg-day	GI Tract	-	HEAST	1997
Iron	-	3.00E-01	mg/kg-day	1.00E+00	3.00E-01	mg/kg-day	Liver/Pancreas	-	EPA-NCEA	04/15/99
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	Chronic	2.40E-02	mg/kg-day	1.00E+00	2.40E-02	mg/kg-day	CNS	1	IRIS	04/15/99
Benz(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

(1) Refer to EPA (1989a; 1985)

(2) Equation used for derivation provided in Section 6.3.4.

IRIS - Integrated Risk Information System (EPA, 1999a)

HEAST - Health Effects Assessment Summary Tables (EPA, 1997a)

TABLE 6-32

NON-CANCER TOXICITY DATA -- INHALATION EXPOSURE ROUTES, SITE 8 (SURFACE AND SUBSURFACE SOIL COPCS ONLY)

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC/RfD Target Organ	Dates of RfC/RfD
1,2,3,4,6,7,8-HpCDD	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
OCDD	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Chromium	Subchronic	---	---	2.86E-05	mg/kg-day	Lung	300	IRIS	04/15/99
Copper	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Benz(a)anthracene	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	---	---	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

IRIS - Integrated Risk Information System (EPA, 1999a)

Oral and dermal SFs, weight of evidence, and sources for selected COPCs in surface soil, subsurface soil, sediment, and surface water are provided in Table 6-33. Inhalation SFs, weight of evidence, and sources for selected COPCs in surface soil and subsurface soil are provided in Table 6-34.

Carcinogenic risks for lead were not quantified, because EPA has not published a SF for inorganic lead. Instead, potential lead exposures were evaluated using a biokinetic model to estimate expected blood-lead increases. A discussion of these results is presented in Section 6.5.6.

6.4.3 EPA Weight of Evidence

The weight-of-evidence designations indicate the preponderance of evidence regarding carcinogenic effects in humans and animals. The categories are defined as follows (EPA, 1992c):

WEIGHT OF EVIDENCE CATEGORY	DEFINTION
A	Known human carcinogen
B1	Probably human carcinogen, limited human data are available
B2	Probable human carcinogen, sufficient animal data are available but inadequate human data are available
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity in humans

6.4.4 Adjustment of Dose-Response Parameters for Dermal Exposure

Risks associated with dermal exposures were evaluated using toxicity values that are specific to absorbed dermal doses. Most oral toxicity values are based on administered doses rather than absorbed doses (TCE being an important exception). Therefore, in accordance with EPA Region III (1995a) and EPA (1989a, Appendix A) guidance, the toxicity values based on administered doses were adjusted before they were used for evaluating absorbed doses.

Dermal RfDs and SFs were obtained from oral RfDs and SFs via the following relationships:

$$RfD_{Adjusted} = RfD_{Oral} * GI_{Oral}$$

$$SF_{Adjusted} = {SF_{Oral}}/{GI_{Oral}}$$

TABLE 6-33

CANCER TOXICITY DATA -- ORAL/DERMAL EXPOSURE ROUTES, SITE 8 SURFACE SOIL, SUBSURFACE SOIL, SEDIMENT, AND SURFACE WATER COPCS

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence/ Cancer Guideline Description	Source Target Organ	Date (2) (MM/DD/YY)
1,2,3,4,6,7,8-HpCDD	1.50E+03	1.00E+00	1.50E+03	1/(mg/kg-day)	B2	HEAST	1997
OCDD	1.50E+02	1.00E+00	1.50E+02	1/(mg/kg-day)	B2	HEAST	1997
Arsenic	1.50E+00	9.50E-01	1.50E+00	1/(mg/kg-day)	A	IRIS	04/15/99
Chromium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benz(a)anthracene	7.30E-01	1.00E+00	N/A	1/(mg/kg-day)	B2	EPA-NCEA	04/15/99
Benzo(a)pyrene	7.30E+00	1.00E+00	N/A	1/(mg/kg-day)	B2	IRIS	04/15/99
Benzo(b)fluoranthene	7.30E-01	1.00E+00	N/A	1/(mg/kg-day)	B2	EPA-NCEA	04/15/99
Dibenz(a,h)anthracene	7.30E+00	1.00E+00	N/A	1/(mg/kg-day)	B2	EPA-NCEA	04/15/99

N/A = Not Applicable
(1) Refer to EPA (1989a; 1985)
(2) Equation used for derivation provided in Section 6.3.4.
IRIS - Integrated Risk Information System (EPA, 1999a)
HEAST - Health Effects Assessment Summary Tables (EPA, 1997a)

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 6-34

CANCER TOXICITY DATA -- INHALATION EXPOSURE ROUTES, SITE 8 SURFACE AND SUBSURFACE COPCS ONLY

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date
1,2,3,4,6,7,8-HpCDD	---	---	---	1.50E+03	1/(mg/kg-day)	B2	HEAST	1997
OCDD	---	---	---	1.50E+02	1/(mg/kg-day)	B2	HEAST	1997
Arsenic	---	---	---	1.51E+01	1/(mg/kg-day)	A	IRIS	04/15/99
Chromium	---	---	---	4.10E+01	1/(mg/kg-day)	A	IRIS	04/15/99
Copper	---	---	---	N/A	N/A	N/A	N/A	N/A
Lead	---	---	---	N/A	N/A	N/A	N/A	N/A
Benz(a)anthracene	---	---	---	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	---	---	---	3.10E+00	1/(mg/kg-day)		EPA-NCEA	04/15/99
Benzo(b)fluoranthene	---	---	---	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	---	---	---	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

IRIS - Integrated Risk Information System (EPA, 1999a)

HEAST - Health Effects Assessment Summary Tables (EPA, 1997a)

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

where:

GI_{Oral}	=	Gastrointestinal (GI) Absorption Efficiency (EPA, 1995a)
RfD_{Oral}	=	Oral Reference Dose (EPA, 1999a; EPA, 1997a; or EPA-NCEA)
SF_{Oral}	=	Oral Slope Factor (EPA, 1999a; EPA, 1997a; or EPA-NCEA)

Dermally adjusted RfDs and SFs for COPCs are presented in Tables 6-31 and 6-33, respectively.

6.4.5 Carcinogenicity of PAHs

Carcinogenic PAHs are related by chemical structure. Only benzo(a)pyrene has an EPA published SF (EPA, 1999a). All other carcinogenic PAHs except carbazole have SFs based on their potency relative to benzo(a)pyrene. The relative potency factors (RPF) for carcinogenic PAH COPCs at Site 8 were as follows: (EPA, 1999b):

- Benzo(a)pyrene (RPF = 1.0)
- Benz(a)anthracene (RPF = 0.1)
- Benzo(b)fluoranthene (RPF = 0.1)
- Dibenz(a,h)anthracene (RPF = 1.0)

6.4.6 Relative Toxicity Factors for Dioxins and Furans

The dose-response assessment for chlorinated dioxin and furan congeners was performed by using toxicity equivalence factors (TEFs). The TEFs for dioxin/furan COPCs were as follows (EPA, 1992d):

- 1,2,3,4,6,7,8-HpCDD (TEF = 0.01)
- OCDD (TEF = 0.001)

6.4.7 Toxicity Criteria for Chromium

The toxicity criteria for hexavalent chromium (Cr^{+6}) were used in this HHRA evaluation because speciation data (i.e., trivalent versus hexavalent) were not available for samples collected in Site 8 media.. Hexavalent chromium was considered to be more toxic than trivalent chromium, therefore, this assumption is conservative in nature.

6.5 RISK CHARACTERIZATION

Potential human health risks resulting from the exposures outlined in the preceding sections are characterized on a quantitative and qualitative basis in this section. Quantitative risk estimates were generated based on risk assessment methods outlined in current EPA guidance (EPA, 1989a).

Noncarcinogenic risk estimates were presented in the form of HQs and HIs that are determined through comparison of estimated intakes with published RfDs. Incremental cancer risk estimates were provided in the form of dimensionless probabilities based on SFs.

Estimated human intakes were developed for each of the specific exposure routes discussed in the preceding sections. Both noncarcinogenic and carcinogenic risks were summarized for each exposure route on a series of tables in this section.

6.5.1 Noncarcinogenic Risks

Noncarcinogenic risk was assessed using the concept of HQs and HIs. The HQ is defined as the ratio of the estimated intake and the RfD for a selected chemical of concern, as follows:

$$HQ = \frac{Intake}{RfD}$$

HIs were generated by summing the individual HQs for the COPCs. If the value of the HI exceeds unity (1.0), the potential for noncarcinogenic health risks associated with exposure to that particular chemical mixture cannot be ruled out (EPA, 1986b). In that case, particular attention should be paid to the target organ(s) affected by each chemical because these are generally the organ(s) associated with RfD-derived effects, and results (HIs) for different organs are not truly additive. The HI is not defined as a mathematical prediction of the severity of toxic effects; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.5.2 Carcinogenic Risks

Incremental cancer risk estimates were generated for each of the exposure pathways using the estimated intakes and published SFs, as follows:

$$Risk = Intake * SF$$

If the above equation results in a risk greater than 0.01, the following equation was used:

$$Risk = 1 - e^{-(Intake*SF)}$$

The risk determined using these equations is defined as a unitless expression of an individual's increased likelihood of developing cancer as a result of exposure to carcinogenic chemicals. An incremental cancer risk of 1E-06 indicates that the exposed receptor has a one in a million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons. The calculated cancer risks should be recognized as upper-limit estimates. SFs are defined as the upper 95 percent confidence limit of a dose-response curve generally derived from animal studies. Actual human risk, while not identifiable, is not expected to exceed the upper limit based on the SFs and may, in fact, be lower.

EPA has generally defined risks in the range of 10^{-4} to 10^{-6} as being acceptable for most hazardous waste facilities addressed under CERCLA. For CERCLA activities, residual risks on the order of 10^{-6} are the primary goal but are often modified by such regulatory requirements as MCLs or chemical-specific clean-up goals.

6.5.3 Comparison of Quantitative Risk Estimates to Benchmark Criteria

In order to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects from individual COPCs contributing to the risk are considered. Only those chemicals that impact the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Thus, COPCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be COCs.

EPA has defined the range of 10^{-4} to 10^{-6} as the incremental cancer risk (ICR) "target range" for most hazardous waste facilities evaluated. Cumulative ICRs greater than 10^{-4} generally will indicate that some degree of remediation is required, and ICRs below 10^{-6} normally will not result in remedial efforts. Whenever ICRs fall between 10^{-4} to 10^{-6}, decisions for remediation will be made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be chemicals of concern (COCs)

Potential RME hazard indices and RME cancer risks were estimated for current and future potential receptors using the methodologies presented in Sections 6.2 through 6.4. The following sections present a summary of the results of the estimation of risk at Site 8.

Receptor risks are presented for each area of interest in the form of tables and summary text. Each of these sections includes summaries of risks estimated by the exposure scenarios. It should be noted that, in each risk summary table where HQs are reported as "N/A", the HQs were not calculable because no RfD has been established. Usually in such cases, carcinogenicity is considered to be more important, since carcinogenicity will generally be seen at lower doses than noncarcinogenic effects. Cancer risks that are reported as "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed.

6.5.4 Site-Specific Noncarcinogenic Risks

Noncarcinogenic risks estimated for potential receptors are discussed below and presented in the appropriate tables..

6.5.4.1 Surface Soil

The estimated RME hazard index for an industrial adult exposed to surface soil at Site 8 was 0.1 (Table 6-35, contribution from ingestion/dermal absorption and Table 6-36, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a casual user child (age 1 - 6) exposed to surface soil at Site 8 was 0.03 (Table 6-37, contribution from ingestion/dermal absorption and Table 6-38, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a casual user pre-adolescent/adolescent (age 7 - 16) exposed to surface soil at Site 8 was 0.01 (Table 6-39, contribution from ingestion/dermal absorption and Table 6-40, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a casual user adult exposed to surface soil at Site 8 was 0.004 (Table 6-41, contribution from ingestion/dermal absorption and Table 6-42, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a residential child exposed to surface soil at Site 8 was 0.6 (Table 6-43, contribution from ingestion/dermal absorption and Table 6-44, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

TABLE 6-35
ESTIMATION OF NON-CANCER HAZARDS - INDUSTRIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	3.52E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	6.68E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	6.59E-06	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	2.20E-02
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.26E-05	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	7.53E-03
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.09E-04	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.65E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.81E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.93E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.17E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.95E-02
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	9.51E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.80E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.90E-06	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	6.65E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.03E-06	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	6.78E-02
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.88E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.39E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.53E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.54E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.06E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												7.44E-02
												Total of Routes	1.04E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-36
ESTIMATION OF NON-CANCER HAZARDS - INDUSTRIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	3.20E-13	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	6.08E-13	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	5.99E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.05E-09	mg/kg-day	--	--	2.86E-05	mg/kg-day	7.18E-05
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.90E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.41E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.55E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.58E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.07E-11	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												7.18E-05

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-37
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.43E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	2.71E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.67E-06	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	8.89E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	9.15E-06	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	3.05E-03
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	8.48E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.07E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.14E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.59E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.75E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.19E-02
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.99E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.78E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.97E-07	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	1.39E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	4.26E-07	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	1.42E-02
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	3.95E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	5.00E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	5.30E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	7.42E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.21E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.56E-02
												Total of Routes	2.75E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-38
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	5.19E-14	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	9.84E-14	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	9.69E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	3.33E-10	mg/kg-day	--	--	2.86E-05	mg/kg-day	1.16E-05
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	3.08E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.90E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	4.13E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	5.79E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.73E-12	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												1.16E-05

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-39
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.09E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	7.76E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	7.65E-07	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	2.55E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.62E-06	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	8.75E-04
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.43E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.08E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.26E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	4.57E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.36E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.42E-03
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.47E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	2.79E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.93E-07	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	1.03E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	3.14E-07	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	1.05E-02
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.91E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.69E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.91E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	5.47E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.63E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.15E-02
												Total of Routes	1.49E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-40
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.98E-14	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.76E-14	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.71E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.27E-10	mg/kg-day	--	--	2.86E-05	mg/kg-day	4.45E-06
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.18E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.49E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.58E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	2.21E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	6.61E-13	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												4.45E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-41
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	8.45E-11	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.60E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.58E-07	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	5.27E-04
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	5.42E-07	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	1.81E-04
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	5.03E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	6.36E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	6.74E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	9.44E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.82E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												7.08E-04
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.55E-11	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	8.64E-11	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	9.08E-08	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	3.19E-04
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	9.74E-08	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	3.25E-03
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	9.02E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.14E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.21E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.69E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.06E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.56E-03
												Total of Routes	4.27E-03

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-42
ESTIMATION OF NON-CANCER HAZARDS - CASUAL USER ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.64E-14	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.11E-14	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.07E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.05E-10	mg/kg-day	--	--	2.86E-05	mg/kg-day	3.68E-06
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	9.75E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.23E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.31E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.83E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.47E-13	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												3.68E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-43
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL CHILD CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.16E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	7.89E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	7.78E-05	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	2.59E-01
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.67E-04	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	8.90E-02
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.47E-03	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.13E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.32E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	4.64E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.39E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.48E-01
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.91E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	5.51E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	5.80E-06	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	2.03E-02
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	6.22E-06	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	2.07E-01
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	5.76E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	7.29E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	7.72E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.08E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	3.23E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.28E-01
												Total of Routes	5.76E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-44
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL CHILD CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.54E-12	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	8.61E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	8.48E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.91E-08	mg/kg-day	--	--	2.86E-05	mg/kg-day	1.02E-03
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.70E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.42E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.62E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	5.07E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.51E-10	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												1.02E-03

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

The estimated RME hazard index for a residential adult exposed to surface soil at Site 8 was 0.07 (Table 6-45, contribution from ingestion/dermal absorption and Table 6-46, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

6.5.4.2 Subsurface Soil

The estimated RME hazard index for an industrial adult exposed to subsurface soil at Site 8 was 0.001 (Table 6-47, contribution from ingestion/dermal absorption and Table 6-48, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a residential child exposed to subsurface soil at Site 8 was 0.01 (Table 6-49, contribution from ingestion/dermal absorption and Table 6-50, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for a residential adult exposed to subsurface soil at Site 8 was 0.001 (Table 6-51, contribution from ingestion/dermal absorption and Table 6-52, contribution from inhalation of fugitive dust), which was below the acceptable level of 1.0.

6.5.4.3 Sediment

The estimated RME hazard index for a recreational pre-adolescent (age 7 - 12) exposed to sediment at off-site areas near Site 8 was 0.02 (Table 6-53, contribution from ingestion/dermal absorption), which was below the acceptable level of 1.0.

6.5.4.4 Surface Water (Total Inorganics)

The estimated RME hazard index for a recreational pre-adolescent (age 7 - 12) exposed to surface water (total inorganics) at off-site areas near Site 8 was 0.0008 (Table 6-54, contribution from ingestion/dermal absorption), which was below the acceptable level of 1.0.

6.5.4.5 Surface Water (Dissolved Inorganics)

The estimated RME hazard index for a recreational pre-adolescent (age 7 - 12) exposed to surface water (dissolved inorganics) at off-site areas near Site 8 was 0.0008 (Table 6-55, contribution from ingestion/dermal absorption), which was below the acceptable level of 1.0.

TABLE 6-45
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.47E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	4.68E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	4.61E-06	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	1.54E-02
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.58E-05	mg/kg-day	3.00E-03	mg/kg-day	N/A	N/A	5.27E-03
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.47E-04	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.86E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.97E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	2.75E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	8.22E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.06E-02
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	6.64E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.26E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.32E-06	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	4.65E-03
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.42E-06	mg/kg-day	3.00E-05	mg/kg-day	N/A	N/A	4.73E-02
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.32E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.67E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.76E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	2.47E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	7.38E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												5.20E-02
												Total of Routes	7.26E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-46
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.43E-12	mg/kg-day	--	--	--	mg/kg-day	--
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	2.72E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.68E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	9.21E-09	mg/kg-day	--	--	2.86E-05	mg/kg-day	3.22E-04
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	8.53E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.08E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.14E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.60E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.78E-11	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												3.22E-04

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-47
ESTIMATION OF NON-CANCER HAZARDS - INDUSTRIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	4.14E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	3.41E-05	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	8.51E-04
	(Total)												8.51E-04
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	1.12E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	3.06E-06	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.28E-04
	(Total)												1.28E-04
												Total of Routes	9.79E-04

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-48
ESTIMATION OF NON-CANCER HAZARDS - INDUSTRIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	3.76E-13	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	3.10E-09	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-49
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL CHILD CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	*OCDD*	4.23E+00	*ug/kg*	4.23E+00	*ug/kg*	M	4.89E-08	*mg/kg-day*	--	*mg/kg-day*	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	4.02E-04	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	1.01E-02
	(Total)												1.01E-02
Dermal	*OCDD*	4.23E+00	ug/kg	4.23E+00	ug/kg	M	3.42E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	9.37E-06	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	3.90E-04
	(Total)												3.90E-04
												Total of Routes	1.04E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-50
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL CHILD CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	5.33E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	4.39E-08	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-51
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	2.90E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	2.38E-05	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	5.96E-04
	(Total)												5.96E-04
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	7.80E-10	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	2.14E-06	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	8.91E-05
	(Total)												8.91E-05
												Total of Routes	6.85E-04

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-52
ESTIMATION OF NON-CANCER HAZARDS - RESIDENTIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	1.69E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	1.39E-08	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-53
ESTIMATION OF NON-CANCER HAZARDS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SEDIMENT SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact with Site 8 Sediment
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	4.20E+00	mg/kg	4.20E+00	mg/kg	M	4.96E-07	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	1.65E-03
	Iron	2.54E+04	mg/kg	2.54E+04	mg/kg	M	3.00E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	9.99E-03
	Manganese	8.48E+02	mg/kg	8.48E+02	mg/kg	M	1.00E-04	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	4.17E-03
	Benzo(a)pyrene	6.50E+02	ug/kg	6.50E+02	ug/kg	M	7.67E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.40E+02	ug/kg	1.40E+02	ug/kg	M	1.65E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.58E-02
Dermal	Arsenic	4.20E+00	mg/kg	4.20E+00	mg/kg	M	2.17E-08	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	7.63E-05
	Iron	2.54E+04	mg/kg	2.54E+04	mg/kg	M	4.11E-05	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.37E-04
	Manganese	8.48E+02	mg/kg	8.48E+02	mg/kg	M	1.37E-06	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	5.71E-05
	Benzo(a)pyrene	6.50E+02	ug/kg	6.50E+02	ug/kg	M	1.05E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	1.40E+02	ug/kg	1.40E+02	ug/kg	M	2.26E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.70E-04
												Total of Routes	1.61E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-54
ESTIMATION OF NON-CANCER HAZARDS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SURFACE WATER (TOTAL INORGANICS)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Total Inorganics)
Exposure Medium: Surface Water (Total Inorganics)
Exposure Point: Contact with Site 8 Surface Water (Total Inorganics)
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Manganese	1.59E+02	mg/kg	1.59E+02	mg/kg	M	1.88E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	7.82E-04
	(Total)												7.82E-04
Dermal	Manganese	1.59E+02	mg/kg	1.59E+02	mg/kg	M	6.38E-07	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	2.66E-05
	(Total)												2.66E-05
												Total of Routes	8.08E-04

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-55
ESTIMATION OF NON-CANCER HAZARDS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SURFACE WATER (DISSOLVED INORGANICS)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Dissolved Inorganics)
Exposure Medium: Surface Water (Dissolved Inorganics)
Exposure Point: Contact with Site 8 Surface Water (Dissolved Inorganics)
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Manganese	1.62E+02	mg/kg	1.62E+02	mg/kg	M	1.91E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	7.97E-04
	(Total)												7.97E-04
Dermal	Manganese	1.62E+02	mg/kg	1.62E+02	mg/kg	M	6.50E-07	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	2.71E-05
	(Total)												2.71E-05
												Total of Routes	8.24E-04

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

6.5.5 Site-Specific Carcinogenic Risks

Carcinogenic risks estimated for potential receptors are discussed below and in the appropriate tables.

6.5.5.1 Surface Soil

The RME cancer risk for an industrial adult exposed to surface soil at Site 8 was estimated at 9.26×10^{-6} which is within EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-56, contribution from ingestion/dermal absorption and Table 6-57, contribution from inhalation of fugitive dust). Arsenic (via ingestion and dermal contact) and 1,2,3,4,6,7,8-HpCDD (via ingestion) were the primary contributors to the estimated cancer risks. Cancer risks estimated for arsenic and 1,2,3,4,6,7,8-HpCDD exceeded 1×10^{-6}.

The RME cancer risk for a casual user child (age 1 - 6) exposed to surface soil at Site 8 was estimated at 8.40×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-58, contribution from ingestion/dermal absorption and Table 6-59, contribution from inhalation of fugitive dust).

The RME cancer risk for a casual user pre-adolescent/adolescent (age 7 - 16) exposed to surface soil at Site 8 was estimated at 4.96×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-60, contribution from ingestion/dermal absorption and Table 6-61, contribution from inhalation of fugitive dust).

The RME cancer risk for a casual user adult exposed to surface soil at Site 8 was estimated at 1.66×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-62, contribution from ingestion/dermal absorption and Table 6-63, contribution from inhalation of fugitive dust).

The RME cancer risk for a lifetime casual user receptor [child (age 1 - 6), pre-adolescent/adolescent (age 7 -16), and adult combined exposure] exposed to surface soil at Site 8 was estimated at 1.50×10^{-6} which is within EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-64, contribution from ingestion/dermal absorption and Table 6-65, contribution from inhalation of fugitive dust). Arsenic (via ingestion and dermal contact) and 1,2,3,4,6,7,8-HpCDD (via ingestion) were the primary contributors to the estimated cancer risks. No individual COPCs have cancer risks that exceeded 1×10^{-6}.

The RME cancer risk for a residential child exposed to surface soil at Site 8 was estimated at 2.26×10^{-5} which is within EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-66, contribution from ingestion/dermal absorption and Table 6-67, contribution from inhalation of fugitive dust). Arsenic (via ingestion), and 1,2,3,4,6,7,8-HpCDD (via ingestion) were the primary contributors to the estimated cancer risks. Cancer risks estimated for arsenic, 1,2,3,4,6,7,8-HpCDD, benzo(a)pyrene, and OCDD exceeded 1×10^{-6}.

TABLE 6-56
ESTIMATION OF CANCER RISKS - INDUSTRIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.26E-09	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.89E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	4.86E-09	mg/kg-day	1.50E+02	1/(mg/kg-day)	7.29E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.35E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	3.53E-06
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	8.07E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	7.48E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	9.47E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	6.91E-08
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.00E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	7.32E-07
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.40E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.03E-07
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.19E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	3.06E-07
	(Total)										7.35E-06
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	3.40E-10	mg/kg-day	3.00E+03	1/(mg/kg-day)	1.02E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.31E-09	mg/kg-day	3.00E+02	1/(mg/kg-day)	3.93E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	6.77E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	1.07E-06
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	7.26E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	6.73E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	8.52E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	9.02E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.26E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	3.77E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.48E-06
										Total of Routes	9.83E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-57
ESTIMATION OF CANCER RISKS - INDUSTRIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.14E-13	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.72E-10
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	4.42E-13	mg/kg-day	1.50E+02	1/(mg/kg-day)	6.62E-11
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.14E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	3.23E-09
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	7.34E-10	mg/kg-day	4.10E+01	1/(mg/kg-day)	3.01E-08
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	6.80E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	8.61E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	9.12E-12	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.83E-11
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.28E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	3.81E-12	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.36E-08

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-58
ESTIMATION OF CANCER RISKS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.22E-10	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.83E-07
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	4.72E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	7.08E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	2.28E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	3.43E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	7.84E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	7.27E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	9.20E-09	mg/kg-day	7.30E-01	1/(mg/kg-day)	6.72E-09
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	9.74E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	7.11E-08
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.36E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	9.96E-09
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.07E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.97E-08
	(Total)										7.14E-07
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.71E-11	mg/kg-day	3.00E+03	1/(mg/kg-day)	5.13E-08
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	6.60E-11	mg/kg-day	3.00E+02	1/(mg/kg-day)	1.98E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.41E-08	mg/kg-day	1.58E+00	1/(mg/kg-day)	5.38E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	3.65E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	3.39E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	4.29E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	4.54E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	6.36E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.90E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.25E-07
										Total of Routes	8.39E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-59
ESTIMATION OF CANCER RISKS - CASUAL USER CHILD (AGE 1-6) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Child Age 1-6

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.44E-15	mg/kg-day	1.50E+03	1/(mg/kg-day)	6.67E-12
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.72E-14	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.57E-12
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	8.31E-12	mg/kg-day	1.51E+01	1/(mg/kg-day)	1.25E-10
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.85E-11	mg/kg-day	4.10E+01	1/(mg/kg-day)	1.17E-09
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.64E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.35E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.54E-13	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.10E-12
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	4.96E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.48E-13	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.31E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-60
ESTIMATION OF CANCER RISKS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	5.84E-11	mg/kg-day	1.50E+03	1/(mg/kg-day)	8.77E-08
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	2.26E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	3.38E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.09E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.64E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	3.75E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	3.47E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	4.40E-09	mg/kg-day	7.30E-01	1/(mg/kg-day)	3.21E-09
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	4.66E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	3.40E-08
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	6.53E-09	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.76E-09
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.95E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.42E-08
	(Total)										3.42E-07
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.10E-11	mg/kg-day	3.00E+03	1/(mg/kg-day)	6.30E-08
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	8.11E-11	mg/kg-day	3.00E+02	1/(mg/kg-day)	2.43E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	4.19E-08	mg/kg-day	1.58E+00	1/(mg/kg-day)	6.61E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	4.49E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	4.16E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	5.27E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	5.58E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	7.82E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.33E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.53E-07
										Total of Routes	4.95E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-61
ESTIMATION OF CANCER RISKS - CASUAL USER PRE-ADOLESCENT/ADOLESCENT (AGE 7-16) CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Pre-Adolescent/Adolescent Age 7-16

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.83E-15	mg/kg-day	1.50E+03	1/(mg/kg-day)	4.25E-12
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.09E-14	mg/kg-day	1.50E+02	1/(mg/kg-day)	1.64E-12
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	5.30E-12	mg/kg-day	1.51E+01	1/(mg/kg-day)	8.00E-11
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.82E-11	mg/kg-day	4.10E+01	1/(mg/kg-day)	7.45E-10
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.68E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.13E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.26E-13	mg/kg-day	3.10E+00	1/(mg/kg-day)	7.00E-13
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.16E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	9.44E-14	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										8.32E-10

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-62
ESTIMATION OF CANCER RISKS - CASUAL USER ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.69E-11	mg/kg-day	1.50E+03	1/(mg/kg-day)	2.54E-08
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	6.53E-11	mg/kg-day	1.50E+02	1/(mg/kg-day)	9.79E-09
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.16E-08	mg/kg-day	1.50E+00	1/(mg/kg-day)	4.74E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.08E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.01E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.27E-09	mg/kg-day	7.30E-01	1/(mg/kg-day)	9.29E-10
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.35E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	9.84E-09
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.89E-09	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.38E-09
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.64E-10	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.11E-09
	(Total)										9.88E-08
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	9.11E-12	mg/kg-day	3.00E+03	1/(mg/kg-day)	2.73E-08
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.52E-11	mg/kg-day	3.00E+02	1/(mg/kg-day)	1.05E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.82E-08	mg/kg-day	1.58E+00	1/(mg/kg-day)	2.87E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.95E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.80E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.28E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.42E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.39E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.01E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										6.65E-08
										Total of Routes	1.65E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-63
ESTIMATION OF CANCER RISKS - CASUAL USER ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Casual User Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	3.28E-15	mg/kg-day	1.50E+03	1/(mg/kg-day)	4.92E-12
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.27E-14	mg/kg-day	1.50E+02	1/(mg/kg-day)	1.90E-12
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	6.13E-12	mg/kg-day	1.51E+01	1/(mg/kg-day)	9.26E-11
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.10E-11	mg/kg-day	4.10E+01	1/(mg/kg-day)	8.63E-10
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.95E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.47E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.61E-13	mg/kg-day	3.10E+00	1/(mg/kg-day)	8.10E-13
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.66E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.09E-13	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										9.63E-10

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-64
ESTIMATION OF CANCER RISKS - LIFETIME CASUAL USER CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Other
Receptor Age: Lifetime Casual User

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.97E-10	mg/kg-day	1.50E+03	1/(mg/kg-day)	2.96E-07
	OCDD	6.83E+00	ug/kg	6.83E+00	ug/kg	M	7.63E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	1.14E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	3.69E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	5.54E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.27E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	1.18E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.49E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.09E-08
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.58E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.15E-07
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	2.20E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.61E-08
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	6.58E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.81E-08
	(Total)										1.15E-06
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.72E-11	mg/kg-day	3.00E+03	1/(mg/kg-day)	1.42E-07
	OCDD	6.83E+00	ug/kg	6.83E+00	ug/kg	M	1.82E-10	mg/kg-day	3.00E+02	1/(mg/kg-day)	5.47E-08
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	9.42E-08	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.49E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	1.01E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	9.35E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	1.18E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	1.25E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.76E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.24E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.45E-07
										Total of Routes	1.50E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-65
ESTIMATION OF CANCER RISKS - LIFETIME CASUAL USER CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Other
Receptor Age: Lifetime Casual User

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	1.06E-14	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.58E-11
	OCDD	6.83E+00	ug/kg	6.83E+00	ug/kg	M	4.08E-14	mg/kg-day	1.50E+02	1/(mg/kg-day)	6.11E-12
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.97E-11	mg/kg-day	1.51E+01	1/(mg/kg-day)	2.98E-10
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	6.77E-11	mg/kg-day	4.10E+01	1/(mg/kg-day)	2.78E-09
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	6.27E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	7.95E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	8.41E-13	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.61E-12
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	1.18E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	3.51E-13	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.10E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-66
ESTIMATION OF CANCER RISKS - RESIDENTIAL CHILD CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	3.56E-09	mg/kg-day	1.50E+03	1/(mg/kg-day)	5.35E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.38E-08	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.06E-06
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	6.66E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.00E-05
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.29E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.12E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	2.68E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.96E-07
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	2.84E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.07E-06
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	3.98E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.91E-07
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.19E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	8.67E-07
	(Total)										2.08E-05
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.49E-10	mg/kg-day	3.00E+03	1/(mg/kg-day)	7.47E-07
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	9.62E-10	mg/kg-day	3.00E+02	1/(mg/kg-day)	2.89E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	4.97E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	7.84E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	5.33E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	4.94E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	6.25E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	6.62E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	9.27E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.77E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.82E-06
										Total of Routes	2.27E-05

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-67
ESTIMATION OF CANCER RISKS - RESIDENTIAL CHILD CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.44E-15	mg/kg-day	1.50E+03	1/(mg/kg-day)	6.67E-12
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.72E-14	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.57E-12
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	8.31E-12	mg/kg-day	1.51E+01	1/(mg/kg-day)	1.25E-10
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	2.85E-11	mg/kg-day	4.10E+01	1/(mg/kg-day)	1.17E-09
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.64E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.35E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.54E-13	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.10E-12
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	4.96E-13	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.48E-13	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.31E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

The RME cancer risk for a residential adult exposed to surface soil at Site 8 was estimated at 6.74×10^{-6} which is within EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-68, contribution from ingestion/dermal absorption and Table 6-69, contribution from inhalation of fugitive dust). Arsenic (via ingestion) and 1,2,3,4,6,7,8-HpCDD (via ingestion) were the primary contributors to the estimated cancer risks. Cancer risks estimated for arsenic and 1,2,3,4,6,7,8-HpCDD exceeded 1×10^{-6}.

The RME cancer risk for a lifetime residential receptor [child and adult combined exposure] exposed to surface soil at Site 8 was estimated at 2.94×10^{-5} which is within EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-70, contribution from ingestion/dermal absorption and Table 6-71, contribution from inhalation of fugitive dust). Arsenic (via ingestion) and 1,2,3,4,6,7,8-HpCDD (via ingestion) were the primary contributors to the estimated cancer risks. Cancer risks estimated for arsenic, 1,2,3,4,6,7,8-HpCDD, benzo(a)pyrene, OCDD, and dibenz(a,h)anthracene had individual cancer risks that exceeded 1×10^{-6}.

6.5.5.2 Subsurface Soil

The RME cancer risk for an industrial adult exposed to subsurface soil at Site 8 was estimated at 2.82×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-72, contribution from ingestion/dermal absorption and Table 6-73, contribution from inhalation of fugitive dust).

The RME cancer risk for a residential child exposed to subsurface soil at Site 8 was estimated at 6.72×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-74, contribution from ingestion/dermal absorption and Table 6-75, contribution from inhalation of fugitive dust).

The RME cancer risk for a residential child exposed to subsurface soil at Site 8 was estimated at 1.89×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-76, contribution from ingestion/dermal absorption and Table 6-77, contribution from inhalation of fugitive dust).

The RME cancer risk for lifetime residential receptors exposed to subsurface soil at Site 8 was estimated at 8.61×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-78, contribution from ingestion/dermal absorption and Table 6-79, contribution from inhalation of fugitive dust).

6.5.5.3 Sediment

The RME cancer risk for a recreational pre-adolescent (age 7 - 12) exposed to sediment at off-site areas near Site 8 was estimated at 1.25×10^{-7} which is below EPA's target risk range of 10^{-4} to 10^{-6} (Table 6-80, contribution from ingestion/dermal absorption).

TABLE 6-68
ESTIMATION OF CANCER RISKS - RESIDENTIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	8.45E-10	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.27E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.26E-09	mg/kg-day	1.50E+02	1/(mg/kg-day)	4.90E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.58E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.37E-06
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	5.42E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	5.03E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	6.36E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.65E-08
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	6.74E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.92E-07
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	9.44E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	6.89E-08
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.82E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.06E-07
	(Total)										4.94E-06
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	2.28E-10	mg/kg-day	3.00E+03	1/(mg/kg-day)	6.83E-07
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	8.79E-10	mg/kg-day	3.00E+02	1/(mg/kg-day)	2.64E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	4.54E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	7.17E-07
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	4.87E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	4.51E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	5.71E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	6.05E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	8.47E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.53E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.66E-06
										Total of Routes	6.60E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-69
ESTIMATION OF CANCER RISKS - RESIDENTIAL ADULT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.92E-13	mg/kg-day	1.50E+03	1/(mg/kg-day)	7.38E-10
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.90E-12	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.85E-10
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	9.20E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	1.39E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	3.16E-09	mg/kg-day	4.10E+01	1/(mg/kg-day)	1.29E-07
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.92E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.70E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.92E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.22E-10
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	5.49E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.64E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.44E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-70
ESTIMATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact with Site 8 Surface Soil
Receptor Population: Resident
Receptor Age: Lifetime

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.41E-09	mg/kg-day	1.50E+03	1/(mg/kg-day)	6.62E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.70E-08	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.55E-06
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	8.24E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.24E-05
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	5.42E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	5.03E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.32E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.42E-07
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	3.52E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.57E-06
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	4.92E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	3.60E-07
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.47E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.07E-06
	(Total)										2.58E-05
Dermal	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	4.77E-10	mg/kg-day	3.00E+03	1/(mg/kg-day)	1.43E-06
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	1.84E-09	mg/kg-day	3.00E+02	1/(mg/kg-day)	5.52E-07
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	9.51E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	1.50E-06
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	4.87E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	4.51E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	5.71E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	6.05E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	8.47E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.53E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.48E-06
										Total of Routes	2.77E-05

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-71
ESTIMATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT WITH SURFACE SOIL SITE 8 (POST-REMOVAL)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: *Contact with Site 8 Particulates*
Receptor Population: Resident
Receptor Age: Lifetime

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	1,2,3,4,6,7,8-HpCDD	3.60E+00	ug/kg	3.60E+00	ug/kg	M	8.81E-13	mg/kg-day	1.50E+03	1/(mg/kg-day)	1.32E-09
	OCDD	1.39E+01	ug/kg	1.39E+01	ug/kg	M	3.40E-12	mg/kg-day	1.50E+02	1/(mg/kg-day)	5.10E-10
	Arsenic	6.73E+00	mg/kg	6.73E+00	mg/kg	M	1.65E-09	mg/kg-day	1.51E+01	1/(mg/kg-day)	2.49E-08
	Chromium	2.31E+01	mg/kg	2.31E+01	mg/kg	M	5.65E-09	mg/kg-day	4.10E+01	1/(mg/kg-day)	2.32E-07
	Lead	2.14E+02	mg/kg	2.14E+02	mg/kg	M	2.92E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benz(a)anthracene	2.71E+02	ug/kg	2.71E+02	ug/kg	M	3.70E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.87E+02	ug/kg	2.87E+02	ug/kg	M	7.02E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.18E-10
	Benzo(b)fluoranthene	4.02E+02	ug/kg	4.02E+02	ug/kg	M	5.49E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.64E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.59E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-72
ESTIMATION OF CANCER RISKS - INDUSTRIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	1.48E-09	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.22E-07
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	1.22E-05	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.22E-07
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	3.99E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	5.99E-08
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	1.09E-06	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										5.99E-08
										Total of Routes	2.82E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-73
ESTIMATION OF CANCER RISKS - INDUSTRIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Industrial
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	1.34E-13	mg/kg-day	1.50E+02	1/(mg/kg-day)	2.02E-11
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	1.11E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.02E-11

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-74
ESTIMATION OF CANCER RISKS - RESIDENTIAL CHILD CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	4.19E-09	mg/kg-day	1.50E+02	1/(mg/kg-day)	6.28E-07
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	3.45E-05	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										6.28E-07
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	2.93E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	4.39E-08
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	8.03E-07	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										4.39E-08
										Total of Routes	6.72E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-75
ESTIMATION OF CANCER RISKS - RESIDENTIAL CHILD CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	4.57E-13	mg/kg-day	1.50E+02	1/(mg/kg-day)	6.85E-11
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	3.76E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										6.85E-11

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-76
ESTIMATION OF CANCER RISKS - RESIDENTIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	9.93E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	1.49E-07
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	8.17E-06	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.49E-07
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	2.67E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	4.01E-08
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	7.33E-07	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										4.01E-08
										Total of Routes	1.89E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-77
ESTIMATION OF CANCER RISKS - RESIDENTIAL ADULT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	5.78E-13	mg/kg-day	1.50E+02	1/(mg/kg-day)	8.67E-11
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	4.75E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										8.67E-11

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-78
ESTIMATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact with Site 8 Subsurface Soil
Receptor Population: Resident
Receptor Age: Lifetime

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	5.18E-09	mg/kg-day	1.50E+02	1/(mg/kg-day)	7.77E-07
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	8.17E-06	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										7.77E-07
Dermal	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	5.60E-10	mg/kg-day	1.50E+02	1/(mg/kg-day)	8.40E-08
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	7.33E-07	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										8.40E-08
										Total of Routes	8.61E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-79
ESTIMATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT WITH SUBSURFACE SOIL SITE 8
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Contact with Site 8 Particulates
Receptor Population: Resident
Receptor Age: Lifetime

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	OCDD	4.23E+00	ug/kg	4.23E+00	ug/kg	M	1.03E-12	mg/kg-day	1.50E+02	1/(mg/kg-day)	1.55E-10
	Copper	3.48E+01	mg/kg	3.48E+01	mg/kg	M	4.75E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.55E-10

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-80
ESTIMATION OF CANCER RISKS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SEDIMENT
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Contact with Site 8 Sediment
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	4.20E+00	mg/kg	4.20E+00	mg/kg	M	4.25E-08	mg/kg-day	1.50E+00	1/(mg/kg-day)	6.37E-08
	Iron	2.54E+04	mg/kg	2.54E+04	mg/kg	M	2.57E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	8.48E+02	mg/kg	8.48E+02	mg/kg	M	8.58E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	6.50E+02	ug/kg	6.50E+02	ug/kg	M	6.58E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.80E-08
	Dibenz(a,h)anthracene	1.40E+02	ug/kg	1.40E+02	ug/kg	M	1.42E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.03E-08
	(Total)										1.22E-07
Dermal	Arsenic	4.20E+00	mg/kg	4.20E+00	mg/kg	M	1.86E-09	mg/kg-day	1.58E+00	1/(mg/kg-day)	2.94E-09
	Iron	2.54E+04	mg/kg	2.54E+04	mg/kg	M	3.52E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	8.48E+02	mg/kg	8.48E+02	mg/kg	M	1.18E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	6.50E+02	ug/kg	6.50E+02	ug/kg	M	9.01E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	1.40E+02	ug/kg	1.40E+02	ug/kg	M	1.94E-10	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.94E-09
										Total of Routes	1.25E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

6.5.5.4 Surface Water (Total Inorganics)

The RME cancer risk for a recreational pre-adolescent (age 7 - 12) exposed to surface water (total inorganics) at off-site areas near Site 8 was not estimated because selected surface water COPCs were not considered carcinogenic (Table 6-81, contribution from ingestion/dermal absorption).

6.5.5.5 Surface Water (Dissolved Inorganics)

The RME cancer risk for a recreational pre-adolescent (age 7 - 12) exposed to surface water (dissolved inorganics) at off-site areas near Site 8 was not estimated because selected surface water COPCs were not considered carcinogenic (Table 6-82, contribution from ingestion/dermal absorption).

6.5.6 Lead Risks

Lead was identified as a COPC in surface soil at Site 8. However, as previously discussed, lead was not quantitatively evaluated in the risk tables. This was necessary because EPA's approach to evaluating lead risks goes beyond providing a single point estimate output and incorporates absorption and pharmacokinetic properties. Section 6.3.4 discusses background information related to blood-lead estimation methods. Exposure to lead in surface soil was evaluated using the EPA IEUBK Lead Model, and those results are described below.

The average concentration of lead in surface soil (119 mg/kg) was used as input into the IEUBK Model. All other media inputs into the IEUBK Model were default parameters. The estimated percentage of residential children with a blood lead level above 10 ug/dL is 0.35%. This is below EPA's protective level cutoff of 5%. Adverse effects to residential children (age 1 - 6) are not expected from lead concentrations in surface soil at Site 8. The IEUBK Model histograms and model specific input parameters are shown in Appendix G, Part 5.

A summary of all Site 8 carcinogenic and noncarcinogenic risks for each exposure scenario is presented on Table 6-83.

6.6 UNCERTAINTY ANALYSIS FOR THE HHRA

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the HHRA. Uncertainties are related to each of the main components of the assessment (i.e., data evaluation, dose-response assessment, exposure assessment, and risk characterization). The effect of a

TABLE 6-81
ESTIMATION OF CANCER RISKS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SURFACE WATER (TOTAL INORGANICS)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Total Inorganics)
Exposure Medium: Surface Water (Total Inorganics)
Exposure Point: Contact with Site 8 Surface Water (Total Inorganics)
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Manganese	1.59E+02	mg/kg	1.59E+02	mg/kg	M	1.61E-06	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										--
Dermal	Manganese	1.59E+02	mg/kg	1.59E+02	mg/kg	M	5.47E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										--
										Total of Routes	--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-82
ESTIMATION OF CANCER RISKS - RECREATIONAL PRE-ADOLESCENT (AGE 7-12) CONTACT WITH SURFACE WATER (DISSOLVED INORGANICS)
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Water (Dissolved Inorganics)
Exposure Medium: Surface Water (Dissolved Inorganics)
Exposure Point: Contact with Site 8 Surface Water (Dissolved Inorganics)
Receptor Population: Other
Receptor Age: Off-Site Recreational Pre-Adolescent Age 7-12

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Manganese	1.62E+02	mg/kg	1.62E+02	mg/kg	M	1.64E-06	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										--
Dermal	Manganese	1.62E+02	mg/kg	1.62E+02	mg/kg	M	5.57E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										--
										Total of Routes	--

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TA[illegible]6-83
SUMMARY OF NONCARCINOGENIC AND CARCINOGEN[illegible]S, SITE 8 (POST-REMOVAL) - ALL EXPOSURE PATHWAYS
REASONABL[illegible]UM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario / Receptor	Industrial Adult	Casual User Child Age 1-6	Casual User Pre-Adol./Adol. Age 7-16	Casual User Adult	Casual User Lifetime*	Residential Child	Residential Adult	Resident Lifetime**	Recreational Pre-Adol. Age 7-12
HAZARD INDEX									
Surface Soil - Exposure Routes									
Incidental Ingestion	2.95E-02	1.19E-02	3.42E-03	7.08E-04	NA	3.48E-01	2.06E-02	NA	NA
Dermal Contact	7.44E-02	1.56E-02	1.15E-02	3.56E-03	NA	2.28E-01	5.20E-02	NA	NA
Fugitive Dust Inhalation	7.18E-05	1.16E-05	4.45E-06	3.68E-06	NA	1.02E-03	3.22E-04	NA	NA
Subtotal of Surface Soil	**0.1**	**0.03**	**0.01**	**0.004**	**NA**	**0.6**	**0.07**	**NA**	**NA**
Subsurface Soil - Exposure Routes									
Incidental Ingestion	8.51E-04	NA	NA	NA	NA	1.01E-02	5.96E-04	NA	NA
Dermal Contact	1.28E-04	NA	NA	NA	NA	3.90E-04	8.91E-05	NA	NA
Fugitive Dust Inhalation	NT	NA	NA	NA	NA	NT	NT	NA	NA
Subtotal of Subsurface Soil	**0.001**	**NA**	**NA**	**NA**	**NA**	**0.01**	**0.001**	**NA**	**NA**
Sediment - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	1.58E-02
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	2.70E-04
Subtotal of Sediment	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.02**
Surface Water (Total Inorganics) - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	7.82E-04
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	2.66E-05
Subtotal of Surface Water (Total)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.001**
Surface Water (Dissolved Inorganics) - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	7.97E-04
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	2.71E-05
Subtotal of Surface Water (Dis.)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.001**
INCREMENTAL CANCER RISK									
Surface Soil - Exposure Routes									
Incidental Ingestion	7.35E-06	7.14E-07	3.42E-07	9.88E-08	1.15E-06	2.08E-05	4.94E-06	2.58E-05	NA
Dermal Contact	2.48E-06	1.25E-07	1.53E-07	6.65E-08	3.45E-07	1.82E-06	1.66E-06	3.48E-06	NA
Fugitive Dust Inhalation	3.36E-08	1.10E-09	8.32E-10	9.63E-10	3.10E-09	1.31E-09	1.44E-07	2.59E-07	NA
Subtotal of Surface Soil	**9.26E-06**	**8.40E-07**	**4.96E-07**	**1.66E-07**	**1.50E-06**	**2.26E-05**	**6.74E-06**	**2.94E-05**	**NA**
Subsurface Soil - Exposure Routes									
Incidental Ingestion	2.22E-07	NA	NA	NA	NA	6.28E-07	1.49E-07	7.77E-07	NA
Dermal Contact	5.99E-08	NA	NA	NA	NA	4.39E-08	4.01E-08	8.40E-08	NA
Fugitive Dust Inhalation	2.02E-11	NA	NA	NA	NA	6.85E-11	8.67E-11	1.55E-10	NA
Subtotal of Subsurface Soil	**2.82E-07**	**NA**	**NA**	**NA**	**NA**	**6.72E-07**	**1.89E-07**	**8.61E-07**	**NA**
Sediment - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	1.22E-07
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	2.94E-09
Subtotal of Sediment	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**1.25E-07**
Surface Water (Total Inorganics) - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	NT
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	NT
Subtotal of Surface Water (Total)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NT**
Surface Water (Dissolved Inorganics) - Exposure Routes									
Incidental Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	NT
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	NT
Subtotal of Surface Water (Dis.)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NT**

* = Lifetime Casual User Risks are the summed Cancer Risks for Casual User Child (Age 1-6), Casual User Pre-Adolescent/Adolescent (Age 7-16), and Casual User Adult (14 year exposure).
** = Lifetime Residential Risks are the summed Cancer Risks for Residential Child (6 year exposure) and Residential Adult (24 year exposure).
NA = Exposure route not applicable in that medium for that receptor.
NT = COPCs for these exposure routes had no quantitative toxicity values, therefore, no toxicity was estimated for these exposure pathways.
Hazard Indices (i.e., summation of the hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects.

particular uncertainty on the outcome of the assessment (i.e., risk estimates) is also indicated, where possible.

As discussed in EPA (1989a), the risk measures used in Superfund site risk assessments are not fully probabilistic estimates of risk but rather are conditional estimates based on a considerable number of assumptions about exposure and toxicity. There are uncertainties associated with each aspect of risk assessment, from environmental data collection through risk characterization. To support decision-making processes, significant HHRA uncertainties are noted below.

6.6.1 Uncertainties Associated with Data Evaluation

Major uncertainties associated with Data Evaluation are highlighted below.

- The areal extent of the samples (including the number collected and location of the sampling points) in a particular medium impacts the calculation of EPCs. A removal of surface soil was conducted at Site 8. Every effort was made to collect samples (both recent samples and historical samples that were not excavated) that reflect actual site conditions and to include areas thought to contain the most significant contamination or exposure problems. This uncertainty is expected to be low for surface and subsurface soil data sets given the large number of soil samples collected over a relatively small site area. This uncertainty is expected to be higher for sediment and surface water samples given the small number of sampling locations in off-site areas near Site 8.

- Established data validation procedures were applied to define analytical uncertainties in terms of qualifying data as inaccurate or imprecise and to eliminate data points that are unusable for risk assessment. This treatment does not eliminate all uncertainty but focuses attention on potential areas of concern regarding accuracy and precision.

- Uncertainties exist regarding selection of a concentration for input into the quantitative risk assessment. The use of the exposure point concentration to estimate risk is generally regarded as a conservative estimate since this entails using either the upper 95 percent confidence limit on the arithmetic mean (based on normal or log-transformed data distribution) or the maximum concentration. The use of the EPC as the input value into the quantitative risk assessment as a representation of site concentrations of COPCs generally lowers the chances of under estimation of the actual risk present in a exposure pathway to a potential receptor. However, the use of the exposure point concentration may overestimate the actual risk present in an exposure pathway at a particular area of interest. To help avoid this problem, the maximum value was used in place of the upper 95 percent limit when the latter was larger.

- The ability (power) of the W test to be able to correctly identify genuine differences between the shape of a sample population versus a reference normal or lognormal population is reduced when too few samples are collected. If an incorrect distributional assumption is made based on this test, this could lead to an over- or underestimate of the upper 95 percent UCL on the mean, which in turn would create some additional uncertainty as to whether the estimated risk is a reasonable approximation of high end exposure. To help limit the potential for overestimation , the maximum value was used in place of the upper 95 percent UCL on the mean when the latter was larger.

- The chemical analytical database has some limitations regarding the representativeness of the laboratory results, the inclusion of nondetected data, data gaps, number of samples collected, and heterogeneity of sample data. The effects of these limitations on the results of the risk assessment are varied. However, every effort was made to collect and use samples that reflect actual site conditions. Nondetected results were treated using one-half the detection limit in all statistical functions. These actions should minimize uncertainty in the database.

- The use of screening concentrations that are based on a single route of exposure (i.e. ingestion) may lead to the underestimation of risks since they do not account for the additive effects across various exposure pathways. The resultant effects of the risks are not considered significant because conservative values, derived from a target Hazard Index of 0.1 for noncarcinogens and a target risk of 1×10^{-6} for carcinogens, were employed.

- The use of residential surface soil screening concentrations for COPC selection under an industrial exposure scenario represents a conservative approach since exposure under an industrial scenario is expected to be lower than exposure under a residential scenario which are the basis of the RBC values. Consequently, COPCs may be selected that are not truly reflective of significant risk exposures under an industrial scenario which is evident from the noncarcinogenic and carcinogenic industrial risks estimated in this HHRA.

- The use of residential surface soil screening concentrations for COPC selection under an casual user exposure scenario represents a conservative approach since exposure under an casual user scenario is expected to be lower than exposure under a residential scenario which are the basis of the RBC values. Consequently, COPCs may be selected that are not truly reflective of significant risk exposures under an casual user scenario which is evident from the noncarcinogenic and carcinogenic casual user risks estimated in this HHRA.

- The use of residential surface soil screening concentrations for sediment COPC selection and residential tap water screening concentrations for surface water under a recreational exposure scenario represents a conservative approach since exposure under an recreational scenario is

expected to be lower than exposure under a residential scenario which are the basis of the RBC values. Consequently, COPCs may be selected that are not truly reflective of significant risk exposures under an recreational user scenario which is evident from the noncarcinogenic and carcinogenic recreational risks estimated in this HHRA.

6.6.2 Uncertainties Associated with Exposure Assessment

Major uncertainties associated with Exposure Assessment are listed below.

- The likelihood of the occurrence of the defined exposure scenarios is not always known. Identified land use and activity patterns at a site are limited to the observations made during the field investigation, known land uses in the surrounding area, and information provided by the Navy on anticipated future land use.

- Several receptor characteristics, such as selection of casual user and recreational receptor age groups, exposure frequency, and exposure duration are generally based on professional judgment.

- There are limitations to using various models and/or equations to estimate exposure doses or contaminant concentrations. For example, modeled concentrations (i.e., generated fugitive dust concentrations) may not be indicative of actual site conditions during exposure.

- In general, the underestimation of risks was prevented using conservative exposure assumptions and exposure concentrations. Maximum detected concentrations are sometimes used as EPCs in exposure pathways at the site. Although maximum concentrations are not a reasonable estimate of the concentration expected to be experienced by a receptor over time, the use of these values does provide a highly conservative estimate of risk to potential receptors.

- Exposure to fugitive dust emissions (surface and subsurface soil exposure only) conservatively assumes that receptors will be exposed to the same concentration indoors as outdoors (a very conservative assumption), that soils within an area have unlimited erosion potential, that emissions can be estimated from mean annual windspeed and vegetative cover, and that dispersion concentrations can be estimated from source area, downwind distance to receptors, and region-wide meteorological factors. Additionally, expected exposure to fugitive dust is based on a default PEF as provided in EPA's Soil Screening Guidance (EPA, 1996c). The effect of this uncertainty is expected to be low based on the fact that carcinogenic and noncarcinogenic risks were several orders of magnitude less than exposure via ingestion and dermal adsorption pathways.

- The model for dermal exposure to soil and sediment assumes that only a very thin, constant thickness layer of solid media is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil or sediment concentration, will be absorbed per unit area of skin and per exposure event. However, adherence to skin varies with such factors as particle size, soil type, and organic carbon content. As estimated by EPA (1992e), the absorbed dermal dose could vary by as much as a factor of 50 from the model estimates, even assuming that activity patterns lead to the exposure duration applied in the experimental trials used to develop absorption factors.

- Prediction of absorption rates for lipophilic compounds is difficult due to, among other reasons, the possibility of a second absorption pathway that depends on the lipid content of the stratum corneum at the application site. Experimental determination of absorption rates indicates that interspecies differences are considerable, which, along with other variability's related to condition and age of skin, differences in lag time, and site of application effects, yields appreciable uncertainty in estimated dermal exposures by using published chemical-specific permeation functions. In addition, literature data indicate a variation by as much as a factor of 300 in chemical absorption rates for skin in different anatomical areas of the body. It should also be noted that children generally have greater absorption rates than adults.

- Exposure assumptions can add uncertainty into the risk assessment process based on input values selected for each exposure route. The rationale for each assumption was provided in each table of input parameters. Receptor characteristics, such as age and skin surface areas, are based on published values. Conservative values (based on reasonable maximum exposure or professional judgment) are used in most exposure equations, except where average values are expected to better correspond to actual site conditions.

6.6.3 Uncertainties Associated with Dose-Response Assessment

The major uncertainties associated with Dose-Response Assessment are listed below.

- There is uncertainty associated with the RfDs and SFs. The uncertainty results from the extrapolation of animal data to humans, the extrapolation of carcinogenic effects from the laboratory high-dose to the environmental low-dose scenarios, and interspecies and intraspecies variations in toxicological endpoints caused by chemical exposure. The use of EPA RfD values is generally considered to be conservative because the reference doses are based on no-effect or lowest-observed-effect levels and then further reduced with uncertainty factors to increase the margin of safety by a factor in the neighborhood of 10 to 1,000-fold.

- The RfDs and SFs of some chemicals have not been established, and therefore toxicity could not be quantitatively assessed. In most cases, where RfDs were unavailable for carcinogens, the carcinogenic risk is considered to be much more significant since carcinogenic effects usually occur at much lower doses.

- The uncertainty associated with the dermal exposure risk estimates is high because of the derivation of the dermal slope factor and reference dose. The dermal toxicity factors are based on default oral absorption factors. This can result in an over- or underestimation of the toxicity factors. It can cause the dermal exposure to be a primary contributor to the cumulative cancer risk and/or hazard index. The uncertainty associated with the dermal exposure route may overestimate the risk posed by Site 8.

- Dermal carcinogenic risks were not estimated for PAHs. EPA (1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens such as benzo(a)pyrene, which cause cancer through direct action at the point of application. The uncertainty associated with not quantitatively evaluating these chemicals may underestimate the carcinogenic risk at Site 8.

- Nonthreshold (carcinogenic) effects are extrapolated from the high doses administered to laboratory animals to the low doses received under more common human exposure scenarios.

- Results of laboratory animal studies are extrapolated to human or environmental receptors.

- There is considerable interspecies variation in toxicological endpoints used in characterizing potential health effects resulting from exposure to a chemical.

- There is considerable variability in sensitivity among individuals of any particular species.

- Short-time toxicological studies are used to predict long-term effects.

As discussed in Section 6.4, established RfDs have an inherent amount of uncertainty. Uncertainty factors for RfDs used in this HHRA are presented in Table 6-20 and 6-21. Some chemical specific uncertainties should be noted as follows:

- Although the more restrictive basis for evaluating risk associated with exposure to arsenic is to assume it is a carcinogen, carcinogenic effects are not the primary health effects expected to be manifested upon exposure to arsenic. The preponderance of scientific information indicates that humans are capable of metabolizing arsenic to expedite its elimination from the body (ATSDR,

1988). Its elimination from the body obviously mitigates the possibility for arsenic to manifest carcinogenic effects. Therefore, evaluating arsenic as a noncarcinogen would be more appropriate. [Specifically, the body methylates the arsenic to form monomethyl arsenic and dimethyl arsenic. There is a limited capacity for the body to metabolize methylate arsenic, but this limit is generally reached when the body's intake of arsenic approximately exceeds 500 µg/day. Concentrations of arsenic in surface soil for potential receptors evaluated in this HHRA result in intakes that are well within the body's ability to metabolize arsenic. Although some humans may be more sensitive to arsenic, in that they are "poor methylators," the average exposure concentration for the site is more than three orders of magnitude below the normal limit of metabolic saturation and is most likely below levels that would trigger responses in sensitive individuals.]

- In nature, chromium (III) predominates over chromium (VI) (Langård and Norseth 1986). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, the latter which is considered to be more toxic. However, at Site 8 chromium speciation was not available for sampled media. Therefore, it was conservatively assumed that chromium is present in the hexavalent form. This would tend to overestimate the noncarcinogenic risks at the site.

Three contaminants; benzo(g,h,i)perylene (surface and subsurface soil), phenanthrene (surface and subsurface soil), and 2-nitrophenol (subsurface soil) did not have listed toxicity values for use in the quantitative risk assessment; therefore, COPC selection and risks were not estimated for exposure to these chemicals. The uncertainty associated with not estimating quantitative risks for these chemicals is discussed qualitatively below:

- Benzo(g,h,i)perylene was detected in 8 of 18 surface soil samples at a maximum concentration of 410 ug/kg and 1 of 23 subsurface soil samples at a concentration of 80 J ug/kg. The exclusion of benzo(g,h,i)perylene could potentially underestimate the carcinogenic and/or noncarcinogenic risk at Site 8. Benzo(g,h,i)perylene was detected at concentrations lower than the major PAHs detected in surface and subsurface soil. Due to the low levels of risk associated with PAHs at the site, the relative levels of benzo(g,h,i)perylene as compared to other PAHs, and the infrequency of detection in subsurface soil, the exclusion of benzo(g,h,i)perylene is not expected to have a significant impact on the surface soil and subsurface soil risks; however, without further toxicity information this remains unknown.

- Phenanthrene was detected in 10 of 18 surface soil samples at a maximum concentration of 2,100 ug/kg and 1 of 23 subsurface soil samples at a concentration of 180 J ug/kg. The exclusion of phenanthrene could potentially underestimate the carcinogenic and/or

noncarcinogenic risk at Site 8. Phenanthrene was detected at concentrations similar to the major PAHs detected in surface soil. Phenanthrene was detected at concentrations lower than the major PAHs detected in subsurface soil. Due to the low levels of risk associated with PAHs at the site, the relative levels of phenanthrene as compared to other PAHs, and the infrequency of detection in subsurface soil, the exclusion of phenanthrene is not expected to have a significant impact on the surface soil and subsurface soil risks; however, without further toxicity information this remains unknown.

- 2-Nitrophenol was detected in 1 of 19 subsurface soil samples at a concentration of 42 J ug/kg. The exclusion of 2-nitrophenol could potentially underestimate the carcinogenic and/or noncarcinogenic risk at Site 8. Due to the infrequency of detection in subsurface soil, the exclusion of 2-nitrophenol is not expected to have a significant impact on the surface soil and subsurface soil risks; however, without further toxicity information this remains unknown.

6.6.4 Uncertainties Associated with Risk Characterization

Major uncertainties associated with Risk Characterization are listed below.

- ICRs and HIs are summed for all potential COPCs and for all applicable routes of exposure. Summing the risks implies that no antagonistic or synergistic effects exist between chemicals. It also assumes that similar mechanisms of action and metabolism are prevalent. Therefore, the use of this approach may either underestimate or overestimate the risks, depending on the chemical-specific interactions, which cannot be predicted. The direction of the uncertainty cannot be defined, but the methodology used is based on current EPA guidance.

- Risks to any individual may also be overestimated by summing multiple assumed exposure pathway risks for any single receptor. Although every effort was made to develop reasonable scenarios, not all individual receptors may be exposed via all pathways considered.

The IEUBK model accounts for the multimedia nature of lead exposure, incorporates absorption and pharmacokinetic information, and allows the risk manager to consider the potential distributions of exposure and risk likely to occur at a site (the model goes beyond providing a single point estimate output). Although uncertainties are associated with blood lead modeling using the IEUBK model, these uncertainties are considered lower than those that conceivably would result from similar lead evaluations performed using a traditional toxicity slope-based approach. Important uncertainties and limitations in the use of the IEUBK model are listed below.

The total carcinogenic risks posed by surface soil to the residential child and lifetime resident were 2.26×10^{-5} and 2.94×10^{-5}, respectively.

- The IEUBK model uses a default of 30 percent lead absorption from soil. However, the bioavailability of lead from different sources may be variable due to differences in lead speciation, particle size, and mineral matrix and may also vary as a function of physiological parameters such as age, nutritional status, gastric pH, and transit time. For example, lead absorption from paint chips in soil may be different than lead absorption from other chemical forms.

- Blood lead variability in the IEUBK model is characterized by a single number, the geometric standard deviation, which is set to a default value of 1.6. This value represents the aggregate uncertainty in all sources of population variability, including biological, uptake, exposure, sampling, and analytical components.

- Child blood lead level predictions obtained using the IEUBK model reflect only the contributions of sources entered into the model and do not take into account any existing body burden that may be the result of prior exposures or any exposures that may have taken place at alternate locations away from the household or neighborhood level, such as parks or daycare centers.

6.7 HHRA CONCLUSIONS FOR SITE 8

No estimated carcinogenic risks or noncarcinogenic risks above EPA's target risk levels of 1×10^{-4} and 1.0, respectively, were present under scenarios evaluated for COPCs in surface soil, subsurface soil, sediment, and surface water (both total and dissolved inorganics) in this HHRA. These are the highest carcinogenic risks identified under reasonably anticipated potential land uses. These risks fall within EPA's target risk range of 1×10^{-4} to 1×10^{-6} and therefore may be considered acceptable. The estimated cancer risks associated with the most likely future land use scenario (industrial) were within the target risk range. Additionally, the casual user exposure scenarios yielded cancer risks that are at the lower end or below the target risk range. Finally, the recreational exposure scenario yielded cancer risks that were at the lower end or below the target risk range. The estimated percentage of residential children exposed to surface soil with a blood lead level above 10 ug/dl (0.35%) is below EPA's protective level cutoff of 5%. Therefore, lead levels in soils do not present an unacceptable risk.

6.8 ECOLOGICAL RISK ASSESSMENT

Ecological receptors on- or off-base, such as aquatic and semi-aquatic biota, may be at risk from contaminants released from Site 8. Accordingly, a screening-level ERA was performed to characterize the potential risks from site-related contaminants to ecological receptors that inhabit the installation area. The ERA was conducted for Site 8 in accordance with EPA guidance (EPA, 1994c, 1994d, 1997c).

Representative exposure point contaminant concentrations in surface water and sediment were compared to benchmark toxicity values (BTVs) that are protective of ecological receptors near the site. Potential risks to ecological receptors were investigated in the form of environmental effects quotients (EEQ) values, which are the ratio of the representative contaminant concentration to the BTV. EEQ values were summed in each medium at each site to generate environmental effects index (EEI) values. Risks were considered possible when an EEQ or EEI value was greater than 1, but other quantitative and qualitative factors were investigated to more fully assess potential risks.

6.8.1 ERA Approach

This section provides an outline of the general approach that was taken to assess the impacts of site contamination on ecological receptors and the habitats that support these organisms. This assessment generally followed a two-step process, as follows:

Step 1: Preliminary Problem Formulation and Ecological Effects Characterization

- Preliminary Problem Formulation (Section 6.8.2) - This is the first phase of an ERA, which discusses the goals, breadth, and focus of the assessment. It includes a general description of Site 8 with emphasis on the habitats and ecological receptors present. This phase also involves characterization of contaminant sources and migration routes, evaluation of routes of contaminant exposure, and selection of ecological contaminants of potential concern (COPCs). Assessment and measurement endpoints that will be evaluated are also selected. Finally, a conceptual model is developed that describes how contaminants associated with Site 8 may come into contact with ecological receptors.

- Ecological Effects Characterization (Section 6.8.3) - In this component, medium-specific ecological benchmarks for each COPC (i.e., concentrations of each contaminant above which adverse effects to ecological receptors may occur) are identified. This step is undertaken concurrently with the exposure assessment described below.

Step 2: Preliminary Exposure Assessment and Risk Characterization

- Preliminary Exposure Assessment (Section 6.8.4) - This portion of the ERA includes the identification of the data used to represent concentrations of contaminants to which ecological receptors may be exposed in various media and the actual selection of exposure point contaminant concentrations from those data.

- Risk Characterization (Section 6.8.5) - In this step, exposure point concentrations are compared to benchmarks in order to characterize potential risk to ecological receptors of concern from contaminant exposure. COPCs found to pose potential risk after these comparisons are placed on a list of ecological contaminants of concern.

When these two steps are completed, the results can be interpreted and the uncertainties associated with the ERA can be addressed (Section 6.8.6). The above process, described in further detail below, represents the general ERA approach and is a summation of EPA Region III BTAG-recommended ERA guidelines (EPA, 1994d), which served as the basis for the ERA methodology (Figure 6-2). Furthermore, the ERA was conducted in accordance with other available ERA guidance documents (EPA, 1992g; Wentsel et al., 1994) and recent publications (Suter, 1993; Calabrese and Baldwin, 1993). Due to the potential complexity of ERAs, they are often conducted using a tiered approach and punctuated with scientific/management decision points (SMDPs), which are meetings involving the risk assessors, risk managers, and client to control costs, prevent unnecessary analyses, and ensure that the ERA is proceeding in an efficient, timely manner. Information analyzed in one tier is evaluated to determine whether the objectives of the study have been met and then may be used to identify the data required for the next tier, if necessary. This ERA can be considered a "screening-level" assessment, or "Tier 1" assessment, since it is based on only a conservative initial screening of contaminant concentrations against contaminant-specific benchmarks (EPA, 1994d). Tier 2 and Tier 3 assessments, referred to as "semi-quantitative" and "quantitative" assessments, respectively, are more focused studies that incorporate the initial screening but also encompass detailed laboratory and field studies or extensive modeling (EPA, 1994d). The same process summarized above was used to assess potential ecological risks for Site 8.

6.8.2 Preliminary Problem Formulation

Site 8 is located along the south side of Kirk Road. The site is drained by a concrete swale that discharges directly into an intermittent drainageway which is channeled and flows to the north on the north side of Kirk Road. The culvert for the swale runs underneath Kirk Road and between Werner Park and a residential zone (Figure 1-3). Trees line the top of the drainageway on the north side of the road, with maintained lawns to the west and grass, gravel, and blacktop (Werner Park) to the east. The intermittent drainageway joins a small, perennial stream approximately 750 feet north of the Kirk Road culvert, and the stream then flows to the northwest through a forested area. The perennial stream originates in the vicinity of Site 4. Therefore, surface water and sediments in the stream may reflect the influences of Site 4 as well as Site 8.

6.8.2.1 Description of Ecological Setting and COPCs

A relatively large forested area borders the stream to the east and southeast. This undisturbed forested area extends back along the stream to Kirk Road near Site 4, and this contiguous wooded area offers the

1. Preliminary Problem Formulation and Ecological Effects Evaluation

↓

2. Preliminary Exposure Assessment and Risk Characterization

↓ SMDP

3. Problem Formulation: Assessment Endpoint Refinement and Testable Hypothesis

↓ SMDP

4. Conceptual Model Refinement: Final Measurement Endpoint Selection and Study Design

↓ SMDP

5. Site Assessment to Confirm Ecological Sampling and Analysis Plan

↓ SMDP

6. Site Field Investigation

↓

7. Final Risk Characterization

↓

8. Risk Management SMDP

FIGURE 6-2
STEPS IN THE ECOLOGICAL RISK ASSESSMENT PROCESS
(Adapted from EPA, 1997c)
SITE 8 – NAWC WARMINSTER, PENNSYLVANIA

most secluded and physically diverse habitat observed during the biological characterization. Snails, earthworms, and amphipods (*Hyallela* sp.) were observed in sediments and leaf packs, as were small numbers of mayfly larvae (*Ephemeroptera*). Various songbirds were observed, and signs of rabbits (*Sylvilagus* sp.), raccoons, and white-tailed deer (*Odocoileus virginianis*) are found in the downstream portion of Area C. No rare, threatened, or endangered species are known to occur on or near Area C (TNC, 1992).

Precipitation runoff in the swale near Site 8 may carry constituents to nearby surface water and sediments in the tributary to the north. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater at Area C, but groundwater does not appear to discharge to the stream north of Site 8.

Since most of Site 8 and the surrounding area is composed of asphalt or mowed grass, no significant terrestrial habitat is present. Hence, the tributary of Little Neshaminy Creek is the focus of the assessment and many terrestrial exposure routes were not applicable. However, terrestrial receptors may come into contact with contaminants in surface water by using it for drinking water, although this exposure route represents a negligible portion of total exposure for most receptors. Aquatic and semi-aquatic organisms inhabiting the unnamed tributary of Little Neshaminy Creek and the surrounding riparian habitats may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. However, potential risks to semi-aquatic receptors were investigated only qualitatively.

Descriptions of habitat types and ecological receptors downgradient from Site 8 presented in Section 3.6. These encompass both aquatic and terrestrial habitats, although aquatic habitats were the only habitats quantitatively assessed in this ERA. Wetlands on and near the installation were assessed in 1994 (HNUS, 1994d), and the results were incorporated into Section 3.6. Data from a base species inventory were also utilized in this ERA (TNC, 1992), as are the results of biological characterizations conducted at the base during 1990 media sampling for this study. An evaluation of threatened and endangered species on and around the three areas was also provided, in accordance with Endangered Species Act (ESA) requirements. ARARs pertinent to this assessment are listed below:

- Executive Order 11988, Protection of Floodplains.
- Executive Order 11990, Protection of Wetlands.
- Clean Water Act (Section 404 40 CFR 230.10).
- Migratory Bird Treaty Act (16 USC 703 et seq.).
- Fish and Wildlife Coordination Act (16 USC 661 et seq.)
- Endangered Species Act (16 USC 1531 et seq.).
- Federal Water Quality Criteria.

To select ecological COPCs, a screen of the RI surface water and sediment sample results was performed. Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media, since they are essential nutrients that are toxic only in extremely high concentrations. Also, contaminants that were detected in 5 percent or less of the samples collected in a given medium at each area were initially excluded as COPCs.

6.8.2.2 Potential Release Pathways and Exposure Routes

The potential release pathways evaluated for Site 8 include combustion, volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in the site soil may volatilize from surficial material or become airborne via resuspension. Contaminated fugitive dust may also be generated during ground-disturbing activities, such as construction or excavation. These contaminants are dispersed in the surrounding environment and transported to downwind locations where they may re-partition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. Nonetheless, combustion and volatilization are assumed to represent a negligible release pathway at Site 8 since surface soils account for a minor portion of contaminated media and open burning activities have ceased.

For the most part, the relevant contaminant migration pathways for Site 8 are aquatic since little or no terrestrial habitat is located at those areas or no contaminant migration pathways to terrestrial habitats exist. Precipitation runoff or stormwater outfalls may carry constituents to nearby surface waters, sediments, and soils. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms.

Site 8 and the nearby unnamed tributary present several possible contaminant exposure routes. Since the focus was mainly aquatic environments, most terrestrial exposure routes were not applicable. However, terrestrial receptors may come into contact with contaminants in surface water by using it for drinking water, although this exposure route represents a negligible portion of total exposure for most receptors. Exposure to contaminants in riparian soils via dermal contact may occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize transfer of contaminants across dermal tissue.

Aquatic and semi-aquatic organisms inhabiting the study may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of

contaminated food items. Aquatic and semi-aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

6.8.2.3 Measurement Endpoints and Ecological Risk Model

As discussed in EPA (1997c) and Wentsel et al. (1994), one of the major tasks in problem formulation is the selection of assessment and measurement endpoints. An assessment endpoint is defined as "an explicit expression of actual environmental values that are to be protected" (EPA, 1997c). Measurement endpoints are "measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint" (EPA, 1997c). For this ERA, the most appropriate assessment endpoint was the maintenance of aquatic receptor populations. Therefore, the specific objectives of this assessment were to determine if exposure to contaminants present in the surface water and sediments near Site 8 is likely to result in declines in ecological receptor populations. Declines in populations could result in a shift in community structure and possible elimination of resident species from aquatic environments.

As indicated above, measurement endpoints are related to assessment endpoints, but these endpoints are more easily quantified or observed. In essence, measurement endpoints serve as surrogates for assessment endpoints. While declines in populations and shifts in community structure can be quantified, studies of this nature are generally time consuming and difficult to interpret. However, measurement endpoints indicative of observed adverse effects on individuals are relatively easy to measure in toxicity studies and can be related to the assessment endpoint. For example, contaminant concentrations that lead to decreased reproductive success or increased mortality of individuals in toxicity tests could, if found in the environment, result in shifts in population structure, potentially altering the community composition associated with the three areas investigated in this ERA.

For surface water, the measurement endpoints were contaminant concentrations in surface water associated with adverse effects on growth, survival, and reproduction of aquatic organisms (surface water benchmark values). For sediments, the measurement endpoints were contaminant concentrations in sediment associated with adverse effects on growth, survival, and reproduction of benthic organisms (sediment benchmark values).

Semi-aquatic receptors, such as piscivorous mammals, may also be exposed to aquatic contaminants. However, the investigation of potential risks to those receptors is more complex and is beyond the scope of this initial screening. Nonetheless, the determination of potential risks to aquatic receptors, as reflected in the measurement endpoints described above, may indirectly indicate potential risks to semi-aquatic receptors. For example, potential risks to aquatic receptors from bioaccumulatable contaminants may

indicate potential risk to semi-aquatic receptors that feed on them. Therefore, endpoints and potential risks for semi-aquatic receptors will be qualitatively assessed in this ERA.

A conceptual ecological risk model was formatted to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with Site 8 were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for an ecological receptor. The conceptual ecological model for the site is presented in Figure 6-3.

6.8.3 Ecological Effects Characterization

For this ERA, ecologically based benchmark toxicity values (BTVs or "benchmarks"), concentrations of contaminants in various media protective of ecological receptors, were selected to screen exposure point concentrations of COPCs in surface water and sediment to determine if they should be retained as COPCs. Methods used for the selection of media-specific benchmarks used in this ERA are provided below.

Actual exposures of aquatic receptors to COPCs were assumed to be primarily chronic (long-term) exposures, usually at sublethal concentrations. For this ERA, benchmark values used to identify surface water COPCs were chronic screening values, primarily federal AWQCs presented as EPA Region III BTAG screening levels (EPA, 1995b) or in 40 CFR Part 131, March 4, 1995. AWQCs are ARARs and are protective of a wide variety of sensitive species. Only total metals in surface water were assessed. Surface water benchmarks used in this ERA and their sources are presented in Table 6-84.

BTVs for sediment-dwelling organisms were gathered from the most widely accepted guidance. EPA Region III BTAG screening levels were preferentially used; these are primarily Effects Range-Low values from NOAA (Long et al., 1995; Long and Morgan, 1989). When values were not available from these sources, BTVs were obtained from Washington Department of Ecology (1991) and the Ontario Ministry of the Environment sediment guidelines (MOE, 1993). Sediment benchmarks used in this assessment are summarized in Tables 6-85 and 6-86. Although total organic carbon (TOC) data were available, the calculation of site-specific sediment benchmarks using TOC was beyond the scope of this initial screening. However, site-specific TOC data and their relation to sediment toxicity at each site are discussed qualitatively in area-specific sections, along with sediment grain size data.

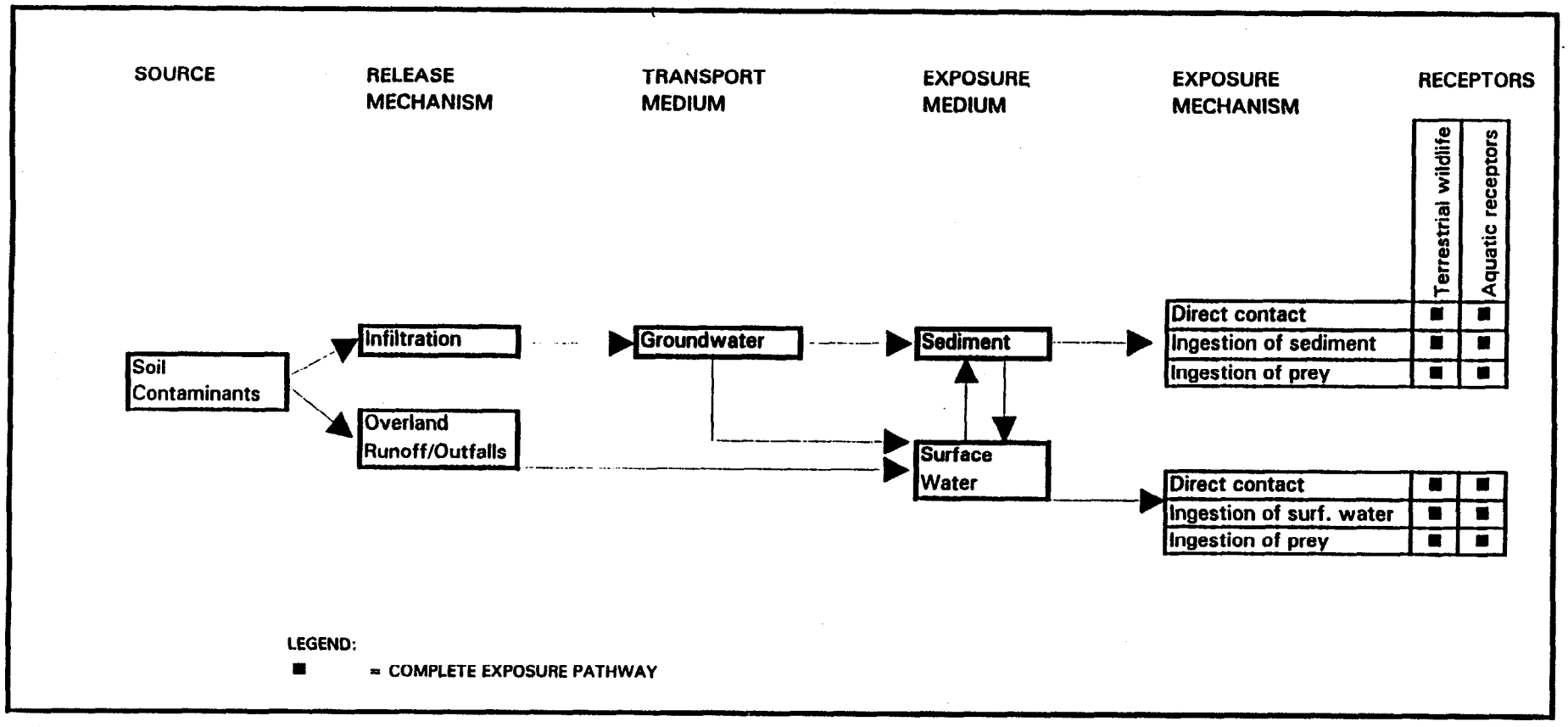

FIGURE 6-3
CONCEPTUAL SITE MODEL - ECOLOGICAL RISK ASSESSMENT
SITE 8 – NAWC WARMINSTER, PENNSYLVANIA

TABLE 6-84

DATA SUMMARY FOR SURFACE WATER INORGANICS (TOTAL METALS) - SITE 8

NAWC WARMINSTER, PENNSYLVANIA

(µg/l)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (µg/l)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
BARIUM	1 / 2	60	1 / 1	93	93	1000 (1)
MANGANESE	1 / 2	83	1 / 1	159	159	14500 (2)

1: Region III BTAG acute freshwater screening level (August 9, 1995): acute screening level/10.

2: Region III BTAG chronic screening level (August 9, 1995).

TABLE 6-85

DATA SUMMARY FOR SEDIMENT INORGANICS - SITE 8

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (mg/kg) (1)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
ARSENIC	2 / 2	2.3 - 2.8	2 / 2	3.4 - 4.2	4.2	8.2 (ER-L) (2)
BARIUM	2 / 3	31.4 - 40.6	2 / 3	49.8 - 74.6	74.6	500 (3)
BERYLLIUM	2 / 2	0.52 - 0.62	2 / 2	0.65 - 0.95	0.95	NA
CADMIUM	NOT DETECTED	-	1 / 1	0.2	0.2	1.2 (ER-L) (2)
CHROMIUM (TOTAL)	3 / 3	7.7 - 11.7	3 / 3	14 - 20.5	20.5	81 (ER-L) (2)
COPPER	2 / 2	5.4 - 7.5	2 / 2	19.5 - 34.6	34.6	34 (ER-L) (2)
LEAD	2 / 3	9.8 - 24.6	3 / 3	20.4 - 38.5	38.5	46.7 (ER-L) (2)
MANGANESE	3 / 3	144 - 220	3 / 3	307 - 848	848	460 (LEL) (4)
NICKEL	2 / 2	4.4 - 6	2 / 2	10 - 10.6	10.6	20.9 (ER-L) (2)
VANADIUM	3 / 3	11.8 - 13.6	3 / 3	18 - 34.2	34.2	NA
ZINC	3 / 3	32.9 - 57.2	3 / 3	59 - 78.5	78.5	150 (ER-L) (2)

NA = Benchmark not available.

ER-L = Effects Range-Low; value from data based on studies conducted primarily on coastal marine and estuarine environments.

LEL = Lowest Effect Level; level of contamination tolerated by the majority of benthic organisms.

1: Benchmarks are for freshwater sediments, unless otherwise indicated.

TABLE 6-86

DATA SUMMARY FOR SEDIMENT ORGANICS - SITE 8

NAWC WARMINSTER, PENNSYLVANIA

(µg/kg)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (µg/kg) (1)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
ACENAPHTHENE	2 / 2	100 - 110	1 / 2	120	120	16 (ER-L) (2)
ACENAPHTHYLENE	NOT DETECTED	-	1 / 2	60	60	44 (ER-L) (2)
ANTHRACENE	2 / 2	252.5 - 330	2 / 2	72 - 290	290	85.3 (ER-L) (2)
BENZ(A)ANTHRACENE	2 / 2	579.5 - 1300	2 / 2	280 - 720	720	261 (ER-L) (2)
BENZO(A)PYRENE	2 / 2	489.5 - 880	2 / 2	270 - 650	650	430 (ER-L) (2)
BENZO(B)FLUORANTHENE	2 / 2	829.5 - 1300	2 / 2	230 - 820	820	3200 (AET) (2)
BENZO(G,H,I)PERYLENE	2 / 2	267.5 - 720	1 / 2	320	320	670 (AET) (2)
BENZO(K)FLUORANTHENE	2 / 2	362.5 - 1000	2 / 2	350 - 370	370	3200 (AET) (2)
BIS(2-ETHYLHEXYL)PHTHALATE	2 / 2	91.5 - 1900	1 / 1	93	93	1300 (AET) (3)
CARBAZOLE	1 / 1	287.5	2 / 2	490 - 1100	1100	NA
CHRYSENE	2 / 2	587.5 - 1500	2 / 2	340 - 470	470	384 (ER-L) (2)
DI-N-OCTYLPHTHALATE	NOT DETECTED	-	1 / 2	94	94	6200 (AET) (2)
DIBENZ(A,H)ANTHRACENE	1 / 2	96	1 / 2	140	140	63.4 (ER-L) (2)
DIBENZOFURAN	NOT DETECTED	-	1 / 2	72	72	NA
FLUORANTHENE	2 / 2	1630 - 3400	2 / 2	670 - 1200	1200	398 (ER-L) (2)
FLUORENE	2 / 2	160 - 190	1 / 2	140	140	19 (ER-L) (2)
PYRENE	2 / 2	1380 - 2900	2 / 2	540 - 1400	1400	665 (ER-L) (2)

NA = Benchmark not available.

AET = Apparent Effects Threshold Value as developed for Puget Sound, State of Washington.

ER-L = Effects Range-Low; value from data based on studies conducted primarily on coastal marine and estuarine environments.

1: Benchmarks are for freshwater sediments, unless otherwise indicated.

2: Region III BTAG fauna screening level (August 9, 1995).

3: NOAA, 1994. NOAA Screening Guidelines for Organics and Inorganics, Quick Reference Cards, HAZMAT REPORT 94-8.

4 USEPA (1996)

6.8.4 Preliminary Exposure Assessment

Data used to obtain exposure point contaminant concentrations used for this ERA were those generated during RI fieldwork. The maximum detected contaminant concentrations or the 95 percent UCL were used as exposure point concentrations in surface water and sediment, in accordance with EPA Region III BTAG guidelines for data usage in ERAs (1994d). Since most of the 95 percent UCL values were less than 80 percent of the maximum detected value, the maximum was used in almost all cases, as recommended by EPA Region III BTAG (1994d). Background data are presented for comparative purposes and were obtained from facility-wide background sampling. Detailed descriptions of sampling locations, data validation, data treatment, and data selection were presented in previous sections. Site-specific sampling data for the unnamed tributary near Site 8 are summarized in Sections 4.6 and 4.7.
Figure 6-3

6.8.5 Risk Characterization

As identified by EPA, the second step in the ecological risk assessment process compares exposure point contaminant concentrations with benchmark concentrations protective of ecological receptors. Once this step was completed for this study, the results were reviewed to determine whether little or no ecological risk is associated with activities on the installation or additional information must be generated to verify that ecological receptors are at risk. The ratio of the exposure point contaminant concentration to the benchmark value is called the Ecological Effects Quotient (EEQ) and is defined as follows:

$$EEQ_i = EPC_i/BTV_i$$

where: EEQ_i = Ecological Effects Quotient for COPC "i" (unitless)
EPC_i = Exposure Point Concentration for COPC "i" (ug/l or mg/kg)
BTV_i = Benchmark Toxicity Value for COPC "i" (ug/l or mg/kg)

When the ratio of the exposure point concentration to its respective benchmark value exceeded 1.0, adverse impacts were considered possible and the COPC was retained. The EEQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an exposure point concentration exceeds or is less than a benchmark. When EEQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most benchmarks are conservatively derived. Furthermore, other factors, such as low frequency of detection, may mitigate potential risks for a COC with an elevated EEQ value. As a result of the conservatism inherent in most benchmark derivation, EPA Region III (1994d) has suggested that EEQs greater than one are indicative of

low to moderate potential risk; EEQs greater than 10 are indicative of moderate potential risk; and EEQs greater than 100 are indicative of high potential risk.

The use of EEQs is probably the most common method used for risk characterization in ERAs. Advantages of this method, according to Barnthouse et al. (1986), include the following:

- The EEQ method is relatively easy to use, is generally accepted, and can be applied to any data.

- The method is useful when a large number of contaminants must be screened.

This method of risk characterization has some inherent limitations. One primary limitation is that it is a "no/maybe" method for relating toxicity to exposure. That is, it uses single values for exposure concentrations and benchmark values and does not account for the variability in both these parameters or for incremental or cumulative toxicity. To address cumulative toxicity, EEQs were summed for all contaminants in a given medium to obtain an Ecological Effects Index (EEI). Although similar to an EEQ in that an EEI value of one or greater indicates potential risk, the EEI should be interpreted with caution. The EEI value may exacerbate the preceding uncertainties in the assessment. For example, most of an EEI value may be due to a single contaminant that has a high EEQ but a low frequency of detection. Also, ecological toxicity is not necessarily additive. As mentioned above, multiple contaminants may have synergistic, and even ameliorating, effects. Different types of contaminants also have different target organs and modes of action, confounding additive effects.

The comparisons described above are presented in area-specific screening tables to select COCs in surface water and sediment in each individual area assessment section. In addition, a data summary table is presented for surface water and sediment data at each area. Data summary tables include the frequency of detection for each COPC, as well as the range of detections, exposure point concentration, and, as mentioned earlier, contaminant-specific benchmarks and their sources. Background values are also presented on data summary tables for comparative purposes. These values need to be taken into account when making risk management decisions, since concentrations of inorganic contaminants can be naturally elevated and exceed screening values. Qualitative discussion is provided when inorganic contaminants that were retained as COCs were present in concentrations comparable to background. Some contaminants were present in some media for which no suitable benchmark values were available. In these instances, these contaminants were conservatively retained as COCs and qualitatively assessed.

Data used to obtain representative exposure point contaminant concentrations were those generated from RI sampling activities. Sampling locations are shown in Figure 6-3. Site 8 surface water and sediment data are summarized in Tables 6-84 through 6-86. Sample-specific data are presented in Appendix A.

No total inorganic COPCs in surface water for Site 8 exceeded BTVs (Table 6-87), and EEI values were negligible. No organics were detected in surface water.

For inorganics in sediments, copper and manganese slightly exceeded BTVs and were retained as COPCs, and the EEI value for inorganics was 5.79 (Table 6-88). Beryllium and vanadium were conservatively retained as COPCs since no suitable BTVs were available. Of the sediment organic COCs, several PAHs exceeded BTVs and were retained, and the EEI value equaled 32.38 (Table 6-89). Two compounds, carbazole and dibenzofuran, were conservatively retained as COPCs since no suitable BTVs were available.

6.8.6 Uncertainty Analysis

Uncertainty is associated with all aspects of the ERA process. This section provides a summary of the uncertainties involved in this ERA, with a discussion of how they may affect the final risk values and conclusions. Once an ERA is complete, the results must be reviewed and evaluated to identify the types and magnitudes of uncertainties involved. Relying on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. If numerous conservative assumptions are combined in the ERA process, the resulting calculations will propagate the uncertainties associated with each of those assumptions. The resulting bias is toward overpredicting risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

Generally, risk assessments carry two types of uncertainty: measurement and informational. Measurement uncertainty refers to the variability inherent in measured data. The risk assessment reflects the accumulated variances of the individual values used for several different parameters. Informational uncertainty stems from the limited availability of necessary information. Often the gap between what is needed and what is available is significant; information regarding the effects of some contaminants on wildlife receptors, the biological mechanism of a contaminant, the impact of physiological differences on exposure pathways, or the behavior of a contaminant in various environmental media is often absent.

Uncertainty is associated with each of the ERA steps, including

- Uncertainty in preliminary problem formulation can result from limited information regarding contaminant sources, release mechanisms, and exposure routes.

TABLE 6-88

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SEDIMENT INORGANICS - SITE 8

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (mg/kg)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
ARSENIC	4.2	8.2	0.51	NO
BARIUM	74.6	500	0.15	NO
BERYLLIUM	0.95	NA	-	YES
CADMIUM	0.2	1.2	0.17	NO
CHROMIUM (TOTAL)	20.5	81	0.25	NO
COPPER	34.6	34	1.02	YES
LEAD	38.5	46.7	0.82	NO
MANGANESE	848	460	1.84	YES
NICKEL	10.6	20.9	0.51	NO
VANADIUM	34.2	NA	-	YES
ZINC	78.5	150	0.52	NO
ECOLOGICAL EFFECTS INDEX (EEI)			5.79	

1: COPC was retained as a COC if the benchmark was exceeded or if no benchmark was available

NA = No benchmark available.

TABLE 6-89

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SEDIMENT ORGANICS - SITE 8

NAWC WARMINSTER, PENNSYLVANIA

(µg/kg)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (µg/kg) (1)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
ACENAPHTHENE	120	16	7.50	YES
ACENAPHTHYLENE	60	44	1.36	YES
ANTHRACENE	290	85.3	3.40	YES
BENZ(A)ANTHRACENE	720	261	2.76	YES
BENZO(A)PYRENE	650	430	1.51	YES
BENZO(B)FLUORANTHENE	820	3200	0.26	NO
BENZO(G,H,I)PERYLENE	320	670	0.48	NO
BENZO(K)FLUORANTHENE	370	3200	0.12	NO
BIS(2-ETHYLHEXYL)PHTHALATE	93	1300	0.07	NO
CARBAZOLE	1100	NA	-	YES
CHRYSENE	470	384	1.22	YES
DI-N-OCTYLPHTHALATE	94	6200	0.02	NO
DIBENZ(A,H)ANTHRACENE	140	63.4	2.21	YES
DIBENZOFURAN	72	NA	-	YES
FLUORANTHENE	1200	600	2.00	YES
FLUORENE	140	19	7.37	YES
PYRENE	1400	665	2.11	YES
ECOLOGICAL EFFECTS INDEX (EEI)			32.38	

1: COPC was retained as a COC if the benchmark was exceeded or no benchmark was available

NA = No benchmark available.

carbazole and dibenzofuran, were conservatively retained as COPCs since no suitable BTVs were available.

6.8.6 Uncertainty Analysis

Uncertainty is associated with all aspects of the ERA process. This section provides a summary of the uncertainties involved in this ERA, with a discussion of how they may affect the final risk values and conclusions. Once an ERA is complete, the results must be reviewed and evaluated to identify the types and magnitudes of uncertainties involved. Relying on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. If numerous conservative assumptions are combined in the ERA process, the resulting calculations will propagate the uncertainties associated with each of those assumptions. The resulting bias is toward overpredicting risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

Generally, risk assessments carry two types of uncertainty: measurement and informational. Measurement uncertainty refers to the variability inherent in measured data. The risk assessment reflects the accumulated variances of the individual values used for several different parameters. Informational uncertainty stems from the limited availability of necessary information. Often the gap between what is needed and what is available is significant; information regarding the effects of some contaminants on wildlife receptors, the biological mechanism of a contaminant, the impact of physiological differences on exposure pathways, or the behavior of a contaminant in various environmental media is often absent.

Uncertainty is associated with each of the ERA steps, including

- Uncertainty in preliminary problem formulation can result from limited information regarding contaminant sources, release mechanisms, and exposure routes.

- Uncertainty in the ecological effects characterization arises from the quality of the existing benchmark values and toxicity data to support a determination of potential adverse impacts to ecological receptors.

- Uncertainty associated with the exposure assessment includes the methods used and the assumptions made to determine exposure point concentrations.

- Uncertainty in risk characterization includes that associated with the potential effects of exposure to multiple contaminants and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

- Uncertainty in the ecological effects characterization arises from the quality of the existing benchmark values and toxicity data to support a determination of potential adverse impacts to ecological receptors.

- Uncertainty associated with the exposure assessment includes the methods used and the assumptions made to determine exposure point concentrations.

- Uncertainty in risk characterization includes that associated with the potential effects of exposure to multiple contaminants and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

6.8.6.1 Uncertainty in the Preliminary Problem Formulation

The site investigated in this ERA received contaminant inputs from more than one source, although initially contaminants are conservatively assumed to stem directly from area-related activities. The stream assessed in this ERA also receives contaminant inputs from runway runoff as well as from off-base sources, including residential developments and commercial businesses. Since contaminant concentrations may reflect inputs from many sources, uncertainties exist regarding whether risk characterized at a discrete area stems from area-related contaminants. Also, different sites and their contaminants may possess different contaminant exposure routes for ecological receptors. Difficulties and limitations exist in trying to obtain exposure routes for individual sites for individual receptors. Since exposure routes may be quite different for different species, risk may be over- or underestimated if this information is not known.

6.8.6.2 Uncertainty in the Ecological Effects Characterization

A great deal of uncertainty in this risk assessment arises from the nature and quality of the available toxicity data used to derive BTVs. This uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; and when postulated mechanisms of toxicity are similar for laboratory and wildlife species. Most benchmark values are based on the most conservative assumptions possible. As such, though an inherent level of conservatism is needed in a screening-level ecological risk assessment to ensure that the most sensitive receptors are protected, conservative BTVs may heavily overestimate potential risks and the resulting EEQ values may be misleading. Both AWQCs and most sediment screening values used in this assessment are based on laboratory studies that do not take into account mitigating or ameliorating physical and chemical conditions in the environment. Therefore, uncertainty is introduced into the assessment, and the results tend to overestimate potential risks.

In addition, ERAs, unlike human health risk assessments, must consider risks to many different species. However, calculation of risk values for each potential receptor species is not possible. For this ERA, conservative BTVs protective of a wide range of ecological receptors were sought. The underlying assumption associated with the use of these benchmarks is that contaminant concentrations in excess of these BTVs are indicative of potential impacts to actual receptors inhabiting the area. However, species-specific physiological differences that may influence an organism's response to a contaminant or subtle behavioral differences that may increase/decrease a receptor's contact with a contaminant are seldom known. Also, some contaminants were present in some media for which no suitable BTVs were available, and as a result, they could not be quantitatively assessed. For these reasons, the use of benchmark values, while necessary, will introduce error into the results of an assessment.

6.8.6.3 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises mainly in the methods used to obtain exposure point concentrations. The maximum detected contaminant concentrations were generally used to represent the highest contaminant concentrations to which ecological receptors might be exposed. If the samples evaluated in this ERA are representative of contaminant concentrations associated with the station, then this approach is conservative and should overestimate potential risks to ecological receptors. The maximum concentration of a contaminant in a given medium may have been collected in a "hot spot" of contamination and may be much higher than the remaining values in the data set. Again, although use of maximum values is appropriate for screening in an ERA, they may grossly overpredict potential risks.

6.8.6.4 Uncertainty in the Risk Characterization

All aspects of the ERA process described in the above sections affect uncertainty in the risk characterization. Uncertainty in risk characterization also stems, in part, from the fact that this process does not fully or toxicologically consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the contaminants evaluated. As mentioned above, the EEI is only an additive measure of total potential risk. Toxicity may actually increase, or even decrease, geometrically based on synergistic or antagonistic effects. Additionally, contaminants that account for a large percentage of potential risk may be mitigated by several factors, including a low frequency of detection or elevated concentrations in areas with no significant habitat. For these reasons, the EEI can be used as a rough estimate of total risk, but it contains uncertainty and must be interpreted with caution.

6.8.7 ERA CONCLUSIONS FOR SITE 8

The focus of the ERA was potential contaminant inputs from Site 8 to the tributary of Little Neshaminy Creek north of Kirk Road, which receives runoff from Site 8. A stretch of the tributary is located in a heavily

wooded area, providing excellent habitat for terrestrial organisms, but no contaminant migration pathways exist to those terrestrial habitats. The tributary provides habitat for aquatic and semi-aquatic receptors, but a diverse aquatic community is not present, mainly due to the limited extent of habitat.

Little to no ecological risk is present from inorganic or organic contaminants in surface water near Site 8. EEQ values for sediment inorganics were indicative of low potential risk to aquatic organisms, as was the EEI value. No BTVs were available for beryllium and vanadium in sediments, but these metals were present in relatively low concentrations. Beryllium was detected in concentrations comparable to background and vanadium was detected in concentrations slightly above background. Potential risks to aquatic organisms from several PAHs and one phthalate compound in sediment were low to moderate.

However, most of the elevated concentrations were present in sediment SampleC11, which was collected in the tributary just north of Kirk Road during 1990 Phase I activities. The same location was sampled during 1992 Phase II activities (sample C12) and nearly all PAHs and phthalates that were detected in the Phase I samples were either not detected in the Phase II sample or present in concentrations one order of magnitude lower, and were generally near or below BTVs. Sediment samples C10 and C13, which were collected further downstream of samples C11 and C13, were not evaluated quantitatively in this assessment since they may receive contaminant inputs from Site 4. Nonetheless, concentrations of PAHs and phthalates in Samples 3-A and 3-B were relatively low, indicating limited migration of organic contaminants in the tributary from Site 8 (and Site 4). In addition, runoff from Kirk Road may also contribute PAHs to the tributary.

In summary, potential ecological risks were negligible due to contaminants in surface water in the tributary of Little Neshaminy north of Site 8. Potential risks from sediment organics were also low. Several PAHs and one phthalate compound significantly exceeded BTVs in a tributary sediment sample, but concentrations, and related potential risks, were much lower in a more recent sample collected at the same location. Moreover, concentrations of organics in sediment samples taken further downstream, that also receive potential contaminant inputs from Site 4, were relatively low. Aquatic habitat in the stretch of the drainageway near Site 8 is also generally limited, precluding significant potential exposure for fish and piscivorous receptors. For these reasons, ecological risks from Site 8 contaminants are low, and further study or remediation based on ecological concerns do not appear to be warranted.

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APPENDIX A

ANALYTICAL DATABASE

SURFACE SOIL SAMPLE DEPTHS – SITE 8

SAMPLE NO.	DEPTH	REMARKS (1) (2)
SS-08-01	1.5 – 2.0'	
SS-08-02	1.5 – 2.0'	
SS-08-03	1.5 – 2.0'	
SS-08-04	1.5 – 2.0'	
SS-08-05	1.5 – 2.0'	
SS-08-06	1.5 – 2.0'	
SS-08-07	1.5 – 2.0'	
SS-08-08	1.5 – 2.0'	
SS-08-09	1.5 – 2.0'	
SS-08-10	0.35'	
SS-08-11	0.35'	Duplicate of SS-08-10
SS-08-12	0.5'	
SS-08-13	0.5'	
SS-08-14	0.5'	
SS-08-15	0.5'	Duplicate of SS-08-14
SS-08-16	0.5'	
SS-08-17	2"	Phase II RI Sample
SS-08-18	2"	Phase II RI Sample
SS-08-19	1.5'	
SS-08-20	1.5'	
SS-08-21	1.5'	
SS-08-22	1.5'	
SS-08-23	1.5'	
SS-08-24	1.5'	
SS-08-25	0.5'	
SS-08-26	1.5 – 2.0'	
SS-08-27	1.5 – 2.0'	Duplicate of SS-08-23
SS-08-28	1.5 – 2.0'	
SS-08-29	1.5 – 2.0'	Duplicate of SS-08-28
SS-08-30	1.5 – 2.0'	
SS-08-31	1.5 – 2.0'	Verification Sample
SS-08-32	1.5 – 2.0'	Verification Sample
SS-08-33	1.5 – 2.0'	Verification Sample
SS-08-34	1.5 – 2.0'	Verification Sample
SS-08-35	1.5 – 2.0'	Verification Sample
SS-08-36	1.5 – 2.0'	Verification Sample
SS-08-37	1.5 – 2.0'	Verification Sample
SS-08-38	1.5 – 2.0'	Verification Sample
SS-08-39	1.5 – 2.0'	Verification Sample
SS-08-40	1.5 – 2.0'	Verification Sample
SS-08-41	1.5 – 2.0'	Verification Sample
SS-08-42	1.5 – 2.0'	Verification Sample
SS-08-43	1.5 – 2.0'	Verification Sample
SS-08-44	1.5 – 2.0'	Verification Sample
SS-08-45	1.5 – 2.0'	Verification Sample
SS-08-46	1.5 – 2.0'	Verification Sample Duplicate of SS-08-33
SS-08-47	1.5 – 2.0'	Verification Sample
SS-08-48	0.2 – 0.5'	

SURFACE SOIL SAMPLE DEPTHS – SITE 8

SAMPLE NO.	DEPTH	REMARKS (1) (2)
SS-08-49	0.3 – 0.5'	
SS-08-50	0.3 – 0.5'	
SS-08-51	0.2 – 0.5'	Duplicate of SS-08-48
SS-08-52	0.2 – 0.5'	
SS-08-53	0.2 – 0.5'	
SS-08-54	0.2 – 0.5'	
SS-08-55	0.2 – 0.5'	
SS-08-56	0.2 – 0.5'	Duplicate of SS-08-52

SUBSURFACE SOIL SAMPLE DEPTHS

SAMPLE NO.	DEPTH	REMARKS (1) (2)
SB-08-01	8.0'	
SB-08-02	6.0'	
SB-08-03	8.0'	
SB-08-04	7.5'	
SB-08-05	8.0'	
SB-08-06	6.0'	
SB-08-07	6.5'	
SB-08-08	6.0'	
SB-08-09	7.0'	
SB-08-10	6.0'	
SB-08-11	7.5'	
SB-08-12	6.0'	
SB-08-13	6.0'	
SB-08-14	7.0'	
SB-08-15	7.0'	
SB-08-16	9.0'	
SB-08-17	6.0'	
SB-08-18	3.5 – 4.0'	Phase II RI Sample
SB-08-19	3.5 – 4.0'	Phase II RI Sample
SB-08-20	6.0'	
SB-08-21	3.0 – 3.2'	
SB-08-22	3.1 – 3.5'	
SB-08-23	3.0 – 3.4'	
SB-08-24	3.2 – 3.6'	

Notes:

(1) Sample information compiled from field logbooks, sample logsheets, and soil boring logs.

(2) No field instrument readings, visible staining, or evidence of potential contamination (e.g., odors, presence of debris) was noted from the Site 8 samples.

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SURFACE SOIL						
SS-08-01	X	X	X	X	X	
SS-08-02	X	X	X	X	X	
SS-08-03	X	X	X	X	X	
SS-08-04	X	X	X	X	X	
SS-08-05	X	X	X	X	X	
SS-08-06	X	X	X	X	X	
SS-08-07	X	X	X	X	X	
SS-08-08	X	X	X	X	X	
SS-08-09	X	X	X	X	X	
SS-08-10		X	X	X	X	8SS-01
SS-08-11		X	X	X	X	8-SS-02; Duplicate of 8-SS-01
SS-08-12	X		X	X		8SS-03 Removed
SS-08-13	X	X	X	X		8SS-04 Removed
SS-08-14	X	X	X	X		8SS-05
SS-08-15	X	X	X	X		8SS-06; Duplicate of 8-SS-05
SS-08-16	X	X	X	X		8SS-07
SS-08-17	X	X	X	X		Phase II RI[a] (W-SS-01)
SS-08-18	X	X	X	X		Phase II RI[a] (W-SS-03)
SS-08-19				X[b]		
SS-08-20				X[b]		

(a) Includes TPH and BTEX
(b) Pb and As only

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SURFACE SOIL						
SS-08-21				X[b]		Removed
SS-08-22				X[b]		Removed
SS-08-23				X[c]		Removed
SS-08-24				X[c]		
SS-08-25				X[c]		
SS-08-26				X[c]		
SS-08-27				X[c]		Duplicate of SS-08-23; Removed
SS-08-28				X		S8SS24
SS-08-29				X		S8SS25; Duplicate of SS-08-28
SS-08-30				X		S8SS23
SS-08-31				X[b]		VS-8-01
SS-08-32				X[b]		VS-8-02
SS-08-33				X[b]		VS-8-03
SS-08-34				X[b]		VS-8-04
SS-08-35				X[b]		VS-8-05
SS-08-36				X[b]		VS-8-06
SS-08-37				X[b]		VS-8-07
SS-08-38				X[b]		VS-8-08

(a) Includes TPH and BTEX
(b) Pb and As only
(c) Pb only

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SURFACE SOIL						
SS-08-39				X[b]		VS-8-09
SS-08-40				X[b]		VS-8-10
SS-08-41				X[b]		VS-8-11
SS-08-42				X[b]		VS-8-12
SS-08-43				X[b]		VS-8-13
SS-08-44				X[b]		VS-8-14
SS-08-45				X[b]		VS-8-15
SS-08-46				X[b]		VS-8-16; Duplicate of SS-08-33
SS-08-47				X[b]		VS-8-17
SS-08-48					X[d]	SS-08-10A
SS-08-49					X[d]	SS-08-10B
SS-08-50					X[d]	SS-08-10C
SS-08-51					X[d]	SS-08-10D; Duplicate of SS-08-48
SS-08-52		X[f]		X[e]		08-SS01
SS-08-53		X[f]		X[e]		08-SS02
SS-08-54		X[f]		X[e]		08-SS03
SS-08-55		X[f]		X[e]		08-SS04
SS-08-56		X[f]		X[e]		08-SS05 Duplicate of SS-08-52

(b) Pb and As only
(d) Includes furans
(e) As, Pb, and V only
(f) PAHs only

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES /PCBs			
SOIL BORINGS						
SB-08-01		X	X	X	X	8SB-01; 8.0'
SB-08-02		X		X	X	8SB-02; 6.0'
SB-08-03		X		X	X	8SB-03; 8.0'
SB-08-04		X		X	X	8SB-04; 7.5'
SB-08-05	X	X		X		8SB-05; 8.0'
SB-08-06	X	X		X		8SB-06; 6.0'
SB-08-07	X	X	X	X		8SB-07; 6.5'
SB-08-08	X	X	X	X		8SB-08; 6.0'
SB-08-09	X	X	X	X		8SB-09; 7.0'
SB-08-10		X		X		8SB-10; 6.0'
SB-08-11		X		X		8SB-11; 7.5'
SB-08-12		X		X		8SB-12; 6.0'
SB-08-13		X		X		8SB-13; 6.0'
SB-08-14		X		X		8SB-14; 7.0'
SB-08-15	X	X	X	X		8SB-15; 7.0'
SB-08-16		X		X		8SB-16; 9.0'
SB-08-17		X		X		8SB-17; 6.0'
SB-08-18	X	X	X	X		Phase II[a] (W-SB-17)
SB-08-19	X	X	X	X		Phase II[a][g](W-SB-19)

(a) Includes TPH and BTEX
(g) Includes ASTM/Water Leachate and TCLP Results

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SOIL BORINGS						
SB-08-20				X[c]		SB-08-26; 6.0'
SB-08-21		X[f]		X[e]		08-SB01; 3.0'
SB-08-22		X[f]		X[e]		08-SB02; 3.1'
SB-08-23		X[f]		X[e]		08-SB03; 3.0'
SB-08-24		X[f]		X[e]		08-SB04; 3.2'

(c) Pb only
(e) As, Pb, V, only
(f) PAHs only

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
TEST PITS						
TP01-08-01	X			X		8.0' (S8-TP01-01)
TP01-08-02	X			X		6.5' (S8-TP01-02)
TP02-08-03	X			X		6.5' (S8-TP02-01)
TP02-08-04	X			X		6.5'; Duplicate of TP02-08-03 (S8-TP02-10)
TP02-08-05	X			X		5.5' (S8-TP02-02)

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SURFACE WATER						
C8-SW	X			X[h]		Background
C10-SW	X	X	X	X		3-SW Phase I RI Background; 3A Phase III RI
C12-SW	X	X	X	X[h]		SW-3 Phase I RI; 4B Phase III RI
C13-SW	X	X	X	X[h]		SW-4 Phase II RI Background; 3B Phase III RI

[h] Also TAL metals (filtered)

SUMMARY OF ANALYTICAL TESTING
AREA C - SITE 8
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs			
SEDIMENT						
C6-SD	X			X		
C8-SD	X			X		Background
C10-SD	X			X		3-SED Phase I RI Background; 3A Phase III RI
C11-SD	X			X		4-SED Phase I RI; 4A Phase III RI
C12-SD	X			X		3D-3 Phase II RI; 4B Phase III RI
C13-SD	X			X		SD-4 Phase II RI Background; 3B Phase III RI

Glossary of Qualifier Codes

J - Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).

U - Value is a non-detected result as reported by the laboratory.

UJ - Non-detected result is considered estimated due to exceedance of technical quality control criteria.

UL - Non-detected result is considered biased low due to exceedance of technical quality control criteria.

UR - Non-detected result is considered unusable due to exceedance of technical quality control criteria.

L - Positive result is considered biased low due to exceedance of technical quality control criteria.

K - Positive result is considered biased high due to exceedance of technical quality control criteria.

B - Positive result is considered to be an artifact of blank contamination, and should not be considered present.

N - Positive result is considered estimated because of low spike recovery (metals).

P - Positive result is considered estimated because of high percent difference between pesticide concentrations on two gas chromatographic (GC) columns.

A-1 Background Soils

TABLE A-1.1

ANALYTICAL RESULTS FOR METALS - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-01	BG-02	BG-03	BG-03-D	BG-05	BG-06	BG-07	BG-08
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	14900	14600	15000	16800	13200	17600	17900	14000
Antimony	6.3 UR	6.4 UR	7.2 UR	7.5 UR	6.7 UR	6.8 UR	7.6 UR	6.4 UR
Arsenic	5.6	6.1	4.4 JL	5.1	5.2	7.2	6.9	4.2 JL
Barium	61.8	39.8	38.1	45	37.2	48.1	113	76.2
Beryllium	0.88	0.64	0.72	0.76	0.69	0.82	1.1	0.83
Cadmium	0.57 U	0.58 U	0.65 U	0.68 U	0.6 U	0.62 U	0.69 U	0.59 U
Calcium	877	684	508	532	603	553	960	972
Chromium	20.9	21.4	19.4	23.3	18.1	27	22.6	15.8
Cobalt	9	8.9	9.3	10.8	7.9	10.7	8.7	6.6
Copper	9.2 JK	11.5 JK	11.5 JK	11.8 JK	12.1 JK	11.5 JK	10.9 JK	10.1 JK
Cyanide	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Iron	22400	23600	22000	25600	20900	28800	21900	15300
Lead	13.2	10	8.2	10.3	9.6	11.3	11.3	11.8
Magnesium	2380	2490	2790	3050	2500	3080	2670	1810
Manganese	352	305	310	377	217	319	573	338
Mercury	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.06 U	0.06 UQ
Nickel	13.4 JK	13.1 JK	12.8 JK	14.4 JK	11.6 UQ	14.7 JK	15 JK	11.5 UQ
Potassium	816	795	963	1250	921	1240	839	516
Selenium	0.76 UR	0.77 UR	0.87 UR	0.9 UR	0.81 UR	0.82 UR	0.93 UR	0.78 UR
Silver	0.76 UR	0.77 UR	0.87 UR	0.9 UR	0.81 UR	0.82 UR	0.93 UR	0.78 UR
Sodium	59.2 UQ	52.9 UQ	66.9 UQ	70 UQ	52.7 UQ	60.6 UQ	58.6 UQ	53.1 UQ
Thallium	0.95 U	0.96 U	1.1 U	1.1 UL	1 U	1 UL	1.2 U	0.98 U
Vanadium	32.3	35.8	36.3	40.1	30.4	42.8	38	24.5
Zinc	31.5	31.9	30.8	33.8	28.8	35.3	50.2	25.6

TABLE A-1.1

ANALYTICAL RESULTS FOR METALS - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-09	BG-10	BG-11	BG-12	BG-13	BG-14	BG-15	BG-16
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	11200	13100	15400	18100	15700	16600	16700	16900
Antimony	5.4 U	5.6 U	10.8 UL	11.6 UL	11 UL	9.9 UL	6.7 UR	13.6 J
Arsenic	6.3	6	12.1 J	0.99 UQ	3.8 J	0.67 UL	3.7 JL	4.6
Barium	37.3	77.4	37.7 UQ	44.5 UQ	105	115	34.1	52.2
Beryllium	0.84	1.1	1.3 UQ	1.4 UQ	1.3 UQ	1 UQ	0.68	1
Cadmium	0.49 UL	0.51 UL	2.2 UQ	3.5 UQ	3.8 UQ	3.9 UQ	0.61 U	0.39 UL
Calcium	1070	1100	913 UQ	963 UQ	643 UQ	980 UQ	1020	840
Chromium	12	14	29.6 JK	35.3 JK	15.7	18.2	20.2	26.6
Cobalt	6.2	8.9	6.4 UQ	14.4	7.2 UQ	6.9 UQ	7.1	11.1
Copper	9.3	22.7	12.8 UQ	12.1 UQ	10.1	6.5	7.9 JK	14.1
Cyanide	1.1 U	1.1 U	2.3 U	2 U	1.8 UL	1.7 UL	1.2 U	n/a
Iron	15100	19100	30300	39900	14400	15500	20000	19600
Lead	7.7	19	12.3	7.7	96.5 J	9.1 J	6.7	8.9
Magnesium	2580	2480	2310 UQ	2600 UQ	1720 UQ	1940 UQ	1910	2930
Manganese	185	414	124	276	718	585	132	546 L
Mercury	0.06 UL	0.06 UL	0.11 U	0.1 U	0.12 U	0.12 U	0.06 U	0.06 U
Nickel	8.1	9.9	9.5	17.5	17.1 UQ	13.4 UQ	10.7 UQ	14.6 J
Potassium	766	1060	760	554 UQ	532 UQ	465	681	1290
Selenium	0.65 U	0.68 U	1.1 UJ	1.2 UL	1 UL	1.1 UL	0.81 UR	0.78 U
Silver	0.65 UL	0.68 UL	2.2 U	2.4 U	2.2 U	2 U	0.81 UR	0.97 UL
Sodium	57.9 UQ	64.7 UQ	747 UQ	1030 UQ	460 UQ	474 UQ	63.2 UQ	73.2 B
Thallium	0.81 U	0.86 U	0.44 UL	0.46 UL	0.41 U	0.45 U	1 U	0.78 UL
Vanadium	18.1	21.3	40.6	45	27.6	27.6	31.6	38.7
Zinc	20.2	33	32.4 UQ	24.6 UQ	60	28.6	19.6	30.3

TABLE A-1.1

ANALYTICAL RESULTS FOR METALS - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-17	BG-18	BG-19	BG-20	BG-21	BG-22	BG-23	BG-23-D
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	13500	14500	12000	14300	8790	7370	16400	17500
Antimony	5.9 U	6 U	5.9 U	5.9 U	5.6 U	5.9 U	6.1 UL	4.9 UJ
Arsenic	4.9	5.1	6.1	6	3.9	3.2	1.6	2.1
Barium	64.3	58.2	34.6	42	67.7	51	58.2	59.6 K
Beryllium	1.1	1	0.67 K	0.75 K	0.94 K	0.67 K	1.6	1.7 K
Cadmium	0.54 U	0.54 U	0.54 UL	0.54 UL	0.51 UL	0.54 UL	0.91 UJ	0.73 UJ
Calcium	788 B	684 B	240	315	828	745	481	498
Chromium	17.1	19.5	23	23.5	25	13.2	20.3 J	20.3 J
Cobalt	8.4 B	9.4	7.6	9.4	3.9	6.5	20.2	22.1
Copper	8.5	9.2	12	10.7	12.7	16.6	16.3	15.1 K
Cyanide	1.1 U	1.2 U	1.2 U	1.2 U	1.1 U	1.2 U	n/a	n/a
Iron	19800	21900	23700	25800	17300	13300	23400	24900
Lead	13.2	12.4	9	11.9	6.4	5.3	4.6 J	4.1 J
Magnesium	1890	2070	2250	2380	2380	1750	1640	1750
Manganese	487	411	335	343	116	370	486	477 K
Mercury	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.06 U	0.37	0.13 B
Nickel	8.7	9.5	9.7 B	12.1 B	9 B	7.2 B	16.5 J	21.7 J
Potassium	608 B	693 B	728	855	494	396	332	314
Selenium	0.72 U	0.72 U	0.72 UL	0.72 UL	0.68 UL	0.72 UL	0.54 B	0.21 U
Silver	0.72 U	0.72 U	0.72 U	0.72 UL	0.68 U	0.72 U	1.9 B	1.1 B
Sodium	54.8 B	54.9 B	76.5 B	57.1 B	80.3 B	74.8 B	70.3	74.1 L
Thallium	0.9 U	0.9 U	0.9 UL	0.9 UL	0.85 UL	0.9 UL	0.42 U	0.42
Vanadium	30.7	33.1	35.1	37.9	29.6	22.6	29.3	31.3 K
Zinc	30.1	29.7	24.8	30	23.7	15.1	28.8	30.8

TABLE A-1.1

ANALYTICAL RESULTS FOR METALS - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	BG-24	BG-25	BG-26	BG-27	BG-28	BG-29	BG-30	---
SAMPLE DATE:								---
STATUS:								---
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	
Aluminum	13200	9310	4780	12700	11700	5260	5860	
Antimony	5.7 UL	5.2 UJ	4.7 UL	6 UL	5.5 UL	5.7 UL	4.7 UL	
Arsenic	0.23 U	2.4	0.2 U	1.3	0.28	0.35	0.83	
Barium	61.1 K	64.8	7.8 B	44.1	225	15 B	35.6	
Beryllium	0.98 K	0.56	0.31	0.69	0.48	0.42	0.57	
Cadmium	0.85 UJ	0.77 UJ	0.7 UJ	0.89 UJ	0.82 UJ	0.85 UJ	0.69 UJ	
Calcium	1910	681	414	408	292	544	443	
Chromium	18.5 J	15.2	13.1 J	20.3 J	12.4 J	13.3 J	7.9 J	
Cobalt	14.5	8.3	1.6	7.7	14	5.9	5.9	
Copper	3.6 K	13.8	4.6	21.6	15.4	30.6	4.6	
Iron	28900	16000	6980	19200	9290	9990	411000	
Lead	23.5 J	5.7 J	1.6 J	3.9 J	1.6 J	1.7 J	3.3 J	
Magnesium	4960	1300	518	1660	583	644	660	
Manganese	470 K	700	30.9	344	2010	151	636	
Mercury	0.12 B	0.05 U	0.05 U	0.05 U	0.19 B	0.05 U	0.05 U	
Nickel	17.1 J	9.1 J	3 UJ	11.5 J	8 J	3.6 UJ	4.1 J	
Potassium	3050	357	89.1	516	90.5	200	142	
Selenium	0.23 U	0.18 U	0.2 U	0.18 U	0.22 B	0.17 U	0.18 U	
Silver	0.24 UJ	1.1 B	0.19 UJ	0.23 B	0.32 B	0.19 UJ	0.22 UJ	
Sodium	115 B	86.7	84.7 B	65.6 B	74.1	78.9 B	55.2	
Thallium	0.26 U	0.37	0.4	0.36 U	0.44 U	0.35 U	0.36 U	
Vanadium	19.4 K	23.9	15.7	30.5	15.4	18.7	15.8	
Zinc	48.6	18	3.1 B	15.8	10.5	8 B	9	

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-11	BG-12	BG-13	BG-14	BG-16	BG-17	BG-18	BG-19
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,1,1-Trichloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,1,2,2-Tetrachloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,1,2-Trichloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,1-Dichloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,1-Dichloroethene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethene (Total)	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloropropane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
2-Butanone	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
2-Hexanone	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
4-Methyl-2-pentanone	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Acetone	12 U	12 U	1500 U	12 U	2 B	12 U	12 U	12 U
Benzene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Bromodichloromethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Bromoform	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Bromomethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	2 B
Carbon Disulfide	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Carbon Tetrachloride	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Chlorobenzene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Chloroethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Chloroform	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Chloromethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Dibromochloromethane	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Ethylbenzene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Methylene Chloride	12 U	12 U	1500 U	12 U	12 U	4 BJ	12 U	12 U
Styrene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Tetrachloroethene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-11	BG-12	BG-13	BG-14	BG-16	BG-17	BG-18	BG-19
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toluene	12 U	12 U	1500 U	12 U	12 U	2 J	12 U	12 U
Trichloroethene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Vinyl Chloride	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
Xylene (Total)	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
cis-1,3-Dichloropropene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U
trans-1,3-Dichloropropene	12 U	12 U	1500 U	12 U	12 U	12 U	12 U	12 U

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-20	BG-21	BG-22	BG-23	BG-23-D	BG-24	BG-25	BG-26
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,1,1-Trichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1,2,2-Tetrachloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1,2-Trichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1-Dichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1-Dichloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethene (Total)	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloropropane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
2-Butanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
2-Hexanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
4-Methyl-2-pentanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Acetone	12 U	12 U	12 U	12 U	10 J	12 J	9 J	12 U
Benzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Bromodichloromethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Bromoform	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Bromomethane	12 U	12 U	12 U	12 U	7 B	12 U	12 U	4 B
Carbon Disulfide	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Carbon Tetrachloride	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chlorobenzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chloroethane	2 B	3 B	3 B	12 U	12 U	12 U	12 U	12 U
Chloroform	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chloromethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	3 J
Dibromochloromethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Ethylbenzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Methylene Chloride	4 B	12 U	7 B	3 B	3 B	12 U	12 U	3 B
Styrene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Tetrachloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-20	BG-21	BG-22	BG-23	BG-23-D	BG-24	BG-25	BG-26
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toluene	12 U	2 J	2 J	12 U	12 U	12 U	12 U	12 U
Trichloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Vinyl Chloride	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Xylene (Total)	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
cis-1,3-Dichloropropene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
trans-1,3-Dichloropropene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-27	BG-28	BG-29	BG-30	--- --- ---	--- --- ---	--- --- ---	--- --- ---
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				
1,1,1-Trichloroethane	17 U	11 U	11 U	11 U				
1,1,2,2-Tetrachloroethane	17 U	11 U	11 U	11 U				
1,1,2-Trichloroethane	17 U	11 U	11 U	11 U				
1,1-Dichloroethane	17 U	11 U	11 U	11 U				
1,1-Dichloroethene	17 U	11 U	11 U	11 U				
1,2-Dichloroethane	17 U	11 U	11 U	11 U				
1,2-Dichloroethene (Total)	17 U	11 U	11 U	11 U				
1,2-Dichloropropane	17 U	11 U	11 U	11 U				
2-Butanone	17 U	11 U	11 U	11 U				
2-Hexanone	17 U	11 U	11 U	11 U				
4-Methyl-2-pentanone	17 U	11 U	11 U	11 U				
Acetone	17 U	11 U	8 J	11 U				
Benzene	17 U	11 U	11 U	11 U				
Bromodichloromethane	17 U	11 U	11 U	11 U				
Bromoform	17 U	11 U	11 U	11 U				
Bromomethane	17 U	11 U	3 B	11 U				
Carbon Disulfide	17 U	11 U	11 U	11 U				
Carbon Tetrachloride	17 U	11 U	11 U	11 U				
Chlorobenzene	17 U	11 U	11 U	11 U				
Chloroethane	17 U	11 U	11 U	11 U				
Chloroform	17 U	11 U	11 U	11 U				
Chloromethane	3 J	11 U	11 U	11 U				
Dibromochloromethane	17 U	11 U	11 U	11 U				
Ethylbenzene	17 U	11 U	11 U	11 U				
Methylene Chloride	5 B	11 U	11 U	11 U				
Styrene	17 U	11 U	11 U	11 U				
Tetrachloroethene	17 U	11 U	11 U	11 U				

TABLE A-1.2

ANALYTICAL RESULTS FOR VOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	BG-27	BG-28	BG-29	BG-30	---	---	---	---
SAMPLE DATE:					---	---	---	---
STATUS:					---	---	---	---
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				
Toluene	17 U	11 U	11 U	11 U				
Trichloroethene	17 U	11 U	11 U	11 U				
Vinyl Chloride	17 U	11 U	11 U	11 U				
Xylene (Total)	17 U	11 U	11 U	11 U				
cis-1,3-Dichloropropene	17 U	11 U	11 U	11 U				
trans-1,3-Dichloropropene	17 U	11 U	11 U	11 U				

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-11	BG-12	BG-13	BG-14	BG-16	BG-17	BG-18	BG-19
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,4-Trichlorobenzene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
1,2-Dichlorobenzene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
1,3-Dichlorobenzene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
1,4-Dichlorobenzene	43 J	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,2'-Oxybis(1-chloropropane)	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,4,5-Trichlorophenol	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
2,4,6-Trichlorophenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,4-Dichlorophenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,4-Dimethylphenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,4-Dinitrophenol	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
2,4-Dinitrotoluene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2,6-Dinitrotoluene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2-Chloronaphthalene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2-Chlorophenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2-Methylnaphthalene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2-Methylphenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
2-Nitroaniline	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
2-Nitrophenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
3,3'-Dichlorobenzidine	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
3-Nitroaniline	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
4,6-Dinitro-2-methylphenol	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
4-Bromophenyl Phenyl Ether	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
4-Chloro-3-methylphenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
4-Chloroaniline	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
4-Chlorophenyl Phenyl Ether	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
4-Methylphenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
4-Nitroaniline	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-11	BG-12	BG-13	BG-14	BG-16	BG-17	BG-18	BG-19
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4-Nitrophenol	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
Acenaphthene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Acenaphthylene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Anthracene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Benz(a)anthracene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Benzo(a)pyrene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Benzo(b)fluoranthene	390 U	380 U	58 J	400 U	400 UJ	400 U	420 U	390 U
Benzo(g,h,i)perylene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Benzo(k)fluoranthene	390 U	380 U	46 J	400 U	400 UJ	400 U	420 U	390 U
Bis(2-chloroethoxy)methane	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Bis(2-chloroethyl)ether	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Bis(2-ethylhexyl)phthalate	390 U	380 U	68 UQ	52 UQ	50 J	400 U	420 U	390 U
Butylbenzylphthalate	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Carbazole	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Chrysene	390 U	380 U	51 J	400 U	400 UJ	400 U	420 U	390 U
Di-n-butylphthalate	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Di-n-octylphthalate	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Dibenz(a,h)anthracene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Dibenzofuran	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Diethylphthalate	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Dimethylphthalate	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Fluoranthene	390 U	380 U	92 J	400 U	400 UJ	400 U	420 U	390 U
Fluorene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Hexachlorobenzene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Hexachlorobutadiene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Hexachlorocyclopentadiene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Hexachloroethane	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-11	BG-12	BG-13	BG-14	BG-16	BG-17	BG-18	BG-19
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Indeno(1,2,3-cd)pyrene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Isophorone	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
N-Nitroso-di-n-propylamine	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
N-Nitrosodiphenylamine	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Naphthalene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Nitrobenzene	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Pentachlorophenol	960 U	930 U	970 U	980 U	990 UJ	970 U	1000 U	950 U
Phenanthrene	390 U	380 U	51 J	400 U	400 UJ	400 U	420 U	390 U
Phenol	390 U	380 U	400 U	400 U	400 UJ	400 U	420 U	390 U
Pyrene	390 U	380 U	100 J	400 U	400 UJ	400 U	420 U	390 U

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	BG-20	BG-21	BG-22	---	---	---	---	---
SAMPLE DATE:				---	---	---	---	---
STATUS:				---	---	---	---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**					
1,2,4-Trichlorobenzene	400 U	390 U	390 U					
1,2-Dichlorobenzene	400 U	390 U	390 U					
1,3-Dichlorobenzene	400 U	390 U	390 U					
1,4-Dichlorobenzene	400 U	390 U	390 U					
2,2'-Oxybis(1-chloropropane)	400 U	390 U	390 U					
2,4,5-Trichlorophenol	970 U	940 U	940 U					
2,4,6-Trichlorophenol	400 U	390 U	390 U					
2,4-Dichlorophenol	400 U	390 U	390 U					
2,4-Dimethylphenol	400 U	390 U	390 U					
2,4-Dinitrophenol	970 U	940 U	940 U					
2,4-Dinitrotoluene	400 U	390 U	390 U					
2,6-Dinitrotoluene	400 U	390 U	390 U					
2-Chloronaphthalene	400 U	390 U	390 U					
2-Chlorophenol	400 U	390 U	390 U					
2-Methylnaphthalene	400 U	390 U	390 U					
2-Methylphenol	400 U	390 U	390 U					
2-Nitroaniline	970 U	940 U	940 U					
2-Nitrophenol	400 U	390 U	390 U					
3,3'-Dichlorobenzidine	400 U	390 U	390 U					
3-Nitroaniline	970 U	940 U	940 U					
4,6-Dinitro-2-methylphenol	970 U	940 U	940 U					
4-Bromophenyl Phenyl Ether	400 U	390 U	390 U					
4-Chloro-3-methylphenol	400 U	390 U	390 U					
4-Chloroaniline	400 U	390 U	390 U					
4-Chlorophenyl Phenyl Ether	400 U	390 U	390 U					
4-Methylphenol	400 U	390 U	390 U					
4-Nitroaniline	970 U	940 U	940 U					

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 5

SAMPLE I.D.:	BG-20	BG-21	BG-22	---	---	---	---	---
SAMPLE DATE:				---	---	---	---	---
STATUS:				---	---	---	---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**					
4-Nitrophenol	970 U	940 U	940 U					
Acenaphthene	400 U	390 U	390 U					
Acenaphthylene	400 U	390 U	390 U					
Anthracene	400 U	390 U	390 U					
Benz(a)anthracene	400 U	390 U	390 U					
Benzo(a)pyrene	400 U	390 U	390 U					
Benzo(b)fluoranthene	400 U	390 U	390 U					
Benzo(g,h,i)perylene	400 U	390 U	390 U					
Benzo(k)fluoranthene	400 U	390 U	390 U					
Bis(2-chloroethoxy)methane	400 U	390 U	390 U					
Bis(2-chloroethyl)ether	400 U	390 U	390 U					
Bis(2-ethylhexyl)phthalate	400 U	390 U	390 U					
Butylbenzylphthalate	400 U	390 U	390 U					
Carbazole	400 U	390 U	390 U					
Chrysene	400 U	390 U	390 U					
Di-n-butylphthalate	400 U	390 U	390 U					
Di-n-octylphthalate	400 U	390 U	390 U					
Dibenz(a,h)anthracene	400 U	390 U	390 U					
Dibenzofuran	400 U	390 U	390 U					
Diethylphthalate	400 U	390 U	390 U					
Dimethylphthalate	400 U	390 U	390 U					
Fluoranthene	400 U	390 U	390 U					
Fluorene	400 U	390 U	390 U					
Hexachlorobenzene	400 U	390 U	390 U					
Hexachlorobutadiene	400 U	390 U	390 U					
Hexachlorocyclopentadiene	400 U	390 U	390 U					
Hexachloroethane	400 U	390 U	390 U					

TABLE A-1.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	BG-20	BG-21	BG-22	---	---	---	---	---
SAMPLE DATE:				---	---	---	---	---
STATUS:				---	---	---	---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**					
Indeno(1,2,3-cd)pyrene	400 U	390 U	390 U					
Isophorone	400 U	390 U	390 U					
N-Nitroso-di-n-propylamine	400 U	390 U	390 U					
N-Nitrosodiphenylamine	400 U	390 U	390 U					
Naphthalene	400 U	390 U	390 U					
Nitrobenzene	400 U	390 U	390 U					
Pentachlorophenol	970 U	940 U	940 U					
Phenanthrene	400 U	390 U	390 U					
Phenol	400 U	390 U	390 U					
Pyrene	400 U	390 U	390 U					

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-01	BG-02	BG-03	BG-03-D	BG-05	BG-06	BG-07	BG-08
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDD	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
4,4'-DDE	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
4,4'-DDT	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Aldrin	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Alpha-BHC	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Alpha-Chlordane	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Aroclor-1016	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Aroclor-1221	81 UJ	82 UJ	83 UJ	81 UJ	80 UJ	82 UJ	84 UJ	80 UJ
Aroclor-1232	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Aroclor-1242	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Aroclor-1248	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Aroclor-1254	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Aroclor-1260	40 UJ	40 UJ	41 UJ	40 UJ	39 UJ	41 UJ	41 UJ	39 UJ
Beta-BHC	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Delta-BHC	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Dieldrin	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Endosulfan I	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Endosulfan II	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Endosulfan Sulfate	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Endrin	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Endrin Aldehyde	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Endrin Ketone	4 UJ	4 UJ	4.1 UJ	4 UJ	3.9 UJ	4.1 UJ	4.1 UJ	3.9 UJ
Gamma-BHC (Lindane)	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Gamma-Chlordane	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Heptachlor	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Heptachlor Epoxide	2.1 UJ	2.1 UJ	2.1 UJ	2.1 UJ	2 UJ	2.1 UJ	2.1 UJ	2 UJ
Methoxychlor	21 UJ	21 UJ	21 UJ	21 UJ	20 UJ	21 UJ	21 UJ	20 UJ

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	BG-01	BG-02	BG-03	BG-03-D	BG-05	BG-06	BG-07	BG-08
SAMPLE DATE:								
STATUS:								
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toxaphene	210 UJ	210 UJ	210 UJ	210 UJ	200 UJ	210 UJ	210 UJ	200 UJ

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-09	BG-10	BG-11	BG-12	BG-13	BG-14	BG-15	BG-16
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDD	3.9 UR	4 U	4 U	16 JP	4 U	4 U	4 UJ	3.9 UJ
4,4'-DDE	3.9 UR	4 U	4 U	820	4 U	4 U	4 UJ	3.9 UJ
4,4'-DDT	3.9 UR	4 U	4 U	1440 JP	4 U	4 U	4 UJ	3.9 UJ
Aldrin	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Alpha-BHC	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Alpha-Chlordane	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Aroclor-1016	39 UR	40 U	40 U	760 U	40 U	40 U	40 UJ	39 UJ
Aroclor-1221	79 UR	81 U	81 U	1600 U	81 U	82 U	81 UJ	79 UJ
Aroclor-1232	39 UR	40 U	40 U	760 U	40 U	40 U	40 UJ	39 UJ
Aroclor-1242	39 UR	40 U	40 U	760 U	40 U	40 U	40 UJ	39 UJ
Aroclor-1248	39 UR	40 U	40 U	760 U	40 U	40 U	40 UJ	39 UJ
Aroclor-1254	39 UR	40 U	40 U	760 U	51	40 U	40 UJ	39 UJ
Aroclor-1260	39 UR	40 U	40 U	760 U	40 U	40 U	40 UJ	39 UJ
Beta-BHC	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Delta-BHC	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Dieldrin	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Endosulfan I	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Endosulfan II	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Endosulfan Sulfate	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Endrin	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Endrin Aldehyde	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Endrin Ketone	3.9 UR	4 U	4 U	76 U	4 U	4 U	4 UJ	3.9 UJ
Gamma-BHC (Lindane)	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Gamma-Chlordane	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Heptachlor	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Heptachlor Epoxide	2 UR	2 U	2 U	39 U	2.1 U	2.1 U	2.1 UJ	2 UJ
Methoxychlor	20 UR	20 U	20 U	390 U	21 U	21 U	21 UJ	20 UJ

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-09	BG-10	BG-11	BG-12	BG-13	BG-14	BG-15	BG-16
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toxaphene	200 UR	200 U	200 U	3900 U	210 U	210 U	210 UJ	200 UJ

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 5

SAMPLE I.D.: SAMPLE DATE: STATUS:	BG-17	BG-18	BG-19	BG-20	BG-21	BG-22	--- --- ---	--- --- ---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		
4,4'-DDD	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
4,4'-DDE	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
4,4'-DDT	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Aldrin	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Alpha-BHC	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Alpha-Chlordane	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Aroclor-1016	40 U	42 U	39 UL	40 U	39 U	39 U		
Aroclor-1221	81 U	86 U	79 UL	81 U	79 U	79 U		
Aroclor-1232	40 U	42 U	39 UL	40 U	39 U	39 U		
Aroclor-1242	40 U	42 U	39 UL	40 U	39 U	39 U		
Aroclor-1248	40 U	42 U	39 UL	40 U	39 U	39 U		
Aroclor-1254	40 U	42 U	39 UL	40 U	39 U	39 U		
Aroclor-1260	40 U	42 U	39 UL	40 U	39 U	39 U		
Beta-BHC	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Delta-BHC	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Dieldrin	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Endosulfan I	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Endosulfan II	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Endosulfan Sulfate	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Endrin	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Endrin Aldehyde	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Endrin Ketone	4 U	4.2 U	3.9 UL	4 U	3.9 U	3.9 U		
Gamma-BHC (Lindane)	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Gamma-Chlordane	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Heptachlor	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Heptachlor Epoxide	2.1 U	2.2 U	2 UL	2.1 U	2 U	2 U		
Methoxychlor	21 U	22 U	20 UL	21 U	21 U	21 U		

TABLE A-1.4

ANALYTICAL RESULTS FOR PESTICIDES - BACKGROUND SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 6

SAMPLE I.D.:	BG-17	BG-18	BG-19	BG-20	BG-21	BG-22	---	---
SAMPLE DATE:							---	---
STATUS:							---	---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		
Toxaphene	210 U	220 U	200 UL	210 U	200 U	200 U		

A-2 Site 8 Surface Soil

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	11500	13300	12600	11200	12700	11800	9940	12100
Antimony	6.2 U	5.8 U	5.9 U	5.8 U	5.6 U	5.7 UJ	5.9 UJ	5.8 U
Arsenic	6.2	4.7	5.4	3.9	4.6	4.7	2	4.4
Barium	70.7	43.9	59.6	47.4	66.1	65.2	80.5	71.6
Beryllium	0.82	0.62	0.77	0.75	0.86	0.81	1.1	0.9
Cadmium	0.57 UL	0.74 L	0.57 L	0.53 L	0.51 UL	0.52 UL	0.54 UL	0.53 UL
Calcium	1100	1580	1210	1480	1280	813	1710	1020
Chromium	15.2	16	17.4	11.8 L	16.5	15.5	13	13.2
Cobalt	7.5	10.5	8.5	10.5	7.5	7.8	8.9	10.5
Copper	7.7	26.4	10.5	7.6	6.1	7.5	4.3	7.6
Cyanide	1.1 U	1.1 U	1 U	1.2 U	1.1 U	1.2 U	1.2 U	1.2 U
Iron	15200	18500	18400	15500	16700	15700	14000	14700
Lead	12.9	19.3	11	10.9	11.7	11.6	11.4	11.8
Magnesium	1840	2760	2550	2610	2500	2210	3410	2370
Manganese	511	322	303	341	316	379	247	636
Mercury	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.06 UL	0.1	0.05 U	0.06 UL
Nickel	9.1	10.7	10.8	9.4	10.2	9.7	13.8	13.2
Potassium	436	947	764	721	918	551	1320	661
Selenium	0.75 U	0.71 U	0.72 U	0.71 U	0.68 U	0.69 U	0.72 U	0.71 U
Silver	0.75 UL	0.71 UL	0.72 UL	0.71 UL	0.68 UL	0.69 UL	0.72 UL	0.71 UL
Sodium	76.4 B	64.7 B	68.9 B	75.1 B	119 B	74	61.1	59.1 B
Thallium	0.94 U	0.88 U	0.9 U	0.88 U	0.85 U	0.87 U	0.9 U	0.88 U
Vanadium	24.4	26.4	27.6	22.7	23.4	26.6	19.3	21.3
Zinc	26.3	34.6	28.2	27.5	28.2	24.9	33.6	28.6

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-12	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95
STATUS:				Excavated	Excavated			
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	14600	11200	10400	9000	9560	11100	11400	10300
Antimony	6.2 U	8.9 UL	8.8 UL	13.7 B	9.5 UR	9.5 UL	9.4 UL	9.4 UL
Arsenic	6.4	4.2	3.6	33.4	10.9	4.7	5	13.9
Barium	42.3	79.3	120	57.3	58.3	101	107	65.4
Beryllium	0.65	0.71	0.65	0.54	0.6	0.77	0.74	0.74
Cadmium	0.57 UL	6.3	5	12.9	10.3	3.8	3.8	3.5
Calcium	776	13400	14200	45500	43400	19500	16400	18900
Chromium	20.8	30.3	30.3	38.9 J	26.2 J	46.1	38.1	18.7
Cobalt	8.6	5.9	6.9	6.8	5.5	5.4	6.1	6.6
Copper	11.9	92.8 J	55 J	49.5	25.8	58.1 L	38.1 L	27.4 L
Cyanide	1.2 U	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Iron	23200	18100	16500	15600	13100	13000	14600	14700
Lead	9.4	163	159	999	759	300	300	204
Magnesium	2670	8900	9570	28400	27100	12100	10300	12100
Manganese	263	407 L	406 L	363	412	431	423	434
Mercury	0.06 UL	0.06 L	0.07 L	0.15 L	0.06 L	0.07 B	0.09 B	0.07 B
Nickel	9.5	11.3 B	14.1 B	25.9	14.1	11.7 B	14.8 B	11.2 B
Potassium	693	560	625	469	482	491	604	501
Selenium	0.76 U	0.63 U	0.63 U	1 K	0.76 K	0.68 U	0.72 K	0.7 K
Silver	0.76 UL	0.85 UL	0.84 UL	0.88 U	0.91 U	0.91 UL	0.9 UL	0.9 UL
Sodium	51.9 B	70.9	79.7	87.8	130	74.2 B	70.7 B	74.9 B
Thallium	0.94 U	0.63 U	0.63 U	0.66 U	0.68 U	0.68 U	0.67 U	0.67 U
Vanadium	36.3	35.6	36.9	71.4	41.5	27.6	29.2	28.2
Zinc	29.2	176	184	1790	857	455	366	269

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SS-08-17	SS-08-18	SS-08-19	SS-08-20	SS-08-21	SS-08-22	SS-08-23	SS-08-23-D
SAMPLE DATE:	06/19/92	06/19/92	07/20/98	07/20/98	09/29/98	09/29/98	09/29/98	09/29/98
STATUS:					Excavated	Excavated	Excavated	Excavated
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	15200	14200 J	n/a	n/a	n/a	n/a	n/a	n/a
Antimony	8.8 UL	11.8 UJ	n/a	n/a	n/a	n/a	n/a	n/a
Arsenic	4.4 L	3.5 L	11	6.9	17.6	10.6	n/a	n/a
Barium	124	96.7	n/a	n/a	n/a	n/a	n/a	n/a
Beryllium	1.1 B	1.2 B	n/a	n/a	n/a	n/a	n/a	n/a
Cadmium	6.1 K	3.1 B	n/a	n/a	n/a	n/a	n/a	n/a
Calcium	4920 B	3040 J	n/a	n/a	n/a	n/a	n/a	n/a
Chromium	23.5	19.5 J	n/a	n/a	n/a	n/a	n/a	n/a
Cobalt	10 K	8.9 B	n/a	n/a	n/a	n/a	n/a	n/a
Copper	59.1 K	35.1 J	n/a	n/a	n/a	n/a	n/a	n/a
Cyanide	1.8 UL	2.3 U	n/a	n/a	n/a	n/a	n/a	n/a
Iron	25500	19100	n/a	n/a	n/a	n/a	n/a	n/a
Lead	61.4 J	40.4 K	161 N	341 N	3130 N	1560 N	2100	1940
Magnesium	4530 B	3050 J	n/a	n/a	n/a	n/a	n/a	n/a
Manganese	690	722 J	n/a	n/a	n/a	n/a	n/a	n/a
Mercury	0.1 U	0.11 UJ	n/a	n/a	n/a	n/a	n/a	n/a
Nickel	20.8 B	11.3 B	n/a	n/a	n/a	n/a	n/a	n/a
Potassium	1840	574	n/a	n/a	n/a	n/a	n/a	n/a
Selenium	0.94 UL	1.2 UJ	n/a	n/a	n/a	n/a	n/a	n/a
Silver	1.8 U	2.4 U	n/a	n/a	n/a	n/a	n/a	n/a
Sodium	772	1110 J	n/a	n/a	n/a	n/a	n/a	n/a
Thallium	0.38 U	0.47 R	n/a	n/a	n/a	n/a	n/a	n/a
Vanadium	36.4 K	29.8	n/a	n/a	n/a	n/a	n/a	n/a
Zinc	105	86.6 J	n/a	n/a	n/a	n/a	n/a	n/a

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	SS-08-24	SS-08-25	SS-08-26	SS-08-28	SS-08-28-D	SS-08-30	SS-08-31	SS-08-32
SAMPLE DATE:	09/29/98	09/29/98	09/29/98	07/20/98	07/20/98	07/20/98	02/15/99	02/15/99
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	n/a	n/a	n/a	12000	16300	10600	n/a	n/a
Antimony	n/a	n/a	n/a	9.1 U	9.1 U	9 U	n/a	n/a
Arsenic	n/a	n/a	n/a	4.8	4.5	4.7	5.9	6.3
Barium	n/a	n/a	n/a	58.9	71.7	65.5	n/a	n/a
Beryllium	n/a	n/a	n/a	0.75 B	0.99 B	0.76 B	n/a	n/a
Cadmium	n/a	n/a	n/a	0.97 U	0.98 U	1.7	n/a	n/a
Calcium	n/a	n/a	n/a	4150	1820	3900	n/a	n/a
Chromium	n/a	n/a	n/a	18.8	24.9	20.5	n/a	n/a
Cobalt	n/a	n/a	n/a	11.4	12.3	9.7 B	n/a	n/a
Copper	n/a	n/a	n/a	12.5	13.6	14.7	n/a	n/a
Iron	n/a	n/a	n/a	19300	25800	18200	n/a	n/a
Lead	487	125	164	16.4	15.3	61.1	131 K	27.8 K
Magnesium	n/a	n/a	n/a	4140	3450	3580	n/a	n/a
Manganese	n/a	n/a	n/a	477	459	458	n/a	n/a
Mercury	n/a	n/a	n/a	0.11 U	0.11 U	0.11 U	n/a	n/a
Nickel	n/a	n/a	n/a	10.5	15.7	11.6	n/a	n/a
Potassium	n/a	n/a	n/a	836 B	1620	873 B	n/a	n/a
Selenium	n/a	n/a	n/a	1.1 B	0.83 U	0.82 U	n/a	n/a
Silver	n/a	n/a	n/a	0.84 B	0.68 U	0.69 B	n/a	n/a
Sodium	n/a	n/a	n/a	85.7 B	114 B	359 B	n/a	n/a
Thallium	n/a	n/a	n/a	1.7 B	1.4 B	1.1 U	n/a	n/a
Vanadium	n/a	n/a	n/a	28.9	34.6	32	n/a	n/a
Zinc	n/a	n/a	n/a	52	56.4	111	n/a	n/a

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	SS-08-33	SS-08-33-D	SS-08-34	SS-08-35	SS-08-36	SS-08-37	SS-08-38	SS-08-39
SAMPLE DATE:	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Arsenic	5.5	5.1	6.6	5.9	7.4	7.3	9	6.4
Lead	24.3 K	34.8 K	93.5 K	64.2 K	44.3 K	102 K	732 K	131 K

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 6

SAMPLE I.D.:	SS-08-40	SS-08-41	SS-08-42	SS-08-43	SS-08-44	SS-08-45	SS-08-47	SS-08-52
SAMPLE DATE:	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	02/15/99	03/09/99
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Arsenic	4.7	6.5	6.8	8.2	7.5	8.3	6.2	4.8 K
Lead	63.2 K	20.1 K	18.4 K	115 K	475 K	181 K	69.5 K	137
Vanadium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	34.2 J

TABLE A-2.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	SS-08-52-D	SS-08-53	SS-08-54	SS-08-55	---	---	---	---
SAMPLE DATE:	03/09/99	03/09/99	03/09/99	03/09/99	---	---	---	---
STATUS:					---	---	---	---
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**				
Arsenic	5.7	5.8	4.2 K	6.3				
Lead	176	128	15.1	36.8				
Vanadium	30.6 J	45.8 J	31.3 J	38.6 J				

TABLE A-2.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,1,1-Trichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
1,1,2,2-Tetrachloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
1,1,2-Trichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
1,1-Dichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,1-Dichloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloroethene (Total)	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
1,2-Dichloropropane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
2-Butanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
2-Hexanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
4-Methyl-2-pentanone	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Acetone	12 U	21 B	12 U	12 U	12 U	12 U	12 U	12 U
Benzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Bromodichloromethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Bromoform	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Bromomethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Carbon Disulfide	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Carbon Tetrachloride	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Chlorobenzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Chloroethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chloroform	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Chloromethane	12 U	3 B	12 U	12 U	12 U	12 U	12 U	12 U
Dibromochloromethane	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Ethylbenzene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Methylene Chloride	8 B	14 B	16 B	22 B	17 B	12 U	12 U	8 B
Styrene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Tetrachloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	3 J

TABLE A-2.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toluene	2 J	12 U	2 J	12 U	3 J	3 J	12 U	3 J
Trichloroethene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
Vinyl Chloride	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U
Xylene (Total)	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
cis-1,3-Dichloropropene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ
trans-1,3-Dichloropropene	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UJ

TABLE A-2.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SS-08-09	SS-08-12	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16	SS-08-17	SS-08-18
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95	06/19/92	06/19/92
STATUS:		Excavated	Excavated					
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,1,1-Trichloroethane	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
1,1,2,2-Tetrachloroethane	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
1,1,2-Trichloroethane	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
1,1-Dichloroethane	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
1,1-Dichloroethene	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
1,2-Dichloroethane	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
1,2-Dichloroethene (Total)	12 U	14 U	n/a	13 U	13 U	12 U	11 U	12 U
1,2-Dichloropropane	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
2-Butanone	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
2-Hexanone	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
4-Methyl-2-pentanone	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
Acetone	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 UJ
Benzene	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Bromodichloromethane	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Bromoform	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Bromomethane	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Carbon Disulfide	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Carbon Tetrachloride	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Chlorobenzene	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
Chloroethane	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Chloroform	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Chloromethane	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Dibromochloromethane	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Ethylbenzene	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
Methylene Chloride	5 B	35 B	12 B	8 B	7 J	7 J	11 U	12 U
Styrene	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
Tetrachloroethene	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U

TABLE A-2.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	SS-08-09	SS-08-12	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16	SS-08-17	SS-08-18
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95	06/19/92	06/19/92
STATUS:		Excavated	Excavated					
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toluene	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
Trichloroethene	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
Vinyl Chloride	12 U	14 U	14 U	13 U	13 U	12 U	11 U	12 U
Xylene (Total)	12 U	14 UJ	14 UJ	13 UJ	13 U	12 U	11 U	12 U
cis-1,3-Dichloropropene	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U
trans-1,3-Dichloropropene	12 U	14 UJ	14 U	13 UJ	13 U	12 U	11 U	12 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,4-Trichlorobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
1,2-Dichlorobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
1,3-Dichlorobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
1,4-Dichlorobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,2'-Oxybis(1-chloropropane)	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,4,5-Trichlorophenol	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
2,4,6-Trichlorophenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,4-Dichlorophenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,4-Dimethylphenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,4-Dinitrophenol	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
2,4-Dinitrotoluene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2,6-Dinitrotoluene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2-Chloronaphthalene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2-Chlorophenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2-Methylnaphthalene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2-Methylphenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
2-Nitroaniline	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
2-Nitrophenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
3,3'-Dichlorobenzidine	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
3-Nitroaniline	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
4,6-Dinitro-2-methylphenol	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
4-Bromophenyl Phenyl Ether	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
4-Chloro-3-methylphenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
4-Chloroaniline	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
4-Chlorophenyl Phenyl Ether	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
4-Methylphenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
4-Nitroaniline	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4-Nitrophenol	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
Acenaphthene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Acenaphthylene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Anthracene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Benz(a)anthracene	92 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Benzo(a)pyrene	79 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Benzo(b)fluoranthene	120 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Benzo(g,h,i)perylene	68 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Benzo(k)fluoranthene	58 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Bis(2-chloroethoxy)methane	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Bis(2-chloroethyl)ether	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Bis(2-ethylhexyl)phthalate	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Butylbenzylphthalate	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Carbazole	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Chrysene	77 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Di-n-butylphthalate	56 B	77 B	80 B	78 B	77 B	58 B	39 B	75 B
Di-n-octylphthalate	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Dibenz(a,h)anthracene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Dibenzofuran	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Diethylphthalate	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Dimethylphthalate	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Fluoranthene	150 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Fluorene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Hexachlorobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Hexachlorobutadiene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Hexachlorocyclopentadiene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Hexachloroethane	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Indeno(1,2,3-cd)pyrene	61 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Isophorone	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
N-Nitroso-di-n-propylamine	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
N-Nitrosodiphenylamine	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Naphthalene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Nitrobenzene	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Pentachlorophenol	960 U	930 U	950 U	940 U	900 U	970 U	940 U	970 U
Phenanthrene	72 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Phenol	400 U	380 U	390 U	390 U	370 U	400 U	390 U	400 U
Pyrene	140 J	380 U	390 U	390 U	370 U	400 U	390 U	400 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16	SS-08-17
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95	06/19/92
STATUS:				Excavated				
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,4-Trichlorobenzene	380 U	420 U	4100 U	n/a	410 UJ	410 UJ	400 UJ	360 U
1,2-Dichlorobenzene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
1,3-Dichlorobenzene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
1,4-Dichlorobenzene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,2'-Oxybis(1-chloropropane)	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,4,5-Trichlorophenol	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
2,4,6-Trichlorophenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,4-Dichlorophenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,4-Dimethylphenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,4-Dinitrophenol	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
2,4-Dinitrotoluene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2,6-Dinitrotoluene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2-Chloronaphthalene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2-Chlorophenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2-Methylnaphthalene	380 U	130 J	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2-Methylphenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
2-Nitroaniline	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
2-Nitrophenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
3,3'-Dichlorobenzidine	380 U	420 U	4100 U	2200 UJ	410 UJ	410 UJ	400 UJ	360 U
3-Nitroaniline	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
4,6-Dinitro-2-methylphenol	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
4-Bromophenyl Phenyl Ether	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
4-Chloro-3-methylphenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
4-Chloroaniline	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
4-Chlorophenyl Phenyl Ether	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
4-Methylphenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
4-Nitroaniline	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16	SS-08-17
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95	06/19/92
STATUS:				Excavated				
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4-Nitrophenol	930 U	1000 U	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
Acenaphthene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	420 U
Acenaphthylene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Anthracene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	590
Benz(a)anthracene	380 U	130 J	4100 U	410 J	330 J	270 J	150 J	980
Benzo(a)pyrene	380 U	180 J	4100 U	570 J	480	400 J	200 J	930
Benzo(b)fluoranthene	380 U	350 J	4100 U	940 J	820	680 J	310 J	1600
Benzo(g,h,i)perylene	380 U	160 J	4100 U	2200 U	410 UJ	410 UJ	400 UJ	410
Benzo(k)fluoranthene	380 U	97 J	4100 U	470 J	270 J	180 J	140 J	360 U
Bis(2-chloroethoxy)methane	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Bis(2-chloroethyl)ether	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Bis(2-ethylhexyl)phthalate	380 U	1400 B	480 BJ	650 B	1700 J	1800 J	310 B	100 BJ
Butylbenzylphthalate	380 U	420 U	4100 U	2200 U	600	400 J	400 UJ	360 U
Carbazole	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	310 J
Chrysene	380 U	160 J	4100 U	910 J	830 J	690 J	280 J	980
Di-n-butylphthalate	45 B	54 J	4100 U	2200 U	50 J	410 UJ	400 UJ	360 U
Di-n-octylphthalate	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Dibenz(a,h)anthracene	380 U	420 U	4100 U	2200 U	78 J	55 J	400 UJ	120 J
Dibenzofuran	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	290 U
Diethylphthalate	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Dimethylphthalate	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Fluoranthene	380 U	220 J	4100 U	1200 J	790 J	660 J	400 J	2000
Fluorene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	540
Hexachlorobenzene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Hexachlorobutadiene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Hexachlorocyclopentadiene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Hexachloroethane	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 6

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16	SS-08-17
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95	06/19/92
STATUS:				Excavated				
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Indeno(1,2,3-cd)pyrene	380 U	130 J	4100 U	2200 U	410 UJ	410 UJ	400 UJ	410
Isophorone	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
N-Nitroso-di-n-propylamine	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
N-Nitrosodiphenylamine	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Naphthalene	380 U	56 J	4100 U	2200 U	410 UJ	410 UJ	400 UJ	48 J
Nitrobenzene	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Pentachlorophenol	930 U	43 J	10000 U	5400 U	990 UJ	1000 UJ	960 UJ	880 U
Phenanthrene	380 U	130 J	4100 U	450 J	330 J	430 J	180 J	2100
Phenol	380 U	420 U	4100 U	2200 U	410 UJ	410 UJ	400 UJ	360 U
Pyrene	380 U	250 J	4100 U	930 J	770	600 J	360 J	1600
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2-Dichloroethene (Total)	n/a	n/a	n/a	14 U	n/a	n/a	n/a	n/a

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	SS-08-18	SS-08-52	SS-08-52-D	SS-08-53	SS-08-54	SS-08-55	---	---
SAMPLE DATE:	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	03/09/99	---	---
STATUS:							---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		
1,2,4-Trichlorobenzene	390 B	n/a	n/a	n/a	n/a	n/a		
1,2-Dichlorobenzene	370 B	n/a	n/a	n/a	n/a	n/a		
1,3-Dichlorobenzene	400 U	n/a	n/a	n/a	n/a	n/a		
1,4-Dichlorobenzene	43	n/a	n/a	n/a	n/a	n/a		
2,2'-Oxybis(1-chloropropane)	400 U	n/a	n/a	n/a	n/a	n/a		
2,4,5-Trichlorophenol	960 U	n/a	n/a	n/a	n/a	n/a		
2,4,6-Trichlorophenol	400 U	n/a	n/a	n/a	n/a	n/a		
2,4-Dichlorophenol	400 U	n/a	n/a	n/a	n/a	n/a		
2,4-Dimethylphenol	400 U	n/a	n/a	n/a	n/a	n/a		
2,4-Dinitrophenol	960 U	n/a	n/a	n/a	n/a	n/a		
2,4-Dinitrotoluene	400 U	n/a	n/a	n/a	n/a	n/a		
2,6-Dinitrotoluene	400 U	n/a	n/a	n/a	n/a	n/a		
2-Chloronaphthalene	400 U	n/a	n/a	n/a	n/a	n/a		
2-Chlorophenol	400 U	n/a	n/a	n/a	n/a	n/a		
2-Methylnaphthalene	400 U	440 U	430 U	840 U	410 U	430 U		
2-Methylphenol	400 U	n/a	n/a	n/a	n/a	n/a		
2-Nitroaniline	960 U	n/a	n/a	n/a	n/a	n/a		
2-Nitrophenol	400 U	n/a	n/a	n/a	n/a	n/a		
3,3'-Dichlorobenzidine	400 U	n/a	n/a	n/a	n/a	n/a		
3-Nitroaniline	960 U	n/a	n/a	n/a	n/a	n/a		
4,6-Dinitro-2-methylphenol	960 U	n/a	n/a	n/a	n/a	n/a		
4-Bromophenyl Phenyl Ether	400 U	n/a	n/a	n/a	n/a	n/a		
4-Chloro-3-methylphenol	400 U	n/a	n/a	n/a	n/a	n/a		
4-Chloroaniline	400 U	n/a	n/a	n/a	n/a	n/a		
4-Chlorophenyl Phenyl Ether	400 U	n/a	n/a	n/a	n/a	n/a		
4-Methylphenol	400 U	n/a	n/a	n/a	n/a	n/a		
4-Nitroaniline	960 U	n/a	n/a	n/a	n/a	n/a		

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 8

SAMPLE I.D.:	SS-08-18	SS-08-52	SS-08-52-D	SS-08-53	SS-08-54	SS-08-55	---	---
SAMPLE DATE:	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	03/09/99	---	---
STATUS:							---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		
4-Nitrophenol	960 U	n/a	n/a	n/a	n/a	n/a		
Acenaphthene	400 U	440 U	430 U	840 U	410 U	430 U		
Acenaphthylene	400 U	440 U	430 U	840 U	410 U	430 U		
Anthracene	400 U	440 U	430 U	840 U	410 U	430 U		
Benz(a)anthracene	80 J	170 J	210 J	150 J	89 J	160 J		
Benzo(a)pyrene	110 J	170 J	150 J	170 J	110 J	180 J		
Benzo(b)fluoranthene	140 J	280 J	260 J	170 J	130 J	210 J		
Benzo(g,h,i)perylene	70 J	95 J	90 J	100 J	61 J	98 J		
Benzo(k)fluoranthene	100 J	130 J	98 J	140 J	61 J	150 J		
Bis(2-chloroethoxy)methane	400 U	n/a	n/a	n/a	n/a	n/a		
Bis(2-chloroethyl)ether	400 U	n/a	n/a	n/a	n/a	n/a		
Bis(2-ethylhexyl)phthalate	220 B	n/a	n/a	n/a	n/a	n/a		
Butylbenzylphthalate	400 U	n/a	n/a	n/a	n/a	n/a		
Carbazole	400 U	440 U	430 U	840 U	410 U	430 U		
Chrysene	130 J	160 J	150 J	170 J	81 J	150 J		
Di-n-butylphthalate	400 U	n/a	n/a	n/a	n/a	n/a		
Di-n-octylphthalate	400 U	n/a	n/a	n/a	n/a	n/a		
Dibenz(a,h)anthracene	400 U	440 U	430 U	840 U	410 U	45 J		
Dibenzofuran	400 U	440 U	430 U	840 U	410 U	430 U		
Diethylphthalate	400 U	n/a	n/a	n/a	n/a	n/a		
Dimethylphthalate	400 U	n/a	n/a	n/a	n/a	n/a		
Fluoranthene	180 J	260 J	280 J	200 J	150 J	240 J		
Fluorene	400 U	440 U	430 U	840 U	410 U	430 U		
Hexachlorobenzene	400 U	n/a	n/a	n/a	n/a	n/a		
Hexachlorobutadiene	400 U	n/a	n/a	n/a	n/a	n/a		
Hexachlorocyclopentadiene	400 U	n/a	n/a	n/a	n/a	n/a		
Hexachloroethane	400 U	n/a	n/a	n/a	n/a	n/a		

TABLE A-2.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	SS-08-18	SS-08-52	SS-08-52-D	SS-08-53	SS-08-54	SS-08-55	---	---
SAMPLE DATE:	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	03/09/99	---	---
STATUS:							---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		
Indeno(1,2,3-cd)pyrene	92 J	120 J	92 J	840 U	59 J	100 J		
Isophorone	400 U	n/a	n/a	n/a	n/a	n/a		
N-Nitroso-di-n-propylamine	400 U	n/a	n/a	n/a	n/a	n/a		
N-Nitrosodiphenylamine	400 U	n/a	n/a	n/a	n/a	n/a		
Naphthalene	400 U	440 U	430 U	840 U	410 U	430 U		
Nitrobenzene	400 U	n/a	n/a	n/a	n/a	n/a		
Pentachlorophenol	960 U	n/a	n/a	n/a	n/a	n/a		
Phenanthrene	86 J	140 J	110 J	120 J	110 J	90 J		
Phenol	400 U	n/a	n/a	n/a	n/a	n/a		
Pyrene	200 J	280 J	320 J	220 J	130 J	220 J		

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDD	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
4,4'-DDE	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
4,4'-DDT	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Aldrin	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Alpha-BHC	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Alpha-Chlordane	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Aroclor-1016	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Aroclor-1221	80 U	78 UL	80 U	78 U	75 U	81 U	79 U	81 U
Aroclor-1232	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Aroclor-1242	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Aroclor-1248	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Aroclor-1254	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Aroclor-1260	40 U	38 UL	39 U	39 U	37 U	40 U	39 U	40 U
Beta-BHC	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Delta-BHC	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Dieldrin	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Endosulfan I	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Endosulfan II	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Endosulfan Sulfate	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Endrin	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Endrin Aldehyde	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Endrin Ketone	4 U	3.8 UL	3.9 U	3.9 U	3.7 U	4 U	3.9 U	4 U
Gamma-BHC (Lindane)	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Gamma-Chlordane	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Heptachlor	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Heptachlor Epoxide	2 U	2 UL	2 U	2 U	1.9 U	2.1 U	2 U	2.1 U
Methoxychlor	20 U	20 UL	20 U	20 U	19 U	21 U	20 U	21 U

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toxaphene	200 U	200 UL	200 U	200 U	190 U	210 U	200 U	210 U

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-12	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95
STATUS:				Excavated	Excavated			
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDD	3.8 U	4.7 P	4.1 U	27 J	16 J	4.1 UJ	4.1 UJ	4 UJ
4,4'-DDE	3.8 U	4.2 U	4.1 U	12 J	25 J	4.1 UJ	4.1 UJ	4 UJ
4,4'-DDT	3.8 U	9 P	5.7 P	90 J	120 J	20 J	23 J	5 J
Aldrin	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	3.2 J	2 UJ
Alpha-BHC	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Alpha-Chlordane	2 U	2.2 U	2.1 U	4 J	0.9 J	n/a	n/a	n/a
Aroclor-1016	38 U	42 U	41 U	11 UJ	11 UJ	41 UJ	41 UJ	40 UJ
Aroclor-1221	78 U	86 U	84 U	22 UJ	23 UJ	83 UJ	84 UJ	81 UJ
Aroclor-1232	38 U	42 U	41 U	11 UJ	11 UJ	41 UJ	41 UJ	40 UJ
Aroclor-1242	38 U	42 U	41 U	11 UJ	11 UJ	41 UJ	41 UJ	40 UJ
Aroclor-1248	38 U	42 U	41 U	11 UJ	11 UJ	41 UJ	41 UJ	40 UJ
Aroclor-1254	38 U	83	56	100 J	120 J	40 J	63 J	13 J
Aroclor-1260	38 U	42 U	41 U	11 UJ	11 UJ	41 UJ	41 UJ	40 UJ
Beta-BHC	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Delta-BHC	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Dieldrin	3.8 U	4.2 U	4.1 U	7.6 J	3.5 J	4.1 UJ	4.1 UJ	4 UJ
Endosulfan I	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Endosulfan II	3.8 U	4.2 U	4.1 U	1.1 UJ	1.1 UJ	4.1 UJ	4.1 UJ	4 UJ
Endosulfan Sulfate	3.8 U	4.2 U	4.1 U	1.1 UJ	1.1 UJ	4.1 UJ	4.1 UJ	4 UJ
Endrin	3.8 U	6.7 P	4.1 U	16 J	13 J	4.1 UJ	4.1 UJ	4 UJ
Endrin Aldehyde	3.8 U	4.2 U	4.1 U	1.1 UJ	1.1 UJ	4.1 UJ	4.1 UJ	4 UJ
Endrin Ketone	3.8 U	4.2 U	4.1 U	1.1 UJ	1.5 J	4.1 UJ	4.1 UJ	4 UJ
Gamma-BHC (Lindane)	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Gamma-Chlordane	2 U	2.2 U	2.1 U	3.7 J	1.4 J	2.1 UJ	2.1 UJ	2 UJ
Heptachlor	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Heptachlor Epoxide	2 U	2.2 U	2.1 U	0.55 UJ	0.58 UJ	2.1 UJ	2.1 UJ	2 UJ
Methoxychlor	20 U	22 U	21 U	5.5 UJ	5.8 UJ	21 UJ	21 UJ	20 UJ

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-12	SS-08-13	SS-08-14	SS-08-14-D	SS-08-16
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	09/28/95	09/28/95	10/03/95	10/03/95	10/03/95
STATUS:				Excavated	Excavated			
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toxaphene	200 U	220 U	210 U	55 UJ	58 UJ	210 UJ	210 UJ	200 UJ

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	SS-08-17	SS-08-18	---	---	---	---	---	---
SAMPLE DATE:	06/19/92	06/19/92	---	---	---	---	---	---
STATUS:			---	---	---	---	---	---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**						
4,4'-DDD	3.6 U	3.5 U						
4,4'-DDE	3.6 U	3.5 U						
4,4'-DDT	3.6 U	3.5 U						
Aldrin	1.9 U	1.8 U						
Alpha-BHC	1.9 U	1.8 U						
Alpha-Chlordane	1.9 U	1.8 U						
Aroclor-1016	36 U	35 U						
Aroclor-1221	74 U	72 U						
Aroclor-1232	36 U	35 U						
Aroclor-1242	36 U	35 U						
Aroclor-1248	36 U	35 U						
Aroclor-1254	36 U	35 U						
Aroclor-1260	36 U	35 U						
Beta-BHC	1.9 U	1.8 U						
Delta-BHC	1.9 U	1.8 U						
Dieldrin	3.6 U	3.5 U						
Endosulfan I	1.9 U	1.8 U						
Endosulfan II	3.6 U	3.5 U						
Endosulfan Sulfate	3.6 U	3.5 U						
Endrin	3.6 U	3.5 U						
Endrin Aldehyde	3.6 U	3.5 U						
Endrin Ketone	3.6 U	3.5 U						
Gamma-BHC (Lindane)	1.9 U	1.8 U						
Gamma-Chlordane	1.9 U	1.8 U						
Heptachlor	1.9 U	1.8 U						
Heptachlor Epoxide	1.9 U	1.8 U						
Methoxychlor	19 U	18 U						

TABLE A-2.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 6

SAMPLE I.D.:	SS-08-17	SS-08-18	---	---	---	---	---	---
SAMPLE DATE:	06/19/92	06/19/92	---	---	---	---	---	---
STATUS:			---	---	---	---	---	---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**						
Toxaphene	190 U	180 U						

TABLE A-2.5

ANALYTICAL RESULTS FOR DIOXINS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SS-08-01	SS-08-02	SS-08-03	SS-08-04	SS-08-05	SS-08-06	SS-08-07	SS-08-08
SAMPLE DATE:	04/21/95	04/21/95	04/21/95	04/21/95	04/21/95	04/23/95	04/23/95	04/23/95
STATUS:								
DIOXINS/FURANS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,3,4,6,7,8-HpCDD	0.0238 U	0.0464 J	0.0119 U	0.0091 J	0.0073 J	0.008 J	0.003 UJ	0.0086 UJ
1,2,3,4,6,7,8-HpCDF	0.0188 B	0.176 J	0.173 J	0.0112 B	0.0119 B	0.0158 U	0.118 B	0.007 B
1,2,3,4,7,8,9-HpCDF	0.0013 U	0.0011 U	0.0018 U	0.0021 UJ	0.0013 U	0.0077 UJ	0.0032 UJ	0.0018 U
1,2,3,4,7,8-HxCDD	0.005 U	0.0027 U	0.0038 U	0.0047 UJ	0.0041 UJ	0.0083 UJ	0.0067 UJ	0.0049 UJ
1,2,3,4,7,8-HxCDF	0.0009 U	0.006 J	0.007 J	0.0009 UJ	0.0015 U	0.0016 UJ	0.0048 J	0.0013 U
1,2,3,6,7,8-HxCDD	0.0041 U	0.0022 U	0.0031 U	0.0035 UJ	0.0033 UJ	0.0067 UJ	0.0054 UJ	0.004 UJ
1,2,3,6,7,8-HxCDF	0.0012 U	0.0011 U	0.0012 U	0.001 UJ	0.002 U	0.0021 UJ	0.0011 UJ	0.0017 U
1,2,3,7,8,9-HxCDF	0.0041 U	0.0013 U	0.0015 U	0.0015 UJ	0.0025 U	0.0025 UJ	0.0014 UJ	0.0021 U
1,2,3,7,8-PeCDD	0.0086 U	0.0074 U	0.0104 U	0.0089 U	0.0145 UJ	0.0145 UJ	0.011 UJ	0.0108 UJ
1,2,3,7,8-PeCDF	0.0041 U	0.0028 U	0.0033 U	0.0033 UJ	0.0054 U	0.0057 UJ	0.004 UJ	0.0053 U
2,3,4,6,7,8-HxCDF	0.0013 U	0.0012 U	0.0014 U	0.0013 UJ	0.0022 U	0.0023 UJ	0.0013 UJ	0.0018 U
2,3,4,7,8-PeCDF	0.0037 U	0.0026 U	0.003 U	0.0031 UJ	0.0049 U	0.0052 UJ	0.0037 UJ	0.0048 U
2,3,4,7,8-PeCDF	0.0037 U	0.0026 U	0.003 U	0.0031 UJ	0.0049 U	0.0052 UJ	0.0037 UJ	0.0048 U
2,3,7,8-TCDD	0.0117 U	0.0144 U	0.0143 U	0.0161 UJ	0.0261 UJ	0.0188 UJ	0.0209 UJ	0.0212 UJ
2,3,7,8-TCDD	0.0117 U	0.0144 U	0.0143 U	0.0161 UJ	0.0261 UJ	0.0188 UJ	0.0209 UJ	0.0212 UJ
2,3,7,8-TCDF	0.0049 U	0.0042 U	0.0078 U	0.009 UJ	0.0066 U	0.0075 UJ	0.006 UJ	0.0087 U
OCDD	2.03 J	1.8 J	1.17 J	0.87 J	1.03 J	1.04 J	0.175 J	0.706 J
OCDF	0.044 B	0.511 B	0.514 B	0.0281 B	0.0284 B	0.0379 J	0.359 B	0.0161 B
OCDF	0.044 B	0.511 B	0.514 B	0.0281 B	0.0284 B	0.0379 J	0.359 B	0.0161 B

TABLE A-2.5

ANALYTICAL RESULTS FOR DIOXINS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-48	SS-08-48-D	SS-08-49	SS-08-50	---
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	03/09/99	03/09/99	03/09/99	03/09/99	---
STATUS:								---
DIOXINS/FURANS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
1,2,3,4,6,7,8-HpCDD	0.0024 UJ	3.2 J	3.6 J	0.804	0.925	0.193 U	0.285	
1,2,3,4,6,7,8-HpCDF	0.0265 B	1.9 UJ	2.2 UJ	0.216 U	0.193 U	0.136 U	0.201 U	
1,2,3,4,7,8,9-HpCDF	0.0032 U	2 UJ	1.6 UJ	0.251 U	0.224 U	0.158 U	0.233 U	
1,2,3,4,7,8-HxCDD	0.0042 UJ	3.5 UJ	2.1 UJ	0.333 U	0.296 U	0.217 U	0.289 U	
1,2,3,4,7,8-HxCDF	0.0009 U	0.28 UJ	0.28 UJ	0.115 U	0.103 U	0.068 U	0.102 U	
1,2,3,6,7,8-HxCDD	0.0034 UJ	0.78 UJ	2 UJ	0.294 U	0.261 U	0.192 U	0.255 U	
1,2,3,6,7,8-HxCDF	0.0012 U	3 UJ	1.2 UJ	0.099 U	0.088 U	0.058 U	0.087 U	
1,2,3,7,8,9-HxCDD	n/a	n/a	n/a	0.294 U	0.261 U	0.187 U	0.255 U	
1,2,3,7,8,9-HxCDF	0.0015 U	0.4 UJ	0.58 UJ	0.112 U	0.099 U	0.069 U	0.103 U	
1,2,3,7,8-PeCDD	0.0101 U	2.2 U	1.1 U	0.352 U	0.328 U	0.261 U	0.284 U	
1,2,3,7,8-PeCDF	0.0043 U	1.8 UJ	0.62 U	0.252 U	0.221 U	0.181 U	0.217 U	
2,3,4,6,7,8-HxCDF	0.0013 U	1.5 UJ	1 UJ	0.108 U	0.096 U	0.066 U	0.1 U	
2,3,4,7,8-PeCDF	0.0039 U	0.6 UJ	0.7 U	0.219 U	0.192 U	0.157 U	0.188 U	
2,3,4,7,8-PeCDF	0.0039 U	0.6 UJ	0.7 U	0.219 U	0.192 U	0.157 U	0.188 U	
2,3,7,8-TCDD	0.0216 U	0.92 U	0.45 U	0.047 U	0.042 U	0.033 U	0.038 U	
2,3,7,8-TCDD	0.0216 U	0.92 U	0.45 U	0.047 U	0.042 U	0.033 U	0.038 U	
2,3,7,8-TCDF	0.008 U	1 UJ	0.65 U	0.031 U	0.034 U	0.022 U	0.025 U	
OCDD	0.067 J	22 J	21 U	6.89	7.94	0.656	2.73	
OCDF	0.0769 B	6.5 B	4 UJ	0.307 U	0.321 U	0.185 U	0.339 U	
OCDF	0.0769 B	6.5 B	4 UJ	0.307 U	0.321 U	0.185 U	0.339 U	
Total HpCDD	n/a	n/a	n/a	0.804	1.6	0.193 U	0.285	
Total HpCDF	n/a	n/a	n/a	0.232 U	0.207 U	0.146 U	0.216 U	
Total HxCDD	n/a	n/a	n/a	0.306 U	0.272 U	0.199 U	0.265 U	
Total HxCDF	n/a	n/a	n/a	0.111 U	0.099 U	0.062 U	0.098 U	
Total PeCDD	n/a	n/a	n/a	0.352 U	0.176 U	0.261 U	0.284 U	
Total PeCDF	n/a	n/a	n/a	0.114 U	0.1 U	0.082 U	0.093 U	
Total TCDD	n/a	n/a	n/a	0.047 U	0 U	0.017 U	0.038 U	

TABLE A-2.5

ANALYTICAL RESULTS FOR DIOXINS - SITE 8 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SS-08-09	SS-08-10	SS-08-10-D	SS-08-48	SS-08-48-D	SS-08-49	SS-08-50	---
SAMPLE DATE:	04/23/95	09/28/95	09/28/95	03/09/99	03/09/99	03/09/99	03/09/99	---
STATUS:								---
DIOXINS/FURANS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
Total TCDF	n/a	n/a	n/a	0.031 U	0.034 U	0.017 U	0.025 U	

A-3 Site 8 Subsurface Soil

TABLE A-3.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SB-08-01	SB-08-02	SB-08-03	SB-08-04	SB-08-05	SB-08-06	SB-08-07	SB-08-08
SAMPLE DATE:	09/28/95	09/28/95	09/28/95	09/28/95	09/29/95	09/29/95	09/29/95	09/29/95
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	6020	6540	7600	6080	6690	7770	11800	8500
Antimony	7.5 UL	7.8 UL	7.1 UL	8.3 UL	7.4 UR	8 UR	7.5 UR	8.1 UR
Arsenic	0.98	0.61	1.1	1.3	0.89	1.8	2.6	1.7
Barium	16.6	16.1	17.9	26.9	18.3	34.3	31.2	23
Beryllium	0.31	0.29	0.35	0.41	0.38	0.51	0.48	0.51
Cadmium	0.54 UJ	0.56 UJ	0.51 UJ	0.59 UJ	0.53 U	0.57 U	0.54 U	0.58 U
Calcium	558	2380	731	720	632	611	837	689
Chromium	7.1	8.6	14.6	10.4	8.3 J	11.2 J	13.9 J	11.4 J
Cobalt	7.4	5.1	6	8.3	4.6	5.8	7.5	5.9
Copper	2.7 B	29.9 J	22 J	14.4 J	7.2	12.8	16.7	25.3
Iron	7080	7230	10400	10500	7440	11300	13100	10800
Lead	2.1	1.9	2.6	3.4	2.4	3.6	4.7	4.1
Magnesium	832	1980	1110	1230	940	1580	1770	1400
Manganese	382 L	342 L	402 L	849 L	277	467	367	213
Mercury	0.05 UL	0.1 L	0.04 UL	0.05 UL	0.05 UL	0.05 UL	0.05 UL	0.06 UL
Nickel	4 B	6 B	6.7 B	5.4 B	5.8	6.6	8.5	7.9
Potassium	145	157	215	413	186	445	590	329
Selenium	0.54 U	0.56 U	0.51 U	0.59 U	0.53 U	0.57 U	0.54 U	0.58 U
Silver	0.72 UL	0.75 UL	0.67 UL	0.79 UL	0.7 U	0.76 U	0.71 U	0.77 U
Sodium	84.4 B	106	95.8	87.7	106	82.5	71.6	78.3
Thallium	0.54 U	0.56 U	0.51 U	0.59 U	0.53 U	0.57 U	0.54 U	0.58 U
Vanadium	9.8	9.9	16.2	14.3	10.7	15.3	19.8	15.8
Zinc	5.1	6.2	6.9	8.2	5.4 B	14	16.5	12.7

TABLE A-3.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SB-08-09	SB-08-10	SB-08-11	SB-08-12	SB-08-13	SB-08-14	SB-08-15	SB-08-16
SAMPLE DATE:	09/29/95	09/29/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	8290	15000	7000	11700	7900	10900	11000	13100
Antimony	7.6 UR	7.9 UR	7.9 UL	8.6 UL	8.7 UL	7.8 UL	7.4 UL	8.3 UL
Arsenic	2	5.2 L	1.5	3.4	2.7	2.9	3.5	5.7
Barium	32	58.5	23.5	50.2	38.8	31	27.5	31.7
Beryllium	0.49	0.83	0.51	0.7	0.48	0.62	0.44	0.53
Cadmium	0.55 U	0.57 U	0.56 UL	0.62 UL	0.62 UL	0.56 UL	0.53 UL	0.59 UL
Calcium	823	1060	557	869	942	719	589	492
Chromium	13.2 J	26.1 J	14.5	17	9.9	13.4	17.9	25.6
Cobalt	8.1	9.3	7.1	13	13.2	8.5	7.3	6.2
Copper	14.1	13.9	5.8 L	12.4 L	13.5 L	10.4 L	7.2 L	12.3 L
Iron	11900	24100	14100	19300	13300	16500	18000	23800
Lead	4.4	7.7	4.5	8.2	5.7	6.4	6	9.1
Magnesium	1480	3070	927	2700	1470	1710	2020	2370
Manganese	479	449	549	678	1020	542	299	143
Mercury	0.05 UL	0.05 UL	0.05 U	0.05 U	0.05 U	0.05 U	0.04 U	0.05 U
Nickel	11.6	13.3	6.5 B	14.8 B	9.9 B	9.4 B	10.2 B	15.1 B
Potassium	487	877 U	326	603	846	332	524	631
Selenium	0.55 U	0.63 K	0.56 U	0.62 U	0.62 U	0.56 U	0.53 U	0.59 U
Silver	0.73 U	0.75 U	0.75 UL	0.82 UL	0.83 UL	0.74 UL	0.7 UL	0.79 UL
Sodium	119	71.5	150 B	116 B	91.9 B	90.8 B	94.3 B	69.4 B
Thallium	0.55 U	0.57 U	0.56 U	0.62 U	0.62 U	0.56 U	0.53 U	0.59 U
Vanadium	17.3	40.8	20.9	27.3	17.6	22.1	29.5	39.5
Zinc	13.1	29.7	5.9	22.3	14.2	16.4	20.3	27.8

TABLE A-3.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SB-08-17	SB-08-18	SB-08-19	SB-08-20	SB-08-21	SB-08-22	SB-08-23	SB-08-24
SAMPLE DATE:	10/03/95	06/19/92	06/19/92	09/29/98	03/09/99	03/09/99	03/09/99	03/09/99
STATUS:								
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Aluminum	12600	17500	15000	n/a	n/a	n/a	n/a	n/a
Antimony	8.1 UL	10.4 UL	14.9 J	n/a	n/a	n/a	n/a	n/a
Arsenic	2.1	3.7 B	5.45 L	n/a	5.9	6.6	5.9	4.4 K
Barium	34.9	96.4	27.6	n/a	n/a	n/a	n/a	n/a
Beryllium	0.77	1.3 B	2.1 B	n/a	n/a	n/a	n/a	n/a
Cadmium	0.58 UL	4.2 B	5.3 B	n/a	n/a	n/a	n/a	n/a
Calcium	1030	3480 B	10100	n/a	n/a	n/a	n/a	n/a
Chromium	14.8	21.7	17.5	n/a	n/a	n/a	n/a	n/a
Cobalt	11.4	9.6	12.6	n/a	n/a	n/a	n/a	n/a
Copper	9.5 L	11	354 J	n/a	n/a	n/a	n/a	n/a
Cyanide	n/a	1.7 UL	1.8 U	n/a	n/a	n/a	n/a	n/a
Iron	17700	20200 UL	27500	n/a	n/a	n/a	n/a	n/a
Lead	7.5	26.7 J	16.4	1.9	13.7	16.9	14	10
Magnesium	2950	3790 B	6980	n/a	n/a	n/a	n/a	n/a
Manganese	313	611	307 J	n/a	n/a	n/a	n/a	n/a
Mercury	0.05 U	0.1 U	0.095 UJ	n/a	n/a	n/a	n/a	n/a
Nickel	14.4 B	17.6 B	8.2 B	n/a	n/a	n/a	n/a	n/a
Potassium	1190	1010	710	n/a	n/a	n/a	n/a	n/a
Selenium	0.58 U	1 UL	1.1 UJ	n/a	n/a	n/a	n/a	n/a
Silver	0.77 UL	2.1 U	2 U	n/a	n/a	n/a	n/a	n/a
Sodium	79.2 B	637 B	1470	n/a	n/a	n/a	n/a	n/a
Thallium	0.58 U	0.43	9.1 J	n/a	n/a	n/a	n/a	n/a
Vanadium	19.9	33.8	42.7 K	n/a	51.8 J	52.3 J	52.5 J	38.4 J
Zinc	23.6	47.6	30 J	n/a	n/a	n/a	n/a	n/a

TABLE A-3.1

ANALYTICAL RESULTS FOR METALS - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	TP01-08-01	TP01-08-02	TP02-08-03	TP02-08-03-D	TP02-08-05	---	---	---
SAMPLE DATE:	11/30/95	11/30/95	11/30/95	11/30/95	11/30/95	---	---	---
STATUS:						---	---	---
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**			
Aluminum	14600	18000	16400	17200	17900			
Antimony	8.5 UJ	7.6 UJ	8.4 UJ	9 UJ	8.1 UJ			
Arsenic	2.5 B	1.8 B	1.2 B	1.5 B	2.3 B			
Barium	107	113	77	71.1	77.2			
Beryllium	1.1	1.3	2.2	2.1	1.2			
Cadmium	0.6 U	0.54 U	0.6 U	0.65 U	0.58 U			
Calcium	814	802	1100	1060	606			
Chromium	16	13.4	17.9	18.2	15			
Cobalt	16.9	22.6	17.2	15.6	10.6			
Copper	14.8	29.4	5.8	6.6	31			
Iron	16900	14100	19800	20700	14300			
Lead	6.5 K	5.3 K	9 K	9.2 K	5.7 K			
Magnesium	2280	1790	4270	4190	2160			
Manganese	1040	1230	405	393	911			
Mercury	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			
Nickel	14.5	12.4	15.9	17.1	11.9			
Potassium	479	519	2270	2250	848 B			
Selenium	0.6 U	0.54 U	0.6 U	0.65 U	0.58 U			
Silver	0.81 UJ	0.72 UJ	0.8 UJ	0.86 UJ	0.77 UJ			
Sodium	82.9	75.1	81.6	75.8	74.2			
Thallium	0.91 B	0.54 U	0.6 U	0.65 U	0.58 U			
Vanadium	23.2	17.2	23.4	25.5	20.4			
Zinc	21.9	13.3	36.1	36	18.9			

TABLE A-3.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SB-08-05	SB-08-06	SB-08-07	SB-08-08	SB-08-09	SB-08-15	SB-08-18	SB-08-19
SAMPLE DATE:	09/29/95	09/29/95	09/29/95	09/29/95	09/29/95	10/03/95	06/19/92	06/19/92
STATUS:								
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,1,1-Trichloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,1,2,2-Tetrachloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,1,2-Trichloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,1-Dichloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,1-Dichloroethene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,2-Dichloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,2-Dichloroethene (Total)	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
1,2-Dichloropropane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
2-Butanone	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
2-Hexanone	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
4-Methyl-2-pentanone	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Acetone	57 U	11 U	12 U	12 U	12 U	36 B	11 U	12 U
Benzene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Bromodichloromethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Bromoform	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Bromomethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Carbon Disulfide	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Carbon Tetrachloride	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Chlorobenzene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Chloroethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Chloroform	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Chloromethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Dibromochloromethane	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Ethylbenzene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Methylene Chloride	25 B	6 B	17 B	11 B	14 B	8 B	11 U	12 UJ
Styrene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Tetrachloroethene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U

TABLE A-3.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SB-08-05	SB-08-06	SB-08-07	SB-08-08	SB-08-09	SB-08-15	SB-08-18	SB-08-19
SAMPLE DATE:	09/29/95	09/29/95	09/29/95	09/29/95	09/29/95	10/03/95	06/19/92	06/19/92
STATUS:								
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Toluene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Trichloroethene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Vinyl Chloride	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
Xylene (Total)	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
cis-1,3-Dichloropropene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U
trans-1,3-Dichloropropene	57 U	11 U	12 U	12 U	12 U	12 U	11 U	12 U

TABLE A-3.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	TP01-08-01	TP01-08-02	TP02-08-03	TP02-08-03-D	TP02-08-05	---	---	---
SAMPLE DATE:	11/30/95	11/30/95	11/30/95	11/30/95	11/30/95	---	---	---
STATUS:						---	---	---
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			
1,1,1-Trichloroethane	12 U	12 U	11 U	11 U	12 U			
1,1,2,2-Tetrachloroethane	12 U	12 U	11 U	11 U	12 U			
1,1,2-Trichloroethane	12 U	12 U	11 U	11 U	12 U			
1,1-Dichloroethane	12 U	12 U	11 U	11 U	12 U			
1,1-Dichloroethene	12 U	12 U	11 U	11 U	12 U			
1,2-Dichloroethane	12 U	12 U	11 U	11 U	12 U			
1,2-Dichloroethene (Total)	12 U	12 U	11 U	11 U	12 U			
1,2-Dichloropropane	12 U	12 U	11 U	11 U	12 U			
2-Butanone	12 U	12 U	11 U	11 U	12 U			
2-Hexanone	12 U	12 U	11 U	11 U	12 U			
4-Methyl-2-pentanone	12 U	12 U	11 U	11 U	12 U			
Acetone	12 U	6 B	11 U	11 U	12 U			
Benzene	12 U	12 U	11 U	11 U	12 U			
Bromodichloromethane	12 U	12 U	11 U	11 U	12 U			
Bromoform	12 U	12 U	11 U	11 U	12 U			
Bromomethane	12 U	12 U	11 U	11 U	12 U			
Carbon Disulfide	12 U	12 U	11 U	11 U	12 U			
Carbon Tetrachloride	12 U	12 U	11 U	11 U	12 U			
Chlorobenzene	12 U	12 U	11 U	11 U	12 U			
Chloroethane	12 UJ	12 UJ	11 UJ	11 UJ	12 UJ			
Chloroform	12 U	12 U	11 U	11 U	12 U			
Chloromethane	12 U	12 U	11 U	11 U	12 U			
Dibromochloromethane	12 U	12 U	11 U	11 U	12 U			
Ethylbenzene	12 U	12 U	11 U	11 U	12 U			
Methylene Chloride	6 B	7 B	7 B	7 B	10 B			
Styrene	12 U	12 U	11 U	11 U	12 U			
Tetrachloroethene	12 U	12 U	11 U	11 U	12 U			

TABLE A-3.2

ANALYTICAL RESULTS FOR VOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	TP01-08-01	TP01-08-02	TP02-08-03	TP02-08-03-D	TP02-08-05	---	---	---
SAMPLE DATE:	11/30/95	11/30/95	11/30/95	11/30/95	11/30/95	---	---	---
STATUS:						---	---	---
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			
Toluene	12 U	12 U	11 U	11 U	12 U			
Trichloroethene	12 U	12 U	11 U	11 U	12 U			
Vinyl Chloride	12 U	12 U	11 U	11 U	12 U			
Xylene (Total)	12 U	12 U	11 U	11 U	12 U			
cis-1,3-Dichloropropene	12 U	12 U	11 U	11 U	12 U			
trans-1,3-Dichloropropene	12 U	12 U	11 U	11 U	12 U			

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SB-08-01	SB-08-02	SB-08-03	SB-08-04	SB-08-05	SB-08-06	SB-08-07	SB-08-08
SAMPLE DATE:	09/28/95	09/28/95	09/28/95	09/28/95	09/29/95	09/29/95	09/29/95	09/29/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,4-Trichlorobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
1,2-Dichlorobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
1,3-Dichlorobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
1,4-Dichlorobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2,2'-Oxybis(1-chloropropane)	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2,4,5-Trichlorophenol	860 U	880 U	870 UR	910 U	900 U	940 U	940 U	980 U
2,4,6-Trichlorophenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
2,4-Dichlorophenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
2,4-Dimethylphenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
2,4-Dinitrophenol	860 U	880 U	870 UR	910 U	900 U	940 U	940 U	980 U
2,4-Dinitrotoluene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2,6-Dinitrotoluene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2-Chloronaphthalene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2-Chlorophenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
2-Methylnaphthalene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
2-Methylphenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
2-Nitroaniline	860 U	880 U	870 U	910 U	900 U	940 U	940 U	980 U
2-Nitrophenol	360 U	42 J	360 UR	370 U	370 U	390 U	390 U	400 U
3,3'-Dichlorobenzidine	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
3-Nitroaniline	860 U	880 U	870 U	910 U	900 U	940 U	940 U	980 U
4,6-Dinitro-2-methylphenol	860 U	880 U	870 UR	910 U	900 U	940 U	940 U	980 U
4-Bromophenyl Phenyl Ether	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
4-Chloro-3-methylphenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
4-Chloroaniline	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
4-Chlorophenyl Phenyl Ether	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
4-Methylphenol	360 U	360 U	360 UR	370 U	370 U	390 U	390 U	400 U
4-Nitroaniline	860 U	880 U	870 U	910 U	900 U	940 U	940 U	980 U

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SB-08-01	SB-08-02	SB-08-03	SB-08-04	SB-08-05	SB-08-06	SB-08-07	SB-08-08
SAMPLE DATE:	09/28/95	09/28/95	09/28/95	09/28/95	09/29/95	09/29/95	09/29/95	09/29/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4-Nitrophenol	860 U	38 J	870 UR	910 U	900 U	940 U	940 U	980 U
Acenaphthene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Acenaphthylene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Anthracene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Benz(a)anthracene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Benzo(a)pyrene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Benzo(b)fluoranthene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Benzo(g,h,i)perylene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Benzo(k)fluoranthene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Bis(2-chloroethoxy)methane	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Bis(2-chloroethyl)ether	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Bis(2-ethylhexyl)phthalate	72 B	44 B	49 B	70 B	110 B	120 B	82 B	110 B
Butylbenzylphthalate	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Carbazole	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Chrysene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Di-n-butylphthalate	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Di-n-octylphthalate	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Dibenz(a,h)anthracene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Dibenzofuran	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Diethylphthalate	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Dimethylphthalate	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Fluoranthene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Fluorene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Hexachlorobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Hexachlorobutadiene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Hexachlorocyclopentadiene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Hexachloroethane	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 3

SAMPLE I.D.:	SB-08-01	SB-08-02	SB-08-03	SB-08-04	SB-08-05	SB-08-06	SB-08-07	SB-08-08
SAMPLE DATE:	09/28/95	09/28/95	09/28/95	09/28/95	09/29/95	09/29/95	09/29/95	09/29/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Indeno(1,2,3-cd)pyrene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Isophorone	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
N-Nitroso-di-n-propylamine	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
N-Nitrosodiphenylamine	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Naphthalene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Nitrobenzene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Pentachlorophenol	860 U	880 U	870 UR	910 U	900 U	940 U	940 U	980 U
Phenanthrene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U
Phenol	360 U	920	360 UR	370 U	370 U	390 U	390 U	400 U
Pyrene	360 U	360 U	360 U	370 U	370 U	390 U	390 U	400 U

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 4

SAMPLE I.D.:	SB-08-09	SB-08-10	SB-08-11	SB-08-12	SB-08-13	SB-08-14	SB-08-15	SB-08-16
SAMPLE DATE:	09/29/95	09/29/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
1,2,4-Trichlorobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
1,2-Dichlorobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
1,3-Dichlorobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
1,4-Dichlorobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,2'-Oxybis(1-chloropropane)	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,4,5-Trichlorophenol	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
2,4,6-Trichlorophenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,4-Dichlorophenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,4-Dimethylphenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,4-Dinitrophenol	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
2,4-Dinitrotoluene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2,6-Dinitrotoluene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2-Chloronaphthalene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2-Chlorophenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2-Methylnaphthalene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2-Methylphenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
2-Nitroaniline	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
2-Nitrophenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
3,3'-Dichlorobenzidine	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
3-Nitroaniline	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
4,6-Dinitro-2-methylphenol	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
4-Bromophenyl Phenyl Ether	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
4-Chloro-3-methylphenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
4-Chloroaniline	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
4-Chlorophenyl Phenyl Ether	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
4-Methylphenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
4-Nitroaniline	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	SB-08-09	SB-08-10	SB-08-11	SB-08-12	SB-08-13	SB-08-14	SB-08-15	SB-08-16
SAMPLE DATE:	09/29/95	09/29/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4-Nitrophenol	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
Acenaphthene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Acenaphthylene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Anthracene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Benz(a)anthracene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Benzo(a)pyrene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Benzo(b)fluoranthene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Benzo(g,h,i)perylene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Benzo(k)fluoranthene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Bis(2-chloroethoxy)methane	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Bis(2-chloroethyl)ether	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Bis(2-ethylhexyl)phthalate	120 B	96 B	220 B	230 B	160 B	210 B	120 B	170 B
Butylbenzylphthalate	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Carbazole	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Chrysene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Di-n-butylphthalate	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Di-n-octylphthalate	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Dibenz(a,h)anthracene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Dibenzofuran	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Diethylphthalate	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Dimethylphthalate	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Fluoranthene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Fluorene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Hexachlorobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Hexachlorobutadiene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Hexachlorocyclopentadiene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Hexachloroethane	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

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SAMPLE I.D.:	SB-08-09	SB-08-10	SB-08-11	SB-08-12	SB-08-13	SB-08-14	SB-08-15	SB-08-16
SAMPLE DATE:	09/29/95	09/29/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95	10/03/95
STATUS:								
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Indeno(1,2,3-cd)pyrene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Isophorone	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
N-Nitroso-di-n-propylamine	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
N-Nitrosodiphenylamine	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Naphthalene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Nitrobenzene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Pentachlorophenol	920 U	920 U	890 UJ	920 UJ	850 UJ	890 UJ	910 UJ	990 UJ
Phenanthrene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Phenol	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ
Pyrene	380 U	380 U	370 UJ	380 UJ	350 UJ	370 UJ	370 UJ	410 UJ

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 7

SAMPLE I.D.:	SB-08-17	SB-08-18	SB-08-19	SB-08-21	SB-08-22	SB-08-23	SB-08-24	---
SAMPLE DATE:	10/03/95	06/19/92	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	---
STATUS:								---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
1,2,4-Trichlorobenzene	380 UJ	380 U	67 B	n/a	n/a	n/a	n/a	
1,2-Dichlorobenzene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
1,3-Dichlorobenzene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
1,4-Dichlorobenzene	380 UJ	380 U	74 B	n/a	n/a	n/a	n/a	
2,2'-Oxybis(1-chloropropane)	380 UJ	n/a	n/a	n/a	n/a	n/a	n/a	
2,4,5-Trichlorophenol	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
2,4,6-Trichlorophenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2,4-Dichlorophenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2,4-Dimethylphenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2,4-Dinitrophenol	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
2,4-Dinitrotoluene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2,6-Dinitrotoluene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2-Chloronaphthalene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2-Chlorophenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2-Methylnaphthalene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
2-Methylphenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
2-Nitroaniline	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
2-Nitrophenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
3,3'-Dichlorobenzidine	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
3-Nitroaniline	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
4,6-Dinitro-2-methylphenol	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
4-Bromophenyl Phenyl Ether	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
4-Chloro-3-methylphenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
4-Chloroaniline	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
4-Chlorophenyl Phenyl Ether	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
4-Methylphenol	380 UJ	n/a	n/a	n/a	n/a	n/a	n/a	
4-Nitroaniline	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

SAMPLE I.D.:	SB-08-17	SB-08-18	SB-08-19	SB-08-21	SB-08-22	SB-08-23	SB-08-24	---
SAMPLE DATE:	10/03/95	06/19/92	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	---
STATUS:								---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
4-Nitrophenol	920 UJ	920 U	930 UJ	n/a	n/a	n/a	n/a	
Acenaphthene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Acenaphthylene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Anthracene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Benz(a)anthracene	380 UJ	120 J	380 U	420 U	420 U	400 U	380 U	
Benzo(a)pyrene	380 UJ	140 J	380 U	420 U	420 U	400 U	380 U	
Benzo(b)fluoranthene	380 UJ	190 J	380 U	420 U	420 U	400 U	380 U	
Benzo(g,h,i)perylene	380 UJ	80 J	380 U	420 U	420 U	400 U	380 U	
Benzo(k)fluoranthene	380 UJ	110 J	380 U	420 U	420 U	400 U	380 U	
Bis(2-chloroethoxy)methane	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Bis(2-chloroethyl)ether	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Bis(2-ethylhexyl)phthalate	140 B	940 B	85 B	n/a	n/a	n/a	n/a	
Butylbenzylphthalate	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Carbazole	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Chrysene	380 UJ	170 J	380 U	420 U	420 U	400 U	380 U	
Di-n-butylphthalate	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Di-n-octylphthalate	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Dibenz(a,h)anthracene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Dibenzofuran	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Diethylphthalate	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Dimethylphthalate	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Fluoranthene	380 UJ	320 J	380 U	420 U	420 U	400 U	380 U	
Fluorene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Hexachlorobenzene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Hexachlorobutadiene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Hexachlorocyclopentadiene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Hexachloroethane	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	

TABLE A-3.3

ANALYTICAL RESULTS FOR SEMIVOLATILES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 9

SAMPLE I.D.:	SB-08-17	SB-08-18	SB-08-19	SB-08-21	SB-08-22	SB-08-23	SB-08-24	---
SAMPLE DATE:	10/03/95	06/19/92	06/19/92	03/09/99	03/09/99	03/09/99	03/09/99	---
STATUS:								---
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
Indeno(1,2,3-cd)pyrene	380 UJ	94 J	380 U	420 U	420 U	400 U	380 U	
Isophorone	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
N-Nitroso-di-n-propylamine	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
N-Nitrosodiphenylamine	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Naphthalene	380 UJ	380 U	380 U	420 U	420 U	400 U	380 U	
Nitrobenzene	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Pentachlorophenol	920 UJ	920 U	930 U	n/a	n/a	n/a	n/a	
Phenanthrene	380 UJ	180 J	380 U	420 U	420 U	400 U	380 U	
Phenol	380 UJ	380 U	380 U	n/a	n/a	n/a	n/a	
Pyrene	380 UJ	290 J	380 U	420 U	420 U	400 U	380 U	

TABLE A-3.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SB-08-01	SB-08-07	SB-08-08	SB-08-09	SB-08-15	SB-08-18	SB-08-19	---
SAMPLE DATE:	09/28/95	09/29/95	09/29/95	09/29/95	10/03/95	06/19/92	06/19/92	---
STATUS:								---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
4,4'-DDD	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
4,4'-DDE	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
4,4'-DDT	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Aldrin	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Alpha-BHC	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Alpha-Chlordane	1.8 U	0.5 U	0.52 U	0.49 U	n/a	2 U	2 U	
Aroclor-1016	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Aroclor-1221	72 U	20 U	20 U	19 U	76 UJ	77 U	79 U	
Aroclor-1232	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Aroclor-1242	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Aroclor-1248	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Aroclor-1254	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Aroclor-1260	36 U	9.6 U	10 U	9.5 U	37 UJ	38 U	39 U	
Beta-BHC	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Delta-BHC	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Dieldrin	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Endosulfan I	1.8 U	0.5 U	0.71 J	0.49 U	1.9 UJ	2 U	2 U	
Endosulfan II	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Endosulfan Sulfate	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Endrin	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Endrin Aldehyde	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Endrin Ketone	3.6 U	0.96 U	1 U	0.95 U	3.7 UJ	3.8 U	3.9 U	
Gamma-BHC (Lindane)	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Gamma-Chlordane	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2	2 U	
Heptachlor	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Heptachlor Epoxide	1.8 U	0.5 U	0.52 U	0.49 U	1.9 UJ	2 U	2 U	
Methoxychlor	18 U	5 U	5.2 U	4.9 U	19 UJ	20 U	20 U	

TABLE A-3.4

ANALYTICAL RESULTS FOR PESTICIDES - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 2

SAMPLE I.D.:	SB-08-01	SB-08-07	SB-08-08	SB-08-09	SB-08-15	SB-08-18	SB-08-19	---
SAMPLE DATE:	09/28/95	09/29/95	09/29/95	09/29/95	10/03/95	06/19/92	06/19/92	---
STATUS:								---
PESTICIDES/PCBS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	
Toxaphene	180 U	50 U	52 U	49 U	190 UJ	200 U	200 U	

TABLE A-3.5

ANALYTICAL RESULTS FOR DIOXINS - SITE 8 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	SB-08-01	SB-08-02	SB-08-03	SB-08-04	---	---	---	---
SAMPLE DATE:	09/28/95	09/28/95	09/28/95	09/28/95	---	---	---	---
STATUS:					---	---	---	---
DIOXINS/FURANS	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				
1,2,3,4,6,7,8-HpCDD	1.8 UJ	1.2 U	0.82 U	1.1 U				
1,2,3,4,6,7,8-HpCDF	0.4 UJ	0.52 UJ	0.58 U	0.88 U				
1,2,3,4,7,8,9-HpCDF	3.2 UJ	1.3 UJ	0.78 U	0.8 U				
1,2,3,4,7,8-HxCDD	0.85 UJ	0.98 U	1.3 U	0.75 U				
1,2,3,4,7,8-HxCDF	1.1 UJ	0.08 UJ	0.85 U	0.42 U				
1,2,3,6,7,8-HxCDD	0.42 UJ	0.8 U	0.85 U	1 U				
1,2,3,6,7,8-HxCDF	1.1 UJ	0.6 UJ	0.65 U	0.72 U				
1,2,3,7,8,9-HxCDF	0.82 UJ	0.62 UJ	0.35 U	0.5 U				
1,2,3,7,8-PeCDD	1.2 U	1 U	0.8 U	0.98 U				
1,2,3,7,8-PeCDF	0.52 UJ	0.28 U	0.35 U	0.35 U				
2,3,4,6,7,8-HxCDF	1.3 UJ	0.25 UJ	0.7 U	0.6 U				
2,3,4,7,8-PeCDF	0.9 UJ	0.25 U	0.5 U	0.42 U				
2,3,4,7,8-PeCDF	0.9 UJ	0.25 U	0.5 U	0.42 U				
2,3,7,8-TCDD	0.62 U	1.6 U	0.4 U	0.58 U				
2,3,7,8-TCDD	0.62 U	1.6 U	0.4 U	0.58 U				
2,3,7,8-TCDF	0.42 UJ	0.4 U	0.38 U	0.16 U				
OCDD	2.5 UJ	5.2 UJ	5.2 U	4.4 J				
OCDF	2 UJ	0.58 UJ	0.0769 U	0.42 U				
OCDF	2 UJ	0.58 UJ	0.0769 U	0.42 U				

A-4 Site 8 Surface Water

TABLE A-4.1

ANALYTICAL RESULTS FOR METALS - AREA C SURFACE WATER

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	C12-SW	---	---	---	---	---	---	---
SAMPLE DATE:		---	---	---	---	---	---	---
INORGANICS	**ug/L**							
Barium	93							
Cadmium	3 U							
Calcium	42800							
Copper	5 U							
Iron	186							
Magnesium	13700							
Manganese	159							
Potassium	2150							
Sodium	42900							

TABLE A-4.2

ANALYTICAL RESULTS FOR DISSOLVED METALS - AREA C SURFACE WATER

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	C12-SW-F	---	---	---	---	---	---	---
SAMPLE DATE:		---	---	---	---	---	---	---
INORGANICS	**ug/L**							
Barium	122							
Cadmium	4 U							
Calcium	48100							
Copper	4 U							
Magnesium	15900							
Manganese	162							
Potassium	2320							
Sodium	45600							

A-5 Site 8 Sediment

TABLE A-5.1

ANALYTICAL RESULTS FOR METALS - AREA C SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.: SAMPLE DATE: STATUS:	C11-SD	C12-SD	C6-SD	--- --- ---	--- --- ---	--- --- ---	--- --- ---	--- --- ---
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**					
Aluminum	3700	5240 J	6750					
Arsenic	3.4	3.1 U	4.2					
Barium	50 U	74.6	49.8					
Beryllium	0.65	1.3 U	0.95 L					
Cadmium	0.2	3.1 U	1.9 U					
Calcium	9900 B	20300 J	3430					
Chromium	14	20.5 J	15.5					
Cobalt	6	9.3 K	8.3 L					
Copper	15.4 U	34.6 J	19.5					
Iron	16200	25400	16300					
Lead	30	20.4 K	38.5					
Magnesium	4600 B	12700 K	3290					
Manganese	500	848 J	307					
Nickel	10	13.2 U	10.6 L					
Potassium	700 B	924	982					
Sodium	50 B	732 J	145 B					
Vanadium	18 K	34.2 K	23.1					
Zinc	59	61.4 J	78.5					

TABLE A-5.2

ANALYTICAL RESULTS FOR SEMIVOLATILES - AREA C SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

PAGE 1

SAMPLE I.D.:	C11-SD	C12-SD	---	---	---	---	---	---
SAMPLE DATE:			---	---	---	---	---	---
STATUS:			---	---	---	---	---	---
SEMIVOLATILES	**ug/kg**	**ug/kg**						
Acenaphthene	5000 U	120 J						
Acenaphthylene	60 J	360 U						
Anthracene	72 J	290 J						
Benz(a)anthracene	280 J	720						
Benzo(a)pyrene	270 J	650						
Benzo(b)fluoranthene	230 J	820						
Benzo(g,h,i)perylene	5000 U	320 J						
Benzo(k)fluoranthene	370 J	350 J						
Bis(2-ethylhexyl)phthalate	93 J	280 U						
Carbazole	n/a	490 J						
Chrysene	340 J	740						
Di-n-octylphthalate	5000 U	94 J						
Dibenz(a,h)anthracene	5000 U	140 J						
Dibenzofuran	5000 U	72 J						
Fluoranthene	670 J	1200						
Fluorene	5000 U	140 J						
Indeno(1,2,3-cd)pyrene	5000 U	360 U						
Phenanthrene	340 J	1200						
Pyrene	540 J	1400						

A-6 Miscellaneous Parameters

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933, SDG 1
LABORATORY: CEIMIC

TPH Analyses (mg/Kg)

Client ID:	SS-08-18 (W-SS-03)
LAB ID:	920329-07
ANALYTE	
TPH	60 L (B)

Dilution Factor: 1.0

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933, SDG 1
LABORATORY: CEIMIC

TPH Analyses (mg/Kg)

Client ID:	W-SB-15-D	W-SB-16	SB-08-18 (W-SB-17)	W-SB-18	SB-08-19 (W-SB-19)	W-SB-19D
LAB ID:	920323-04	920323-05	920323-09	920323-10	920328-01	920328-02
ANALYTE						
TPH	35 UL(z)	32 UL(z)	34 UL(z)	37 UL(z)	35 UL(z)	31 UL(z)
Dilution Factor:	1.0	1.0	1.0	1.0	1.0	1.0

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

BTEX Analyses (ug/Kg)

Client ID:		W-SB-17	W-SB-18	SS-08-17 (W-SS-01)	W-SS-02
LAB ID:		920323-09	920323-10	920323-11	920323-12
ANALYTE	RL				
Benzene	1	1 U	1 U	1 U	1 U
Ethylbenzene	1	1 U	1 U	1 U	1 U
Toluene	1	1 U	1 U	1 U	1 U
Xylenes(total)	1	1 U	1 U	1 U	1 U
Dilution Factor:		1.0	1.0	1.0	1.0

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

BTEX Analyses (ug/Kg)

Client ID:		W-SB-19		W-SB-19-D		SS-08-18 (W-SS-03)		W-SB-13	
LAB ID:		920328-01		920328-02		920328-07		920323-01	
ANALYTE	RL								
Benzene	1	1	U	1	U	1	U	1	U
Ethylbenzene	1	1	U	1	U	1	U	2	
Toluene	1	1	U	1	U	1	U	1	U
Xylenes(total)	1	1	U	1	U	1	U	7	
Dilution Factor:		1.0		1.0		1.0		1.0	

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

BTEX Analyses (ug/Kg)

Client ID:		SB-08-18 (W-SB-17)		W-SB-18		W-SS-01		W-SS-02	
LAB ID:		920323-09		920323-10		920323-11		920323-12	
ANALYTE	RL								
Benzene	1	1	U	1	U	1	U	1	U
Ethylbenzene	1	1	U	1	U	1	U	1	U
Toluene	1	1	U	1	U	1	U	1	U
Xylenes(total)	1	1	U	1	U	1	U	1	U
Dilution Factor:		1.0		1.0		1.0		1.0	

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

BTEX Analyses (ug/Kg)

Client ID:		SB-08-19 (W-SB-19)		SB-08-19-D (W-SB-19-D)		W-SS-03		W-SB-13	
LAB ID:		920328-01		920328-02		920328-07		920323-01	
ANALYTE	RL								
Benzene	1	1	U	1	U	1	U	1	U
Ethylbenzene	1	1	U	1	U	1	U	2	
Toluene	1	1	U	1	U	1	U	1	U
Xylenes(total)	1	1	U	1	U	1	U	7	
Dilution Factor:		1.0		1.0		1.0		1.0	

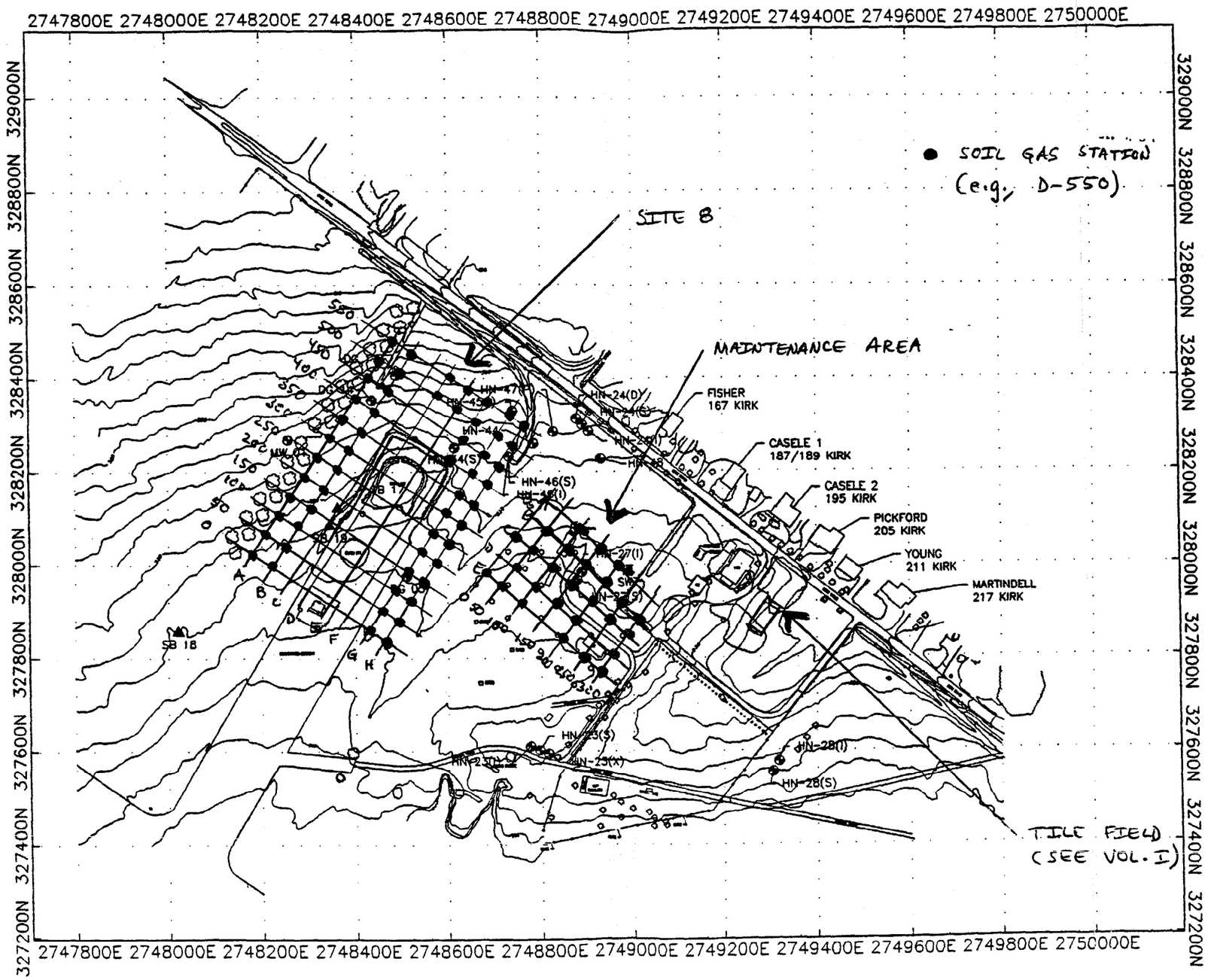
SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

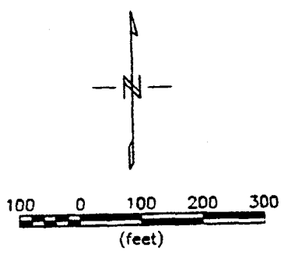
TCLP Volatile Analyses (ug/L)

Client ID:	SB-08-19 (W-SB-19)		W-SB-19-D	
LAB ID:	920328-01		920328-02	
ANALYTE				
Benzene	5	U	5	U
Carbon Tetrachloride	5	U	5	U
Chlorobenzene	5	U	5	U
Chloroform	5	U	5	U
1,2-Dichloroethane	5	U	5	U
1,1-Dichloroethylene	5	U	5	U
Methylethylketone	10	U	10	U
Tetrachloroethylene	5	U	5	U
Trichloroethylene	5	U	5	U
Vinyl Chloride	10	U	10	U
Dilution Factor:	1.0		1.0	

APPENDIX B

SOIL GAS SURVEY RESULTS





MAP SHOWING SOIL GAS SAMPLE LOCATIONS

AREA C

NAWC WARMINSTER, PA

Brown & Root Environmental

00152E082

WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	A-000-03	A-000-05	A-050-03	A-050-05	A-50-05-DUP	A-100-03	A-100-05	A-150-03	A-150-05	A-200-03	A-200-03-DUP	A-200-05
	PID Data File ID	C619H014	C619H015	C619H016	C619H017	C619H020	C619H026	C619H027	C620H021	C620H022	C620H003	C620H009	C620H004
	ECD Data File ID	D619H014	D619H015	D619H016	D619H017	D619H020	D619H026	D619H027	D620H021	D620H022	D620H003	D620H009	D620H004
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	37 B	U	U	U	100 B	U	U	U	U	U	U	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/19/95	06/19/95	06/19/95	06/19/95	06/19/95	06/19/95	06/19/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95
	Injected by	PLA	PLA	PLA	PLA	PLA	PLA	PLA	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	A-250-03	A-250-05	A-300-03	A-300-05	A-350-03	A-350-03-DUP	A-350-05	A-350-05-DUP	A-400-03	A-400-05	A-450-03	A-450-03-DUP
	PID Data File ID	C620H010	C620H011	C620H012	C620H013	C620H025	C620H026	C620H027	C620H028	C620H029	C620H030	C621H011	C621H019
	ECD Data File ID	D620H010	D620H011	D620H012	D620H013	D620H025	D620H026	D620H027	D620H028	D620H029	D620H030	D621H011	D621H019
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	U	U	81 B	U	U	U	U	U	U	U	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/21/95	06/21/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	PLA	PLA
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS

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WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	A-450-05	A-500-03	A-500-05	A-550-03	A-550-05	B-000-03	B-000-05	B-050-03	B-050-05	B-100-03	B-100-05	B-150-03
	PID Data File ID	C621H012	C621H013	C621H014	C621H015	C621H016	C619H012	C619H013	C619H018	C619H019	C619H021	C619H022	C620H014
	ECD Data File ID	D621H012	D621H013	D621H014	D621H015	D621H016	D619H012	D619H013	D619H018	D619H019	D619H021	D619H022	D620H014
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	U	U	U	U	U	U	U	U	U	28 B	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/19/95	06/19/95	06/19/95	06/19/95	06/19/95	06/19/95	06/20/95
	Injected by	PLA	PLA	PLA	PLA	PLA	PLA	PLA	PLA	PLA	PLA	PLA	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS

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WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	B-150-05	B-200-03	B-200-05	B-250-03	B-250-05	B-300-03	B-300-05	B-300-05-DUP	B-350-03	B-350-05	B-400-03	B-400-05
	PID Data File ID	C620H015	C620H005	C620H006	C620H007	C620H008	C620H018	C620H019	C620H020	C620H023	C620H024	C621H007	C621H008
	ECD Data File ID	D620H015	D620H005	D620H006	D620H007	D620H008	D620H018	D620H019	D620H020	D620H023	D620H024	D621H007	D621H008
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq Headsp	Aq Headsp	Aq Headsp.	Aq Headsp.	Aq. Headsp.	Aq. Headsp.	Aq Headsp.	Aq. Headsp.	Aq. Headsp	Aq. Headsp.	Aq. Headsp.	Aq Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	34 B	160 B	26 B	U	U	U	U	U	U	U	U	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	26 J	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/20/95	06/21/95	06/21/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	PLA	PLA
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

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WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	B-450-03	B-450-05	B-550-03	B-550-05	D-500-03	D-500-03-DUP	D-500-05	D-550-03	D-550-03-DUP	D-550-05	E-500-03	E-500-05
	PID Data File ID	C621H009	C621H010	C621H017	C621H018	C621H030	C621H031	C621H032	C621H024	C621H035	C621H025	C621H027	C621H028
	ECD Data File ID	D621H009	D621H010	D621H017	D621H018	D621H030	D621H031	D621H032	D621H024	D621H035	D621H025	D621H027	D621H028
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	U	U	U	35 B	28 B	35 B	46 B	49 B	65 B	36 B	30 B
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95	06/21/95
	Injected by	PLA	PLA	PLA	PLA	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA C – SITE 8

	SAMPLE ID	E-500-05-DUP	E-550-03	E-550-05	F-400-03	F-400-05	F-450-03	F-450-03-DUP	F-450-05	F-500-03	F-500-05	F-550-03	F-550-03-DUP
	PID Data File ID	C621H029	C621H023	C621H026	C615H012	C615H013	C615H014	C615H026	C615H015	C615H020	C615H021	C615H022	C615H023
	ECD Data File ID	D621H029	D621H023	D621H026	D615H012	D615H013	D615H014	D615H026	D615H015	D615H020	D615H021	D615H022	D516H023
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq Headsp	Aq Headsp	Aq Headsp	Aq Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq Headsp.	Aq Headsp.	Aq Headsp
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	35 B	40 B	32 B	U	31 B	U	240 B	33 B	29 B	U	35 B	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	4.6 J	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/21/95	06/21/95	06/21/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	F-550-05	F-550-05-DUP	G-000-03	G-000-05	G-050-03	G-50-03-DUP	G-050-05	G-100-03	G-100-05	G-150-03	G-150-05	G-200-03
	PID Data File ID	C615H024	C615H025	C616H028	C616H027	C616H023	C616H024	C616H022	C616H021	C616H020	C616H014	C616H015	C616H040
	ECD Data File ID	D615H024	D615H025	D616H028	D616H027	D616H023	D616H024	D616H022	D616H021	D616H020	D616H014	D616H015	D616H040
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	59 B	U	U	U	61 B	56 B	40 B	440 B	U	33 B	36 B	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	1.4 J	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/15/95	06/15/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	G-200-05		G-250-03		G-250-03-DUP		G-250-05		G-300-03		G-300-05		G-350-03		G-350-05		G-400-03		G-400-05		G-450-03		G-450-05	
	PID Data File ID	C616H013		C616H008		C616H010		C616H009		C616H006		C616H007		C616H004		C616H005		C615H010		C615H011		C615H018		C615H019	
	ECD Data File ID	D616H013		D616H008		D616H010		D616H009		D616H006		D616H007		D616H004		D616H005		D615H010		D615H011		D615H018		D615H019	
	Factor to Multiply PQL by	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0	
		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.	
PQL	COMPOUND	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
50	acetone	42	B	U		29	B	36	B	U		U		92	B	U		25	B	59	B	140	B	84	B
2.0	1,1-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
5.0	trans-1,2-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
15	1,1-dichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
50	2-butanone	U		U		U		U		U		U		U		U		U		U		U		U	
5.0	cis-1,2-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	chloroform	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	1,1,1-trichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
0.030	carbon tetrachloride	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	benzene	U		U		U		U		U		U		U		U		U		U		U		U	
15	1,2-dichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	trichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	toluene	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	tetrachloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	ethyl benzene	1.2	J	U		U		U		U		U		U		U		U		U		U		U	
6.0	m-xylene/p-xylene	U		U		U		U		U		U		U		U		U		U		U		U	
6.0	o-xylene/styrene	U		U		U		U		U		U		U		U		U		U		U		U	
	Date Sampled	06/16/95		06/16/95		06/16/95		06/16/95		06/16/95		06/16/95		06/16/95		06/16/95		06/15/95		06/15/95		06/15/95		06/15/95	
	Injected by	DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK	
	Reviewed by	RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS	

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	G-500-03	G-500-03-DUP	G-500-05	G-550-03	G-550-05	H-000-03	H-000-03-DUP	H-000-05	H-000-05-DUP	H-050-03	H-050-05	H-100-03
	PID Data File ID	C615H031	C615H039	C615H034	C615H027	C615H028	C616H029	C616H030	C616H035	C616H036	C616H025	C616H026	C616H019
	ECD Data File ID	D615H031	D615H039	D615H034	D615H027	D615H028	D616H029	D616H030	D616H035	D616H036	D616H025	D616H026	D616H019
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	U	U	34 B	27 B	U	U	U	U	220 B	52 B	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	1.7 J	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

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WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	H-100-05	H-150-03	H-150-05	H-150-05-DUP	H-200-03	H-200-05	H-250-03	H-250-05	H-300-03	H-300-05	H-350-03	H-350-05
	PID Data File ID	C616H018	C616H041	C616H042	C616H037	C616H038	C616H039	C616H011	C616H012	C614H035	C614H036	C615H006	C615H007
	ECD Data File ID	D616H018	D616H041	D616H042	D616H037	D616H038	D616H039	D616H011	D616H012	D614H035	D614H036	D615H006	D615H007
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	27 B	U	U	32 B	U	30 B	29 B	28 B	57 B	33 B	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/16/95	06/14/95	06/14/95	06/15/95	06/15/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

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WARMINSTER SOIL GAS AREA C -- SITE 8

	SAMPLE ID	H-400-03	H-400-05	H-450-03	H-450-05	H-500-03	H-500-05	H-550-03	H-550-05	RW-200-03	RW-200-05
	PID Data File ID	C615H008	C615H009	C615H037	C615H038	C615H035	C615H036	C615H029	C615H030	C621H033	C621H034
	ECD Data File ID	D615H008	C615H009	D615H037	D615H038	D615H035	D615H036	D615H029	D615H030	D621H033	D621H034
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	U	U	U	U	U	30 B	U	40 B	160 B
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/15/95	06/21/95	06/21/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

APPENDIX C

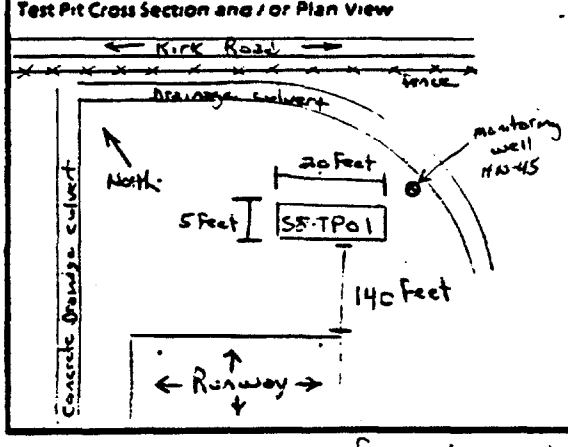
TEST PIT INFORMATION

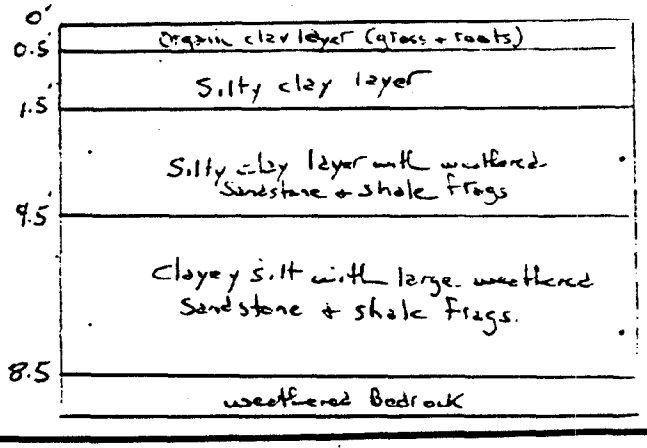
TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NAWC Warminster — TEST PIT NO.: 58-TP01
PROJECT NO.: CTO-159 — DATE: 10-30-95
LOCATION: Area C, Site 5 (near end of runway)
FIELD GEOLOGIST: Vincent Shischla

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
0.5		Dark Brown silty clay with grass + roots		Damp 0.0 ppm
		Light Brown silty clay with small		Moist 0.0 ppm
1.5		amount of weathered shale frags		Native soil or clean fill
		Dark Red-Brown silty clay with weathered		Moist 0.0 ppm
		sandstone + shale fragments		Native soil or clean fill
4.5				
		Dark Red Brown clayey silt with		Moist 0.0 ppm
		gravel to cobble size weathered		Native soil or clean fill
		sandstone + shale fragments		
		(Fragment size + density increasing with depth)		
8.5				
		Weathered Bedrock / Saprolite		Moist 0.0 ppm

Test Pit Cross Section and / or Plan View





REMARKS: No evidence of waste contamination or debris disposal. Horizon depths are average and may vary by up to 1 foot throughout excavation. A deactivated, used excess electrical line was encountered at a depth of 1 foot along extreme western edge of Test Pit (line was in Northeast to Southwest direction).

PHOTO LOG: R.P. 1, R.P. 2, R.P. 3, R.P. 4, R.P. 5 (refer to logbook Number P-252 for descriptions).

TEST PIT 58-TP01

PAGE 1 OF

TP01-08-01

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page ____ of ____

Case # _____

By _____

Project Site Name NAWC Warminster Project Site Number CTO -159

NUS Source No. S8-TP01-01 Source Location Site 8 - Test Pit Number one

Sample Method: Stainless steel hand trowel from backhoe bucket

Depth Sampled: 8.0 Feet

Sample Date & Time: 10-30-95 1005

Sampled By: Vincent Shickora

Signature(s): [illegible]

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red-Brown	clayey silt with weathered sandstone frags (damp)

Analysis:

4 ounce Jar - VOA

8 ounce Jar - TAL Metals

Observations / Notes

- Sample collected from eastern end of Test Pit #1 at site 8
- Test Pit located 140 feet north-northeast of northeast corner of runway and 37 feet west of well # HN-45.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5603
Date Shipped	10-30-95	
Time Shipped	1830	
Lab	CEIMIC	
Volume	See Analysis	

TP01-08-02

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page ____ of ____

Case # _____

By _____

Project Site Name NAWC Warminster Project Site Number CTO-159

NUS Source No. S8-TP01-02 Source Location Site 8- Test Pit Number one

Sample Method: Stainless Steel hand trowel from backhoe bucket

Depth Sampled: 6.5 feet

Sample Date & Time: 10-30-95 1030

Sampled By: Vincent Shickora

Signature(s): [signature]

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red-Brown	clayey silt + sandstone / shale frags (damp)

Analysis:

4ounce Jar - VOA

8ounce Jar - TAL Metals

Observations / Notes

- Collected from western end of Test Pit #1 at site 8.
- Test Pit located 140 feet north-northeast of northeastern corner of runway and 37 feet west of well # HN-45.
- No HNU readings above background.

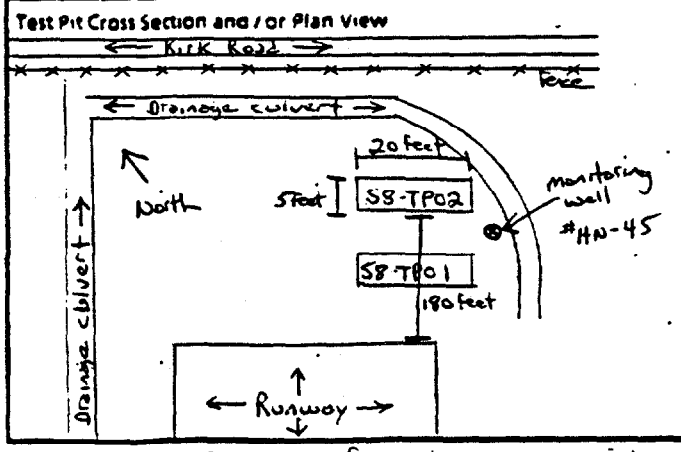
	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5603
Date Shipped	10-30	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NAWC Warminster — TEST PIT NO.: S8-TP02
PROJECT NO.: CTO-159 — DATE: 10-30-95
LOCATION: Area C, Site 8 (Near end of runway)
FIELD GEOLOGIST: Vincent Shickora

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
0.5		Dark Brown silty clay with Grass + Roots		Damp 0.0 ppm
		Light Brown silty clay with small amount		moist 0.0 ppm
1.5		of weathered shale fragments		Native soil or clean fill
		Red-Brown silt clay with gravel size		damp to moist 0.0 ppm
		weathered sandstone + shale fragments		Native soil or clean fill
5.5				
		Dark Red-Brown clayey silt with		damp to moist 0.0 ppm
		gravel to cobble sized weathered		Native soil
		sandstone + shale fragments.		
		(Fragment size + density increases with depth)		
8.0				
		Saprolite / weathered Bedrock		0.0 ppm

Test Pit Cross Section and / or Plan View



0'	
0.5'	organic clay layer (grass + roots)
1.5'	silty clay layer
	silty clay layer with weathered sandstone + shale frags.
5.5'	clayey silt layer with weathered sandstone + shale frags
8.0'	weathered Bedrock

REMARKS No Evidence of waste contamination, or debris disposal. Horizon depths are average and may vary up to 1 foot throughout excavation. A deactivated lead encased electrical line was encountered at a depth of 1 foot at the center of Test Pit. (Line runs in Northeast to southwest direction)

PHOTO LOG R.P6, R.P7, R.P8, R.P9, R.P10 — TEST PIT S8-TP02
(refer to logbook number P-252 for description)

PAGE 2 OF

TP02-08-03

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page ____ of ____

Case # _____

By _____

Project Site Name NAWC Warminster Project Site Number CTO-159

NUS Source No. 58-TP02-01 Source Location Site 8 - Test Pit number 2

Sample Method: Stainless steel Trowel from backhoe bucket

Depth Sampled: 6.5 feet

Sample Date & Time: 10-30-95 1145

Sampled By: Vincent Shickora

Signature(s): [illegible]

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red-Brown	clayey silt + sandstone/shale frags (damp)

Analysis:

4ounce Jar - VOA (3)

8ounce Jar - TAL metals (3)

Observations / Notes

- Sample used as Matrix Spike/Matrix Spike duplicate
- collected west end of Test Pit #2 at site 8.
- Test Pit located 180 feet north-northeast of northeast corner of runway and 32 feet northwest of well # HN-45.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5603
Date Shipped	10-30-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See Analysis	

TP02-08-05

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page ____ of ____

Case # _____

By _____

Project Site Name NAWC Warminster Project Site Number CTO-159

NUS Source No. S8-TP02-02 Source Location Site 8 - Test Pit number 2

	Composite Sample Data		
Sample Method: Stainless steel Trowel from backhoe bucket	Sample	Time	Color / Description
Depth Sampled: 5.5 feet			
Sample Date & Time: 10-30-95 1202			
Sampled By: Vincent Shickola			
Signature(s): [signature]			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Dark Red	Clayey Silt + sandstone frags (damp)

Analysis:

4 ounce Jar - VOA

8 ounce Jar - TAL Metals

Observations / Notes

- Sample collected from eastern end of Test Pit S8-TP02.
- Test Pit located 180 feet north-northeast of northeast corner of Tanway and 32 feet northwest of well # HN-45.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5603
Date Shipped	10-30-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See Analysis	

TP02-08-04
Dup of. TP02-08-03

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page _____ of _____
Case # _____
By _____

Project Site Name NAWC. Warminster Project Site Number CTO-159
NUS Source No. 58-TP02-10 Source Location Site 8 - Test Pit Number 2

Sample Method: Stainless steel Trowel from backhoe bucket.	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.5 feet			
Sample Date & Time: 10-30-95 1145			
Sampled By: Vince Shickora			
Signature(s): [signature]			
Type of Sample			
☒ Low Concentration			
☐ High Concentration			
☒ Grab			
☐ Composite			
☐ Grab - Composite			

Sample Data	
Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Red-Brown	clayey silt & shale / sandstone frags (damp)

Analysis:
4 ounce Jar - VOA
8 ounce Jar - TAL Metals

Observations / Notes
- Duplicate of sample # 58-TP02-01

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5603
Date Shipped	10-30-95	
Time Shipped	1830	
Lab	CEIMIC	
Volume	See Analysis	

APPENDIX D

BORING LOGS

SB-08-01

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-01 Source Location S. to S

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 8.0 feet			
Sample Date & Time: 9-28-95 1400			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry; Moist, Wet, etc.)
Red Brown	Silt with some sand (dry to damp)

Analysis:

- 4ounce Jar - VOA (1)
- 8ounce Jar - TAL Metals (1)
- 8ounce Jar - Pest/PCB/SVA (1)
- 8ounce Jar - Dioxin

Observations / Notes

- 58 feet west of well # BG-05 (Same location as WH-SSS-01)
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505134122	(SWOK-2505135286)
Date Shipped	9-28-95	
Time Shipped	1830	
Lab	CEI	NIC (SWOK for Dioxin)
Volume	See Analysis	

SB-08-02

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-02
DATE 9-28-95
DRILLER R. Reab
FIELD GEOLOGIST V. Shickera

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	15 / 16			Stiff	Gray Tan	Upper 3" → Asphalt. – Gravel and Sand		0 ppm Fill material
1538	2.0	9 / 11	15"/24"		Stiff	Brown	clay (very dry)		0 ppm clean fill or native soil
S-2 @		8 / 14			Stiff	"	"		"
1543	4.0	8 / 12	18"/24"		Stiff	"	clay (damp)		"
S-3 @		12 / 12			Stiff	Red Brown	Silty clay with weath Sandstone Frags		"
1550	6.0	15 / 16	22"/24"		Stiff	Dark Red Brown	Clayey silt with weath. Sandstone frags		"
S-4 @		16 / 16				"	"		"
1555	8.0	22 / 30					Saprolite refusal at 7.75 feet		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-ecor model 15B drill rig
± 160 lb hammer

BORING NO.
PAGE _____ OF _____

* See Legend on Back

S-3 for sample # WH-8SB-02

SB-08-02

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-02 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel

Depth Sampled: 6.0 feet

Sample Date & Time: 9-28-95 1557

Sampled By: Vincent Shickora

Signature(s):

Type of Sample
- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Clayey silt + sandstone frags (damp)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)
- 8 ounce Jar - BNA (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- collected 101.5 feet east of east corner of fire training structure and 118 feet west of well # BG-05
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505134122	(swck-2505135286)
Date Shipped	9-28-95	
Time Shipped	1830	
Lab	CEI (swack for Dioxin)	MIC
Volume	See Analysis	

SB-08-03

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-03
DATE 9-28-95
DRILLER R. Reab.
FIELD GEOLOGIST V. Shickus

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	15 / 9	16"/24"		Stiff	Gray white	Gravel clay fill under 3 inchs Asphalt.		0 ppm Fill
1430	2.0	10 / 12			Stiff	Gray Brown	Clay (very dry)		0ppm Fill material
S-2 @		8 / 11			Stiff	Brown	Silty clay (very dry)		0ppm Natural soil or clean Fill
1435	4.0	10 / 10	16"/24"		Stiff	Brown	Silty clay (damp)		"
S-3 @		10 / 13			Stiff	"	"		"
1441	6.0	15 / 11	24"/24"		Stiff	Red Brown	clayey silt		"
S-4 @		11 / 16			Very Stiff	Red Brown	clayey silt with some weath. Sandstone Frags		"
1450	8.0	17 / 17			Very Stiff		"		"
S-5 @		17 / 19			Very Stiff				
1456	10.0	23 / 30		—	Hard		refusal at 9.80 ft.		
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill Rig
140 lb hammer

BORING NO.
PAGE ____ OF ____

S-4 for Sample # WH-8SB-03

* See Legend on Back

SB-08-03

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____
By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304
NUS Source No. WH-SSB-03 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 8.0 feet			
Sample Date & Time: 9-28-95 1500			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample
- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt + sandstone frags (damp)

Analysis:
- 4ounce Jar - VOA (1)
- 8ounce Jar - TAL metals (1)
- 8ounce Jar - BNA (1)
- 8ounce Jar - Dioxin (1)

Observations / Notes
- collected 134 feet northeast of east corner of fire training structure and 63 feet from northwestern side of runway.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505134122 (SWCK-2505135286)	
Date Shipped	9-28-95	
Time Shipped	18:30	
Lab	CEMIC (SWCK for Dioxin)	
Volume	See Analysis	

SB-08-04

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 85B-04
DATE 9-28-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickata

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	15 / 14			Stiff	Gray Tan	upper 3" → Asphalt Gravel and Sand		0 ppm Fill material
	2.0	11 / 10	14"/24"		Stiff	Brown	clay (damp)		0 ppm Native soil or clean Fill
S-2 @		7 / 8			Med Stiff	"	"		"
	4.0	8 / 11	24"/24"		Stiff	"	silty clay		"
S-3 @		10 / 12			Stiff	"	"		"
	6.0	12 / 14	22"/24"		Stiff	Red Brown	Clayey silt		"
S-4 @		16 / 19			Very Stiff	Dark Red Brown	Clayey silt with weath Sandstone Frags		"
	8.0	19 / 21	20"/24"		Very Stiff	Red Tan	weathered sandstone Saprolite at 8.0 ft.		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24"x2" split spoon sampler
Telecon Model 15B drill rig

BORING NO.
PAGE _____ OF _____

* See Legend on Back

S-4 for sample WH-85B-04

58 75

SB-08-04

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____
By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304
NUS Source No. WH-SSB-04 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.5 feet			
Sample Date & Time: 9-28-95 1635			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample: ☒ Low Concentration ☐ High Concentration ☒ Grab ☐ Composite ☐ Grab - Composite			

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Clayey Silt + sandstone frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - BNA (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- Collected 58 feet northeast of east corner fire training structure and 65 feet from northwest side of runway.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505134122	(swok - 2505135286)
Date Shipped	9-28-95	
Time Shipped	1830	
Lab	CEIMIC (swok for Dioxin).	
Volume	See Analysis	

SB-08-05

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412(CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-05
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	20 / 19			Very Stiff	Black Gray	upper 3" → Asphalt. Gravel fill material		0 ppm Fill material
0950	2.0	14 / 14	8"/24"		Stiff	—	—		"
S-2 @		11 / 11			Stiff	—	No recovery		—
0955	4.0	8 / 9	0"/24"		Stiff	—	"		"
S-3 @		13 / 16			Stiff		No recovery		"
	6.0	18 / 20			Very Stiff		"		"
							move location over approx 1 foot - Try again		
S-1 @	0.0	15 / 16			Very Stiff	Black Gray	upper 3" → Asphalt Gravel fill material		0 ppm Fill material
1013	2.0	8 / 10	20"/24"		Stiff	Dark Brown	clay (damp)		0 ppm - clean Fill material or native soil
S-2 @		7 / 9			Stiff	"	"		"
1018	4.0	7 / 7	16"/24"		Med Stiff	Light Brown	"		"
S-3 @		10 / 11			Stiff	"	"		"
1023	6.0	12 / 15	24"/24"		Stiff	Red Brown	silty clay (damp)		"
S-4 @		19 / 17			Very Stiff	"	"		"

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Telecon Model 15B drill Rig
160 lb hammer

BORING NO.
PAGE _____ OF _____

* See Legend on Back

SB-08-05

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-05 (continued)
DATE 9-29-95
DRILLER R. Reab.
FIELD GEOLOGIST V. Shickole

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1029	8.0	15 / 17	24" / 24"		Very Stiff	Dark Red Brown	clayey silt with weath. sandstone frags		0 ppm Native soil or clean fill
S-5 @		20 / 21			Very Stiff	"	Saprolite at 8.5 ft		0 ppm Native
1041	10.0	21 / 16	16" / 24"		Very Stiff	"	Saprolite		"
							No Augering done at this location.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Telecon Model 15B drill rig
160 lb hammer

BORING NO.
PAGE _____ OF _____

S-4 for sample # WH-8SB-05

* See Legend on Back

SB-08-05

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-05 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 8.0 feet			
Sample Date & Time: 9-29-95 : 1046			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample: ☑ Low Concentration ☐ High Concentration ☑ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt + sandstone frags (moist)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)
- 8 ounce Jar - BNA (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- Collected 71.5 feet northeast of Fire Training structure and 28 feet from west side of runway.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135264	(SWOK-2505135275)
Date Shipped	9-29-95	
Time Shipped	1730	
Lab	CEI (SWOK for Dioxin)	MIC
Volume	See Analysis	

SB-08-06

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-06
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	28 / 24			Hard	Black Gray	upper 3 inches → Asphalt Gravel fill material		0ppm Fill material
1127	2.0	17 / 15	11"/24"		Very Stiff		"		"
S-2 @		8 / 9			Stiff		No recovery		—
1135	4.0	11 / 13	0"/24"		Stiff		—		—
S-3 @		14 / 14			Stiff		No recovery		
1141	6.0	13 / 15			Stiff		—		—
							move location over 1 foot and Auger through first foot.		
S-1 @	0.0	0 / 0	—	—	—	Black Gray	Asphalt and Gravel Fill Material		Auger to 1 Ft.
1151	2.0	6 / 10			Stiff	Brown	Clay (damp)		0ppm clean fill or native soil
S-2 @		8 / 9	16"/24"		Stiff	"	"		"
1158	4.0	7 / 7			Med Stiff	"	"		"
S-3 @		7 / 10	17"/24"		Stiff	"	"		"
1202	6.0	15 / 17			Very Stiff	Red Brown	Silty clay with weath sandstone frags.		0ppm Native soil or clean fill
S-4 @ 1210		20 / 20	24"/24"		Very Stiff	"	Saprolite at 6.5 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

S-3 for sample # WH-8SB-06

* See Legend on Back

SB-08-06

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page [illegible] of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-06 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 9-29-95 1216			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay + sandstone frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)
- 8 ounce Jar - BNA (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- Collected 37 feet northeast of fire training structure and 45 feet from west side of runway.

- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135264	(Swok - 2505135275
Date Shipped	9-29	-95
Time Shipped	17	30
Lab	CEI (Swok for	MIC Dioxin).
Volume	See	Analysis

SB-08-07

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Westminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SSB-07
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 4			Soft	Dark Brown	Silty clay with grass/roots and sandstone frags		0 ppm Native soil or clean fill
1325	2.0	4 / 3	16"/24"		Soft	Brown	Silty clay with weath sandstone frags (damp)		"
S-2 @		5 / 5			Med Soft	Light Brown	Silty clay with weath shale + sandstone (moist)		"
1330	4.0	6 / 6	20"/24"		Med Soft.	"	"		"
S-3 @		5 / 8			Med Stiff	"	"		"
1334	6.0	11 / 15	24"/24"		Stiff	Red Brown	Clayey silt with weath. sandstone frags		0 ppm Native soil or clean fill
S-4 @		12 / 12			Stiff				
	8.0	11 / 15	24"/24"	—	Stiff		Saprolite at 7.5 ft		
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24"x2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb. hammer

S-3 for sample WH-SSB-07

BORING NO.
PAGE _____ OF _____

* See Legend on Back

SB-08-07

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page ____ of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-07 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.5 feet			
Sample Date & Time: 9-29-95 1340			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample: ☒ Low Concentration ☐ High Concentration ☒ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt & Sandstone Frags (moist)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - BNA/PCB/Pest (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- location same as WH-SSS-03 (see logsheet page 34)
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135264	(Swock-2505135275)
Date Shipped	9-29-95	
Time Shipped	1730	
Lab	CEI	MIC (Swock For Dioxin)
Volume	See	Analysis

SB-08-08

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SSB-08
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	5 / 6			Med Stiff	Dark Brown	Silty clay with grass/roots and some gravel		0 ppm Fill material?
1355	2.0	3 / 7	6"/24"		Med Stiff	–	—		"
S-2 @		7 / 6			Med Stiff	Brown	Silty clay with weath sandstone Frags		0 ppm Native soil or clean Fill
1359	4.0	7 / 5	12"/24"		Med. Stiff	"	"		"
S-3 @		7 / 9			Stiff	"	"		"
1404	6.0	12 / 19	20"/24"		Very Stiff	Red Brown	Clayey Silt with weath sandstone Frags.		0 ppm Native soil or clean Fill
S-4 @		16 / 17			Very Stiff	"	"		"
	8.0	17 / 18			Very Stiff		Saprolite at 7.5 ft		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-Econ model 15B drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

S-3 for sample # WH-SSB-08

* See Legend on Back

SB-08-08

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 37 of 52
Case # _____
By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304
NUS Source No. WH-SSB-08 Source Location Site 8

Sample Method: 24"x2" split spoon Sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 9-29-95 : 1410			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample: ☑ Low Concentration ☐ High Concentration ☑ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt (moist)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)
- 8 ounce Jar - BNA/PCB/Pest (1)
- 8 ounce Jar - Dioxin (1)

Observations / Notes

- location same as WH-SSS-04 (see logsheet page 36)
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	25051352 64	(SWOK-25051352 75)
Date Shipped	9-29	-95
Time Shipped	17	30
Lab	CEI (SWOK Pes	MIC Dioxin)
Volume	See	Analysis

SB-08-09

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTC-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SSB-09
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 3			Soft	Brown	Silty clay with grass/roots and some gravel		0 ppm Fill material ?
1424	2.0	4 / 10	17"/24"		Med Stiff	Dark Brown	Silty clay with weath. sandstone & shale frags.		0 ppm clean fill or Native soil
S-2 @		7 / 7			Med Stiff	"	"		"
1428	4.0	8 / 8	24"/24"		Med Stiff	Brown	"		"
S-3 @		8 / 9			Med Stiff	"	"		"
1431	6.0	12 / 12	24"/24"		Stiff	Red Brown	Clayey silt with weath sandstone frags		0 ppm Native soil
S-4 @		16 / 16			Very Stiff	"	"		"
	8.0	18 / 19			Very Stiff	"	Saprolite at 7.75 ft		"
							No Augering Done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 150 drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-4 for sample # WH-SSB-09

SB-08-09

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 37 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-09 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.0 feet			
Sample Date & Time: 9-29-95 1440			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			
Type of Sample			
☑ Low Concentration			
☐ High Concentration			
☑ Grab			
☐ Composite			
☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt + sandstone Frags (moist)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - BNA/PCB/Pest (1)
- 8 ounce Jar - Dioxin

Observations / Notes

- collected 43 feet northeast of WH-SSB-08 and 44 feet north of north corner fire training structure.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135264	(Swck-2505135275
Date Shipped	9-29-95	
Time Shipped	1730	
Lab	CEI (swck for Dioxin)	MIC
Volume	See Analysis	

SB-08-10

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-10
DATE 9-29-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickor

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 2	19" / 24"		Soft	Dark Brown	Silty clay with grass/roots and some gravel fill		0 ppm fill material
1503	2.0	5 / 7			Med Stiff	"	Silty clay with weath sandstone Frags		0 ppm clean fill or native soil
S-2 @		7 / 8			Med Stiff	"	"		"
1508	4.0	8 / 9	21" / 24"		Stiff	Brown	"		"
S-3 @		9 / 9			Stiff	"	"		"
1514	6.0	11 / 15	24" / 24"		Stiff	Red Brown	clayey silt with weath. sandstone Frags.		0 ppm Native soil
S-4 @		15 / 15			Stiff	"	"		"
1519	8.0	19 / 25			Very Stiff	"	Saprolite at 7.0 ft.		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24"x2" split spoon sampler
Tel-ecor Model 15B drill rig
160 lb. hammer

BORING NO.
PAGE _____ OF _____

S-3 for sample # WH-8SB-10

* See Legend on Back

SB-08-10

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-10 Source Location Site 8

Sample Method: 24"x2" split spoon Sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 Feet			
Sample Date & Time: 9-29-95 1521			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			
Type of Sample: ☒ Low Concentration ☐ High Concentration ☒ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Red Brown	clayey silt + Sandstone Frags (moist)

Analysis:

8 ounce Jar - BNA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 38 feet northeast of WH-SSB-09 and 43 feet northwest of WH-SSB-05
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5264
Date Shipped	9-29-95	
Time Shipped	1730	
Lab	CEI	MIC
Volume	See Analysis	

SB-08-11

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-11
DATE 10-3-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 3			Soft	Dark Brown	Organic silt clay with grass / roots		0 ppm Native soil or clean fill
1047	2.0	4 / 4	17" / 24"		Soft	Brown	Silty clay with weak sandstone frags		"
S-2 @		7 / 7			Med Stiff	Light Brown	Silty clay		"
1053	4.0	7 / 8	16" / 24"		Med Stiff	"	"		"
S-3 @		12 / 17			Stiff	"	"		"
1102	6.0	19 / 19	24" / 24"		Very Stiff	Red Brown	Silty silt with weak sandstone frags		0 ppm Native soil or clean fill
S-4 @		17 / 17			Very Stiff	"	"		"
1111	8.0	17 / 17	24" / 24"		Very Stiff	Dark Red Brown	" Possible saprolite at 8.0 ft.		"
S-5 @		14 / 17			Very Stiff	Dark Red Brown	Saprolite at 8.5 ft		0 ppm Native soil
	10.0	18 / 19	23" / 24"		Very Stiff	"	Saprolite		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Telecor model 15B drill rig
160 lb. hammer

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-4 for sample # WH-8SB-11

SB-08-11

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____
By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304
NUS Source No. WH-SSB-11 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.5 feet			
Sample Date & Time: 10-3-95 : 1113			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			
Type of Sample: ☑ Low Concentration ☐ High Concentration ☑ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown Red	clayey silt + Sandstone Frags (moist)

Analysis:
- Source Ref - BNA (1)
- Source Ref - TAL Metals (1)

Observations / Notes
- collected 41 feet northeast of WH-SSB-10 and 1.5 feet northwest of runway.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	25051.3	5242
Date Shipped	10-3	-95
Time Shipped	19	00
Lab	CEI	MIC
Volume	See	Analysis

SB-08-12

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 85B-12
DATE 10-3-95
DRILLER R. Reab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	5 / 5			Med Stiff	Dark Brown	organic silty clay with grass/roots		0 ppm Native soil or clean fill
1155	2.0	6 / 6	16"/24"		Med Stiff	Brown	silty clay		"
S-2 @		5 / 7			Med Stiff	"	"		"
1202	4.0	7 / 9	24"/24"		Stiff	"	"		"
S-3 @		9 / 8			Stiff	"	"		"
1210	6.0	15 / 16	16"/24"		Very Stiff	Red Brown	clayey silt with weath. sandstone frags		0 ppm Native soil or clean fill
S-4 @		17 / 18			Very Stiff	"	"		"
1218	8.0	20 / 22	18"/24"		Very Stiff	Dark Red Brown	Saprolite at 7.8 feet		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24"x2" split spoon sampler
Tetecon model 15B drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-3 for Sample # WH-85B-12

SB-08-12

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-8SB-12 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 10-3-95 1220			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Red Brown	clayey silt + sandstone frags (moist)

Analysis:

8 ounce Jar - TAL metals (1)
8 ounce Jar - BNA (1)

Observations / Notes

- location 23.5 feet northeast of WH-8SB-11 and 1.5 feet northwest of runway
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5242
Date Shipped	10-3-95	
Time Shipped	1900	
Lab	CEI	MIC
Volume	See	Analysis

SB-08-13

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTG-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 85B-13
DATE 10-3-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	5 / 5			Med Stiff	Dark Brown	organic silty clay with grass/roots and some gravel		0 ppm Native Soil or clean fill
1335	2.0	6 / 7	20"/24"		Med Stiff	Brown	Silty clay with weath sandstone frags		"
S-2 @		5 / 7			Med Stiff	"	Silty clay		"
1341	4.0	8 / 8	10"/24"		Stiff	"	"		"
S-3 @		5 / 13			Stiff	"	"		"
1348	6.0	17 / 24	22"/24"		Very Stiff	Red Brown	clayey silt with weath. sandstone frags.		0 ppm Native Soil
S-4 @		20 / 25			Very Stiff	Dark Red Brown	" Saprolite at 7.0 ft		"
1355	8.0	30 / 25	23"/24"		Very Stiff	"	Saprolite		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb. hammer.

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-3 for sample ~~SW~~-85B-13

SB-08-13

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 4 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-13 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 10-3-95 1357			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☐ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt + sandstone flags (moist)

Analysis:

8 ounce Jar - BNA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

- collected 23 feet northeast of WH-SB-12 and 1.5 feet northwest of runway.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5242
Date Shipped	10-3-95	
Time Shipped	1900	
Lab	CEI	MIC
Volume	See Analysis	

SB-08-14

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-14
DATE 10-3-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickor

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* BOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	15 / 17			Very Stiff	Black Gray	Upper 6 inches → Asphalt Sandy gravel Fill		0 ppm Fill material
	2.0	16 / 16	8" / 24"		Very Stiff	"	"		Auger to 2 feet
S-2 @		8 / 7			Stiff	Red Brown	Silty clay with weath sandstone Frags.		0 ppm Native soil or clean fill
	4.0	8 / 8	19" / 24"		Stiff	"	-		"
S-3 @		8 / 10			Stiff	Brown	"		"
	6.0	12 / 14	17" / 24		Stiff	"	"		"
S-4 @		15 / 16			Very Stiff	Red Brown	clayey silt with weath sandstone Frags		"
	8.0	18 / 19	24" / 24"		Very Stiff	"	" Saprolite at 7.8 feet		"
							2 feet of Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill rig
160 lb hammer.

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-4 for sample WH-8SB-14

SB-08-14

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

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Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. W14-SSB-14 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.0 feet			
Sample Date & Time: 10-3-95 : 1505			
Sampled By: Vincent Shickora			
Signature(s):			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Red Brown	clayey silt + sandstone Frags (moist)

Analysis:

- Source Jar - BNA (1)
- Source Jar - TAL Metals (1)
- Soil Jar - Dioxin (1)

Observations / Notes

- collected 15 feet south of north corner of runway and 15.5 feet from the northwest side of runway.

- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135242	(SWOK-2505135253)
Date Shipped	10-3-95	
Time Shipped	1900	
Lab	CEI (Swok for Dioxin)	MIC
Volume	See Analysis	

SB-08-15

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-15
DATE 10-3-95
DRILLER R. Reab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 4			Soft	Brown	organic silt-clay with grass/roots and gravel Fill		0ppm fill material
1527	2.0	4 / 4	20"/24"		Med Stiff	Brown	Silty clay with sandstone + shale frags		0ppm Native soil or clean fill
S-2 @		6 / 8			Med Stiff	"	"		"
1532	4.0	7 / 8	12"/24"		Med Stiff	Brown gray	Silty clay with weath. sandstone frags		0ppm Native soil or clean fill
S-3		9 / 9			Stiff	"	"		"
1539	6.0	8 / 7	24"/24"		Med Stiff	"	"		"
S-4 @		7 / 10			Stiff	"	"		"
1545		13 / 16			Stiff	Red Brown	Saprolite at 7.8 ft.		0ppm Native soil
							No Augering done at this location		

REMARKS 3.5" I.D. HSA → 24"x2" split spoon sampler
Tel-ecor model 15B drill rig
160lb hammer.

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-4 for sample WH-8SB-15

SB-08-15

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 7 of 52
Case # _____
By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304
NUS Source No. WH-SSB-15 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.0 feet			
Sample Date & Time: 10-3-95 1545			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample
- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown Gray	Silty clay + sandstone frags (moist)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TTL Metals (1)
- 8 ounce Jar - BNA/PCB/Pest (1)
- Dioxin - 8 ounce Jar (1)

Observations / Notes
- Collected 41 feet due north of WH-SSB-14
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135242	(SWOK-2505135253)
Date Shipped	10-3-95	
Time Shipped	1400	
Lab	CEI (SWOK for Dioxin)	MIC
Volume	See Analysis	

SB-08-16

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 8SB-16
DATE 10-3-95
DRILLER R. Reab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	4 / 4			Med Stiff	Brown	organic silty clay with grass / roots		0 ppm Native soil or clean fill
1604	2.0	6 / 10	20" / 24"		Stiff	orange Brown	Silty clay with weath sandstone frags.		"
S-2 @		6 / 7			Med Stiff	"	"		"
1609	4.0	8 / 9	15" / 24"		Stiff	Red Brown	Silty clay		0 ppm Native soil or clean fill
S-3 @		8 / 10			Stiff	Brown	Silty clay with small amount weath. Sandstone frags		"
1615	6.0	10 / 10	16" / 24"		Stiff	"	"		"
S-4 @		8 / 8			Stiff	"	"		"
1620		9 / 10	24" / 24"		Stiff	"	"		"
S-5 @		8 / 10			Stiff	Red Brown	Clayey silt with weath sandstone frags		0 ppm Native Soil
1630		12 / 16	23" / 24"		Stiff	"	" Saprolite at 9.75 feet		
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-e-con model 15B drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

* See Legend on Back

S-5 for sample # WH-8SB-16

SB-08-16

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-16 Source Location Site 8

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 9.0 feet			
Sample Date & Time: 10-3-95 : 1640			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Red Brown	clayey Silt (moist)

Analysis:

- Source Jar - BNA (1)
- Source Jar - TAL Metals (1)

Observations / Notes

- Collected 41 feet north of WH-SSB-15 and 15 feet east of monitoring well DG-14
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135242	
Date Shipped	10-3-95	
Time Shipped	1900	
Lab	CEI	MIC
Volume	See Analysis	

42 42.5

SB-08-17

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 85B-17
DATE 10-3-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 3			Soft	Brown	Silty clay with grass/rootlets and weath. Sandstone Frags		0 ppm Native soil or clean fill
0923	2.0	5 / 5	20" / 24"		Med Stiff	Light Brown	Silty clay with weath Sandstone + shale Frags		"
S-2 @		6 / 7			Med Stiff	Brown	"		"
0928	4.0	9 / 11	17" / 24"		Stiff	Red Brown	"		"
S-3 @		7 / 9			Stiff	Brown	"		"
0933	6.0	10 / 15	24" / 24"		Stiff	Red Brown	Clayey silt with weath Sandstone Frags		0 ppm Native soil or clean fill
S-4 @		11 / 9			Stiff	"	"		"
0937	8.0	14 / 21	22" / 24"		Very Stiff	"	Saprolite at 7.5 feet		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill rig
160 lb hammer.

BORING NO.
PAGE ____ OF ____

S-3 for sample # WH-85B-17

* See Legend on Back

SB-08-17

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. WH-SSB-17 Source Location Site 8

Sample Method: 24"x2" split spoon Sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 10-4-95 0940			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample: ☒ Low Concentration ☐ High Concentration ☒ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	clayey silt + sandstone frags (moist)

Analysis:

- 8 ounce Jar - BNA (1)
- 8 ounce Jar - TAL metals (1)

Observations / Notes

- collected 105 feet northeast of well DG-14 and 3 feet east of drainage culvert.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5216
Date Shipped	10-4-95	
Time Shipped	1600	
Lab	CEI	MIC
Volume	See	Analysis

SB-08-21

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

TETRA TECH NUS, INC.

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other _____

Project Site Name: NAWC warminster

Project Site Number: 7603

Source Number: 08-SB01

Source Location: Site 8

Sample Method: Stainless steel Auger and hand Trowel

Depth Sampled: 3.0 Ft to 3.2 Ft

Sample Date & Time: 3-9-99 1125

Sampled by: Vince Shickora

Signature(s): [signature]

Composite Sample Data

Sample	Time	Color and Description

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

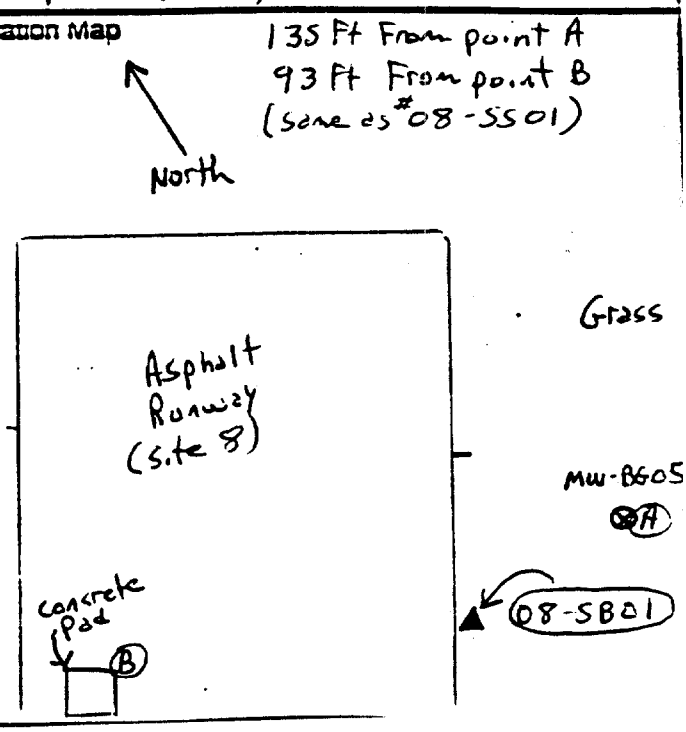
Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Silty clay (moist)

Analysis	Preservative:
[ ] TCL VOAs	dark, 4°C
[ ] TCL SVOAs	dark, 4°C
[ ] TCL Pest/PCBs	dark, 4°C
[ ] TAL Metals	4°C
[ ] Cyanide	4°C
[x] PAH Lead, Arsenic, Vanadium	4°C -

Sample Location Map

135 Ft From point A
93 Ft From point B
(same as #08-SS01)



Observations and Notes

- [ ] Duplicate sample taken:

- No elevated PID readings
- No stains or odors observed

SB-08-22

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

TETRA TECH NUS, INC.

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other _____

Project Site Name: NAWC Warminster

Project Site Number: 7603

Source Number: 08-SB02

Source Location: Site 8

Sample Method: Stainless steel Auger and hand Trowel

Depth Sampled: 3.1 ft to 3.5 ft

Sample Date & Time: 3-9-99 1205

Sampled by: Vince Shickora

Signature(s): [signature]

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[ ] TCL VOAs	dark, 4°C
[ ] TCL SVOAs	dark, 4°C
[ ] TCL Pest/PCBs	dark, 4°C
[ ] TAL Metals	4°C
[ ] Cyanide	4°C
[x] PAH Lead, Arsenic, Vanadium	4°C

Composite Sample Data

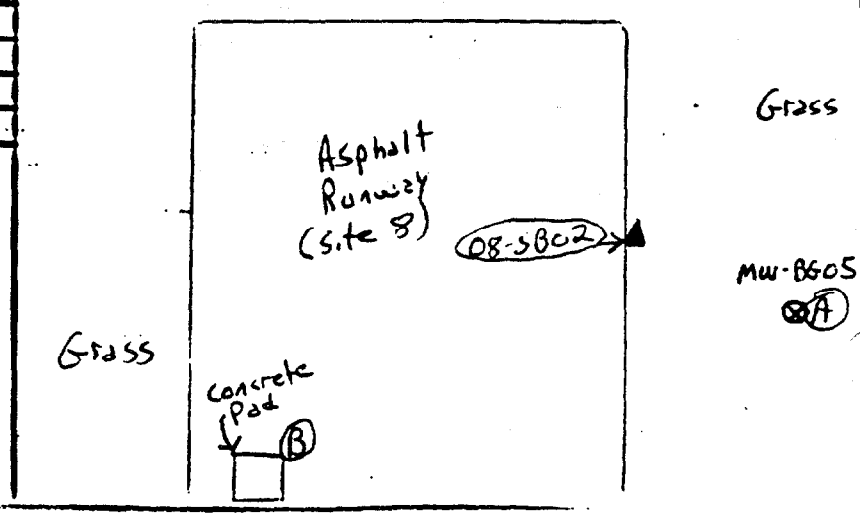
Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Orange Brown	Silty Clay (moist)

Sample Location Map

Sample is 58 ft from point A and 204 ft. from point B. (same location as #08-SS02)



Observations and Notes

- [ ] Duplicate sample taken

- No elevated PID readings
- No stains or odors observed

SB-08-23

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

TETRA TECH NUS, INC.

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other _____

Project Site Name: NAWC Warminster

Project Site Number: 7603

Source Number: 08-SB03

Source Location: Site 8

Sample Method: Stainless steel Auger and Hand Trowel

Depth Sampled: 3.0 Ft to 3.4 Ft.

Sample Date & Time: 3-9-99 1240

Sampled by: Vince Shickora

Signature(s): [signature]

Composite Sample Data

Sample	Time	Color and Description

Sample Type

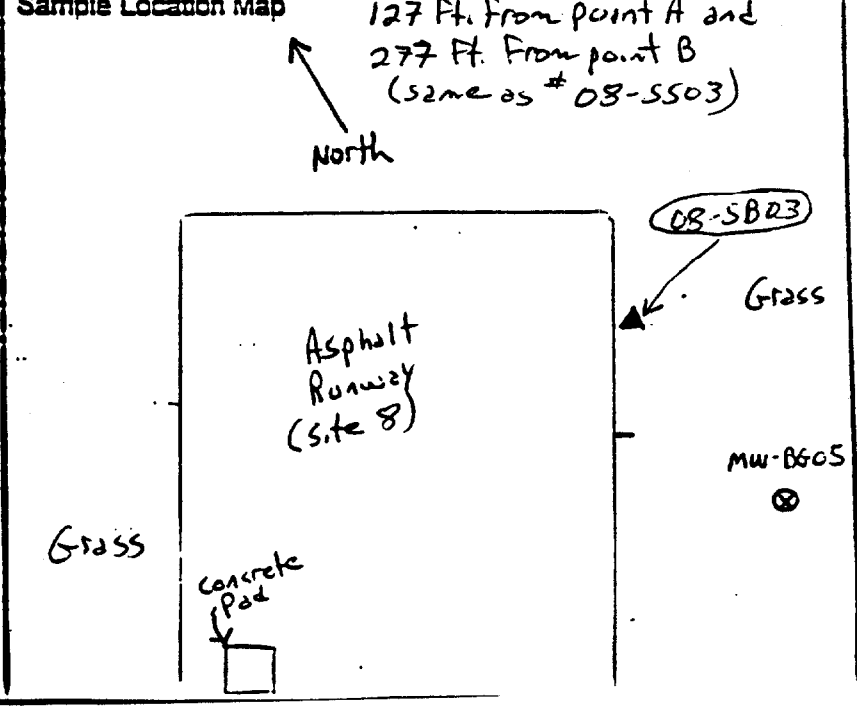
- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Orange Brown	Silty clay (moist)

Analysis	Preservative:
[ ] TCL VOAs	dark, 4°C
[ ] TCL SVOAs	dark, 4°C
[ ] TCL Pest/PCBs	dark, 4°C
[ ] TAL Metals	4°C
[ ] Cyanide	4°C
[x] PAH Lead, Arsenic, Vanadium	4°C

Sample Location Map



Observations and Notes

- [ ] Duplicate sample taken

- No elevated PID readings
- No stains or odors observed

SB-08-24

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

TETRA TECH NUS, INC.

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other _____

Project Site Name: NAWC warminster

Project Site Number: 7603

Source Number: 08-SB04

Source Location: Site 8

Sample Method: Stainless steel Auger and Hand Trowel

Depth Sampled: 3.2 Ft to 3.6 Ft

Sample Date & Time: 3-9-99 1320

Sampled by: Vince Shickora

Signature(s): [signature]

Composite Sample Data

Sample	Time	Color and Description

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[ ] TCL VOAs	dark, 4°C
[ ] TCL SVOAs	dark, 4°C
[ ] TCL Pest/PCBs	dark, 4°C
[ ] TAL Metals	4°C
[ ] Cyanide	4°C
[x] PAH, Lead, Arsenic, Vanadium	4°C

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Orange Brown	Silty clay (moist)

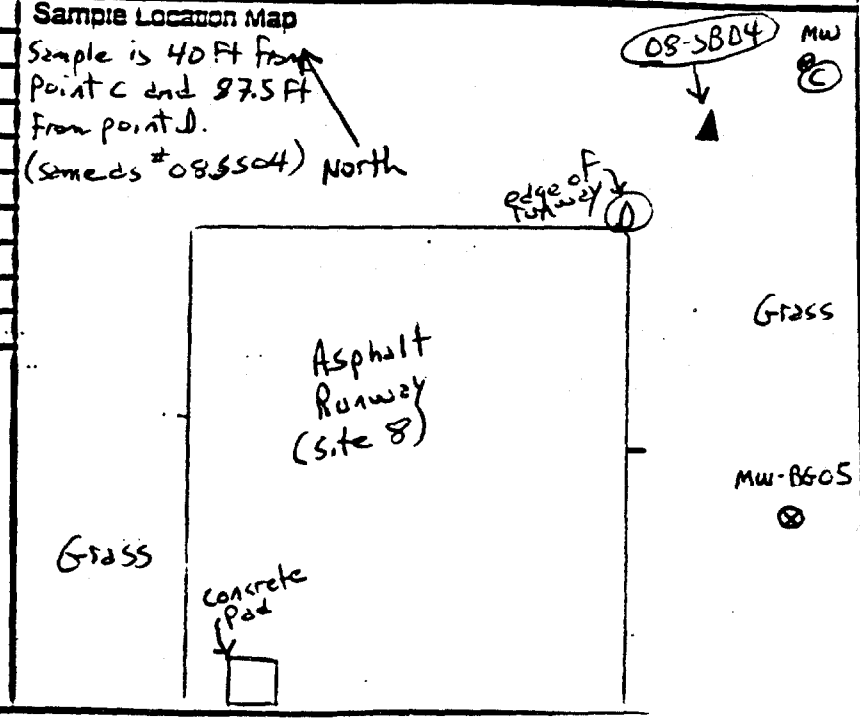
Observations and Notes

- [ ] Duplicate sample taken

- No elevated PID readings
- No stains or odors observed

Sample Location Map

Sample is 40 Ft from Point C and 87.5 Ft from point D. (Same as #08SS04)



APPENDIX E

TABULATED SURVEY DATA

FEATURE COORDINATES			
The following coordinates were obtained using March 24, 1973 aerial photographs. Refer to EPIC Report 93053, Figure 14 for descriptions of features listed.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
LQ 1	2748498.891	328245.541	328.967
P 2 - West	2748336.273	327979.584	332.412
P 3 - Center	2748369.366	327980.665	332.320
P 4 - East	2748390.856	327976.362	332.313
POSS P 5	2748415.219	328050.115	330.759
Pennsylvania coordinate system, south zone. 1927 North American Datum. National Geodetic Vertical Datum of 1929.			

SITE 8

Job Number - 4022-02 Halliburton NUS
December 29, 1995 / January 23, 1996

LOCATIONS OF SOIL BORINGS

SOIL BORING	NORTHING	EASTING
IM(4)	328303.9773	2745879.1309
IM(5)	328226.0669	2745823.4990
IM(6)	328281.9851	2745747.4202
S2-SB-01	328002.4974	2746324.5647
S2-SB-03	327870.0810	2746275.8221
S2-SB-06	327970.3125	2746450.9384
S2-SB-11	328083.7859	2746230.1976
S2-TP-02	327972.3545	2746371.8971
S3-TP-01	327897.5139	2746487.2701
S7-TP-01	326164.2505	2751355.7333
S7-TP-02	326334.7369	2751109.5689
S7-TP-03	325704.8665	2752064.3864
S7-TP-04	325730.9358	2752020.7313
S8-TP-01	328338.6303	2748683.1565 — SITE 8
WH-8SB-01	327952.3770	2748462.8695
WH-8SB-03	328045.5682	2748414.1846
WH-8SB-07	327961.7724	2748290.4796
WH-8SB-12	328067.3329	2748350.4788
WH-8SB-16	328344.7806	2748458.8990
WH-BCSB-03	327933.7120	2749290.4324
WH-MASB-01	327714.4464	2748928.8124
WH-SB-01	326086.5374	2751923.5896
WH-SB-07	326216.4179	2751936.0382
WH-SB-09	326159.6771	2751796.0413
WH-SB-13	326164.4366	2751924.8273
WH-SB-17	326218.8828	2751836.8343

FEATURE COORDINATES			
The following coordinates were obtained using March 31, 1965 aerial photographs. Refer to EPIC Report 93053, Figure 7 for descriptions of features listed.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
Site 8 - Center point	2748355.816	327934.269	335.015
TR 7 - End point	2747740.335	325173.516	348.967
TR 7 - Center point	2747962.920	325482.693	348.873
TR 7 - End point	2748168.321	325770.701	350.955
Pennsylvania coordinate system, south zone. 1927 North American Datum. National Geodetic Vertical Datum of 1929.			

APPENDIX F

TENTATIVELY IDENTIFIED COMPOUND (TIC) DATA

TETRA TECH NUS, INC.
600 Clark Avenue, Suite 3 ▪ King of Prussia, PA 19406-1433
(610) 491-9688 ▪ FAX (610) 491-9645 ▪ www.tetratech.com

C-51-3-9-9

March 9, 1999

Project 1412

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mailstop #82
10 Industrial Highway
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N642472-90-D-1298
Contract Task Order (CTO) No. 159

Subject: Tentatively Identified Compounds (TICs) for Site 8 Samples
Former Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Monaco:

As requested, Tetra Tech NUS (TtNUS) has compiled TIC soil data for the Site 8 samples that were collected during the Phase II and III RI field work (Enclosure 1). The surface and subsurface soil data were previously provided on May 18, 1998 (refer to BRPH/51-5-8-28). The groundwater TICs were compiled from readily available monitoring data for the Site 8 area (Enclosure 2).

The TIC data indicate that petroleum products and their derivatives are present in Site 8 surface and subsurface soils. Copies of this letter and the enclosure are being provided to Navy, EPA, and PADEP officials. Please contact Jeff Orient or me if you have any questions or comments.

Sincerely,

Neil Teamerson

Neil Teamerson
Project Coordinator

ANT/ejc

Enclosures

c: Thomas Ames (NAVFACENGCOM)
Timothy McEntee (NAVCFACENGCOM)
April Flipse (PADEP)
Darius Ostrauskas (EPA Region III) (with two enclosures)
Jeffrey Orient (Tetra Tech NUS)
Garth Glenn (Tetra Tech NUS) (without enclosures)

ENCLOSURE 1

SOILS TIC DATA FOR SITE 8

SS-08-01

EPA SAMPLE NO.

W-SS-08-01

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

~~Lab~~ Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-04

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CL805

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 15 Date Analyzed: 04/26/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SS-08-02

EPA SAMPLE NO

W-SS-08-02

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

~~Lab~~ Name: CEIMIC CORP. Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-05

Sample wt/vol: 5.0 (g/mL) G Lab File ID: B0316

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 14 Date Analyzed: 04/25/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

015

SS-08-03

EPA SAMPLE NO.

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

W-SS-08-03

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-06

Sample wt/vol: 5.0 (g/mL) G Lab File ID: B0317

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 15 Date Analyzed: 04/25/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

Number TICs found: 1

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	13.80	12	J

017

SS-08-04

EPA SAMPLE NO

W-SS-08-04

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

~~Lab~~ Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-07

Sample wt/vol: 5.0 (g/mL) G Lab File ID: B0318

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 18 Date Analyzed: 04/25/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	17.04	10	J

SS-08-05

EPA SAMPLE NO.

W-SS-08-05

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

~~Lab~~ Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-08

Sample wt/vol: 5.0 (g/mL) G Lab File ID: BO319

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 15 Date Analyzed: 04/25/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

21

KP 6/7

SS-08-06

EPA SAMPLE NO.

W-SS-08-06

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: WTB042

Matrix: (soil/water) SOIL Lab Sample ID: 950260-02

Sample wt/vol: 5.0 (g/mL) G Lab File ID: SB143

Level: (low/med) LOW Date Received: 04/25/95

% Moisture: not dec. 16 Date Analyzed: 04/29/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	15.22	29	J

0014

SS-08-07

EPA SAMPLE NO.

W-SS-08-07

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: WTB042

Matrix: (soil/water) SOIL Lab Sample ID: 950260-03

Sample wt/vol: 5.0 (g/mL) G Lab File ID: GB160

Level: (low/med) LOW Date Received: 04/25/95

% Moisture: not dec. 19 Date Analyzed: 04/30/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

0010

SS-08-08

EPA SAMPLE NO.

W-SS-08-08

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-09

Sample wt/vol: 5.0 (g/mL) G Lab File ID: BO320

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 17 Date Analyzed: 04/25/95

GC Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

023

SS-08-09

EPA SAMPLE NO.

W-SS-08-09

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

~~Lab~~ Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: _____ SDG No.: TB0421

Matrix: (soil/water) SOIL Lab Sample ID: 950254-10

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CL806

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: not dec. 18 Date Analyzed: 04/26/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

55-08-12

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO
WH-BSS-03

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-05

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0940

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 31 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 75694	Methane, trichloromonofluoro	3.12	51	JN
2.	Unknown	4.77	9	J

SS-08-12 (RE)

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-03RE

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-05RE

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP010

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 31 Date Analyzed: 10/09/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	19.47	9	J
2.	Benzene, dichloro- isomer	19.86	13	J
3.	Unknown	20.20	29	J
4.	Siloxane isomer	21.03	7	J

SS-08-13

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-04

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-07

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0941

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 27 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 75694	Methane, trichloromonofluoro	3.15	12	JN
2.	Unknown	20.20	8	J

SS-08-14

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-05

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-03

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0943

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: not dec. 21 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

Dup of SS-08-14
SS-08-15

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-06

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-04

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0944

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: not dec. 21 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	3.41	9	J

SS-08-16

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-BSS-07

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-05

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0945

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: not dec. 18 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

55-08-16 (RE

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-07RE

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-05RE

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0961

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: not dec. 18 Date Analyzed: 10/07/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Benzene, dichloro- isomer	19.87	12	J
2.	Aliphatic hydrocarbon	20.21	26	J

SS-08-17

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
W-SS-01

ab Name: CEIMIC CORP Contract: NUS

ab Code: CEIMIC Case No.: 3933 SAS No.: _____ SDG No.: W-SB-13

atrix: (soil/water) SOIL Lab Sample ID: 920323-11

ample wt/vol: 5.0 (g/mL) G Lab File ID: CA285

evel: (low/med) LOW Date Received: 06/19/92

Moisture: not dec. 10 Date Analyzed: 06/25/92

C Column: DB-624 ID: 0.530 (mm) Dilution Factor: 1.0

oil Extract Volume: _____ (uL) Soil Aliquot Volume: _____(uL)

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	20.92	130	J

00

TOTAL PETROLEUM HYDROCARBON

BY IR

EPA Method 418.1

Client: Halliburton NUS

Project: 920323

Date Samples Received: 6/19/92

Concentration in: mg/kg(ppm)*

Client ID	Laboratory ID	Sample Concentration	Method Reporting Limit
W-SB-13	920323-01	ND	36
W-SB-14	920323-02	ND	36
W-SB-15	920323-03	ND	34
W-SB-15-D	920323-04	ND	35
W-SB-16	920323-05	ND	32
W-SB-17	920323-09	ND	34
W-SB-18	920323-10	ND	37
* W-SS-01	920323-11	200	33
W-SS-02	920323-12	ND	37
SS-08-17			
QA/QC			
Method Blank	I0623-B1	ND	33
Laboratory Control Spike	I0623-LCS1	71%	
Independent Calibration Standard	I0708-ICS1	88%	

ND = Not detected
- = dry weight basis

Reported by: N. [illegible]

Approved by: [illegible]

55-08-18

EPA SAMPLE NO.

W-SS-03

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: CEIMIC CORP Contract: NUS

Lab Code: CEIMIC Case No.: 3933 SAS No.: _____ SDG No.: W-SB-19

Matrix: (soil/water) SOIL Lab Sample ID: 920328-07

Sample wt/vol: 5.0 (g/mL) G Lab File ID: G2307

Level: (low/med) LOW Date Received: 06/23/92

% Moisture: not dec. 18 Date Analyzed: 06/24/92

GC Column: SP-1000 ID: 2.00 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

00 028

TOTAL PETROLEUM HYDROCARBON

BY IR

EPA Method 418.1

Client: Halliburton NUS

Project: 920328

Date Samples Received: 6/23/92

Concentration in: mg/kg (ppm)*

Client ID	Laboratory ID	Sample Concentration	Method Reporting Li
W-SB-19	920328-01	ND	35
W-SB-19-D	920328-02	ND	31
* W-SS-03	920328-07	60	41
SS-08-18			
QA/QC			
Method Blank	I0625-B1	ND	30
Laboratory Control Spike	I0625-LCS1	69% Recovery	
Independent Calibration Standard	I0708-ICS1	88% Recovery	

ND = Not detected

+ = Dry weight basis

Reported by: HC

Approved by: Henry Lib

1174

SS-08-01

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-03-01

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-04

Sample wt/vol: 30.1 (g/mL) G Lab File ID: AG618

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 17 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/05/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 15

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.24	28000	ABJN
2. 000000	Unknown	4.38	440	BJ
3. 000000	Unknown	4.51	120	BJ
4. 000000	Unknown	4.66	80	BJ
5.	Unknown	5.44	80	J
6. 000000	Unknown	5.53	160	BJ
7. 000000	Unknown	5.85	120	BJ
8. 000000	Unknown	6.08	640	BJ
9. 000000	Unknown	7.85	320	BJ
10.	Unknown	8.68	80	J
11.	Unknown	9.52	160	J
12.	Unknown amide	20.25	120	J
13. 000000	Unknown amide	22.02	400	BJ
14.	C20H12 Polynuclear aromatic	22.69	160	J
15.	Aliphatic hydrocarbon	23.87	120	J

SS-08-02

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-08-02

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-05

Sample wt/vol: 30.1 (g/mL) G Lab File ID: DG389

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 14 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/06/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.5

Number TICs found: 17

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 000000	Unknown	4.46	1100	BJ
2. 141797	3-Penten-2-one, 4-methyl-	5.28	22000	ABJN
3.	Unknown	5.48	77	J
4.	Unknown	5.66	19000	J
5. 123422	2-Pentanone, 4-hydroxy-4-met	6.17	35000	ABJN
6.	Unknown	6.78	77	J
7.	Unknown	7.16	270	J
8. 000000	Unknown	7.26	120	BJ
9. 000000	Unknown	7.55	77	BJ
10. 000000	Unknown	7.73	660	BJ
11.	Unknown	7.94	120	J
12.	Unknown	11.02	120	J
13.	Unknown	11.21	77	J
14.	Unknown amide	21.24	230	J
15. 000000	Unknown amide	23.36	850	BJ
16.	Unknown aldehyde	23.66	77	J
17.	Aliphatic hydrocarbon	25.75	150	J

SS-08-03

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-08-03

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-06

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DG390

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 16 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/06/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	000000	Unknown	4.06	120	BJ
2.		Unknown	4.35	79	J
3.	000000	Unknown	4.47	1200	BJ
4.		Unknown	4.57	200	J
5.	141797	3-Penten-2-one, 4-methyl-	5.29	23000	ABJN
6.		Unknown	5.67	1300	J
7.	123422	2-Pentanone, 4-hydroxy-4-met	6.18	40000	ABJN
8.		Unknown	7.15	200	J
9.	000000	Unknown	7.26	160	BJ
10.	000000	Unknown	7.73	600	BJ
11.		Unknown	7.94	160	J
12.	000000	Unknown	9.45	79	BJ
13.		Unknown	10.58	79	J
14.		Unknown	11.02	240	J
15.		Unknown	11.20	200	J
16.		Unknown amide	21.25	120	J
17.		Aliphatic hydrocarbon	22.80	79	J
18.	000000	Unknown amide	23.35	360	BJ
19.		Aliphatic hydrocarbon	25.74	120	J

SS-08-04

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-08-04

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-07

Sample wt/vol: 30.2 (g/mL) G Lab File ID: DG391

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 15 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/06/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.7

Number TICs found: 12

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 000000	Unknown	4.47	930	BJ
2.	Unknown	4.56	270	J
3. 141797	3-Penten-2-one, 4-methyl-	5.26	20000	ABJN
4. 000000	Unknown	5.65	2100	BJ
5. 123422	2-Pentanone, 4-hydroxy-4-met	6.11	27000	ABJN
6.	Unknown	7.14	230	J
7. 000000	Unknown	7.65	190	BJ
8. 000000	Unknown	7.73	350	BJ
9. 000000	Unknown	9.42	310	BJ
10.	Unknown	11.01	160	J
11.	Unknown amide	21.25	78	J
12. 000000	Unknown amide	23.35	230	BJ

SS-08-05

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE No.

W-SS-08-05

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-08

Sample wt/vol: 30.3 (g/mL) G Lab File ID: AG616

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 12 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/05/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 7

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.29	33000	ABJN
2. 000000	C9H20 isomer	4.38	150	BJ
3. 000000	Unknown	5.54	150	BJ
4. 000000	Unknown	5.86	150	BJ
5. 000000	Unknown	6.09	560	BJ
6. 000000	Unknown	7.86	190	BJ
7. 000000	Unknown	22.02	190	BJ

SS-08-06

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

W-SS-08-06

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: SDG No.: WTB042

Matrix: (soil/water) SOIL Lab Sample ID: 950260-02

Sample wt/vol: 30.1 (g/mL) G Lab File ID: JD050

Level: (low/med) LOW Date Received: 04/25/95

% Moisture: 18 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/12/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 000000	Unknown	4.98	120	BJ
2. 000000	Unknown	5.48	1000	BJ
3. 141797	3-Penten-2-one, 4-methyl-	6.42	14000	ABJN
4. 000000	Unknown	6.82	3400	BJ
5. 000000	Unknown	6.95	850	BJ
6. 123422	2-Pentanone, 4-hydroxy-4-met	7.26	19000	ABJN
7.	Unknown	7.53	200	J
8.	Unknown	7.96	120	J
9.	Unknown	8.36	240	J
10. 000000	Unknown	8.45	160	BJ
11. 000000	Unknown	8.79	160	BJ
12. 000000	Unknown	8.91	970	BJ
13. 000000	Unknown	9.09	160	BJ
14.	Unknown	9.58	1100	J
15.	Unknown	9.96	120	J
16.	Unknown	22.13	280	J
17.	Unknown	24.61	930	J
18.	Aliphatic hydrocarbon	25.46	120	J
19.	Unknown	25.53	160	J
20.	Aliphatic hydrocarbon	27.67	160	J

0035

SS-08-07

EPA SAMPLE NO.

W-SS-08-07

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: WTB042

Matrix: (soil/water) SOIL Lab Sample ID: 950260-03

Sample wt/vol: 30.4 (g/mL) G Lab File ID: JD045

Level: (low/med) LOW Date Received: 04/25/95

% Moisture: 16 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/11/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 000000	Unknown	5.04	160	BJ
2.	Unknown	5.15	78	J
3. 000000	Unknown	5.54	1300	BJ
4. 141797	3-Penten-2-one, 4-methyl-	6.47	13000	ABJN
5. 000000	Unknown	6.84	2600	BJ
6. 123422	2-Pentanone, 4-hydroxy-4-met	7.30	17000	ABJN
7. 000000	Unknown alkane	7.44	160	BJ
8. 000000	Unknown alkane	7.56	230	BJ
9.	Unknown	8.00	120	J
10. 000000	Unknown	8.51	78	BJ
11.	Unknown	8.76	78	J
12. 000000	Unknown	8.85	160	BJ
13. 000000	Unknown	8.95	510	BJ
14.	Unknown	9.26	78	J
15.	Unknown	9.62	1000	J
16.	Unknown	10.00	78	J
17.	Unknown	10.42	160	J
18. 000000	Unknown	10.66	470	BJ
19.	Unknown amide	24.67	78	J

0038

SS-08-08

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

W-SS-08-08

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CT0159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-09

Sample wt/vol: 30.1 (g/mL) G Lab File ID: AG617

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 18 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/05/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 12

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	123422	2-Pentanone, 4-hydroxy-4-met	4.30	32000	ABJN
2.	000000	C9H20 isomer	4.39	160	BJ
3.	000000	Unknown	4.68	81	BJ
4.	000000	Unknown	5.54	160	BJ
5.	000000	Unknown	5.86	120	BJ
6.	000000	Unknown	6.08	410	BJ
7.		Unknown	6.40	81	J
8.	000000	Unknown	7.85	320	BJ
9.		Unknown amide	20.25	120	J
10.	000000	Unknown amide	22.07	410	BJ
11.		Unknown	22.29	120	J
12.		Aliphatic hydrocarbon	23.38	81	J

SS-08-09

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-08-09

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: CTO159 SAS No.: SDG No.: TB-042

Matrix: (soil/water) SOIL Lab Sample ID: 950254-10

Sample wt/vol: 30.0 (g/mL) G Lab File ID: AG615

Level: (low/med) LOW Date Received: 04/22/95

% Moisture: 14 decanted: (Y/N) N Date Extracted: 04/27/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 05/05/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.5

Number TICs found: 6

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.22	28000	ABJN
2. 000000	Unknown	4.37	120	BJ
3. 000000	Unknown	5.53	120	BJ
4. 000000	Unknown	6.07	230	BJ
5.	Unknown amide	20.25	190	J
6. 000000	Unknown amide	22.02	620	BJ

51-08-10

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SS-01

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-16

Sample wt/vol: 30.1 (g/mL) G Lab File ID: DI144

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 22 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 22 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	5.42	3200	AJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	6.14	6800	ABJN
3.	Unknown	7.83	470	J
4.	Unknown	8.02	430	J
5.	Unknown	9.51	940	J
6.	Aliphatic hydrocarbon	13.92	380	J
7.	Aliphatic hydrocarbon	20.05	340	J
8.	Unknown	21.33	470	J
9.	Aliphatic hydrocarbon	22.77	470	J
10.	Aliphatic hydrocarbon	23.27	720	J
11.	Unknown	23.40	430	J
12.	Unknown aldehyde	23.50	1100	J
13.	Unknown alkene	23.88	4300	J
14.	Polynuclear aromatic hydroca	24.20	430	J
15.	Aliphatic hydrocarbon	25.18	1400	J
16.	Unknown alcohol/alkene	25.28	430	J
17.	Unknown steroid	26.91	430	J
18.	Aliphatic hydrocarbon	27.06	720	J
19.	Unknown steroid	27.86	720	J
20.	Unknown	29.40	380	J
21.	Unknown	29.67	720	J
22.	Unknown	30.39	680	J

SS-08-11
Dup of SS-08-10

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE N

WH-8SS-02

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-17

Sample wt/vol: 30.3 (g/mL) G Lab File ID: DI161

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 21 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/19/95

Injection Volume: 2.0 (uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) Y pH: 7.1

Number TICs found: 20

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.64	10000	AJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.38	8800	ABJN
3. 000000	Unknown	7.14	840	BJ
4.	Unknown	8.81	840	J
5.	Unknown	21.36	1700	J
6.	Unknown	22.15	840	J
7.	Unknown	22.77	840	J
8.	Polynuclear aromatic hydroca	22.87	840	J
9.	Aliphatic hydrocarbon	23.04	1300	J
10.	Unknown alcohol/alkene	23.10	4200	J
11.	Polynuclear aromatic hydroca	23.27	840	J
12.	Aliphatic hydrocarbon	23.56	1300	J
13.	Unknown	23.96	1700	J
14.	Aliphatic hydrocarbon	24.16	1700	J
15.	Unknown	24.31	1700	J
16.	Unknown	25.82	840	J
17.	Unknown	25.97	1700	J
18.	Unknown steroid	26.38	1300	J
19.	Unknown	27.06	1700	J
20.	Unknown steroid	27.75	1300	J

SS-08-12

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE I

WH-8SS-03

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-05

Sample wt/vol: 30.3 (g/mL) G Lab File ID: JF150

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 23 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/21/95

Injection Volume: 2.0(uL) Dilution Factor: 40.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 4 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Polynuclear aromatic hydroca	18.38	3400	J
2.	Aliphatic hydrocarbon	18.98	3400	J
3.	Unknown	19.24	3400	J
4.	Unknown	19.30	3400	J

SS-08-13

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

WH-8SS-04

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-07

Sample wt/vol: 30.3 (g/mL) G Lab File ID: DI244

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 27 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0(uL) Dilution Factor: 5.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	141797	3-Penten-2-one, 4-methyl-	4.62	11000	ABJN
2.		Unknown	7.11	2000	J
3.	2091294	9-Hexadecanoic acid	18.36	1400	JN
4.	57103	Hexadecanoic acid	18.51	2700	JN
5.		Unknown	18.82	1600	J
6.		Unknown fatty acid	19.71	2900	J
7.		Aliphatic hydrocarbon	22.12	1400	J
8.		Unknown aldehyde	22.74	1800	J
9.		Unknown alkene	23.07	12000	J
10.		Polynuclear aromatic hydroca	23.27	1600	J
11.		Aliphatic hydrocarbon	23.52	1100	J
12.		Unknown	23.62	1600	J
13.		Unknown	23.91	1400	J
14.		Aliphatic hydrocarbon	24.13	5200	J
15.		Unknown alkene	24.25	2500	J
16.		Unknown	24.39	1400	J
17.		Unknown	24.98	1400	J
18.		Aliphatic hydrocarbon	25.67	2500	J
19.	83476	.gamma.-Sitosterol	26.34	2000	JN
20.		Unknown	27.00	2700	J
21.	1058613	Stigmast-4-en-3-one	27.71	1600	JN

SS-08-14

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-05

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-03

Sample wt/vol: 30.3 (g/mL) G Lab File ID: DI241

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 20 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.73	25000	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.49	7000	ABJN
3.	Unknown	8.79	1400	J
4. 1002842	Pentadecanoic acid	17.39	1100	JN
5. 2091294	9-Hexadecanoic acid	18.39	1100	JN
6.	Unknown	18.45	660	J
7.	Unknown	18.84	1300	J
8. 112801	Oleic acid	19.74	3000	JN
9.	Unknown alcohol/alkene	20.29	620	J
10.	Aliphatic hydrocarbon	22.12	620	J
11.	Unknown fatty acid	22.42	1700	J
12.	Unknown aldehyde	22.74	780	J
13.	Unknown alcohol/alkene	23.06	2800	J
14.	Unknown aldehyde	23.79	820	J
15.	Aliphatic hydrocarbon	24.13	1100	J
16.	Unknown	24.29	820	J
17.	Unknown	24.38	820	J
18.	Polynuclear aromatic hydroca	25.16	660	J
19.	Unknown steroid	26.32	620	J
20.	Unknown	27.00	990	J
21.	Unknown	27.41	700	J

Dup of SS-08-14
SS-08-15

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-06

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-04

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DI242

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 20 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.0

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.79	28000	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.53	9600	ABJN
3. 57103	Hexadecanoic acid	18.57	1900	JN
4.	Unknown	18.85	1500	J
5. 112801	Oleic acid	19.72	4200	JN
6.	Aliphatic hydrocarbon	22.13	1300	J
7.	Unknown aldehyde	22.73	1700	J
8.	Aliphatic hydrocarbon	23.02	4200	J
9.	Unknown alcohol	23.05	6200	J
10.	Aliphatic hydrocarbon	24.14	3800	J
11.	Unknown alcohol/alkene	24.24	1400	J
12.	Aliphatic hydrocarbon	25.68	2000	J
13.	Unknown steroid	26.32	2000	J
14.	Unknown	26.54	1100	J
15.	Unknown	26.92	1700	J
16.	Unknown	27.03	2000	J
17.	Unknown	27.41	3700	J
18.	Unknown	27.76	2700	J
19.	Unknown	28.34	2600	J
20.	Terpene alcohol	28.66	1700	J
21.	Terpene alcohol	29.56	3500	J
22.	Terpene alcohol	29.78	7900	J

SS-08-16

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SS-07

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-05

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DI243

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 17 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.72	26000	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.50	8000	ABJN
3. 000000	Unknown	7.16	960	BJ
4.	Unknown	8.80	1200	J
5. 1002842	Pentadecanoic acid	17.38	760	JN
6. 2091294	9-Hexadecanoic acid	18.39	800	JN
7.	Unknown	18.46	600	J
8. 57103	Hexadecanoic acid	18.54	1300	JN
9.	Unknown alcohol/alkene	18.84	1100	J
10.	Unknown fatty acid	19.73	720	J
11. 112856	Docosanoic acid	21.61	600	JN
12.	Unknown fatty acid	22.00	480	J
13.	Aliphatic hydrocarbon	22.12	800	J
14.	Unknown fatty acid	22.42	520	J
15.	Unknown aldehyde	22.74	880	J
16.	Unknown alcohol/alkene	23.07	2600	J
17.	Unknown	23.62	480	J
18.	Unknown	23.81	520	J
19.	Aliphatic hydrocarbon	24.13	1000	J
20.	Unknown alcohol/alkene	24.23	720	J
21.	Unknown	24.39	560	J
22.	Aliphatic hydrocarbon	25.67	520	J

FORM I SV-TIC

SS-08-17

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

W-SS-01

Lab Name: CEIMIC CORP Contract: NUS

Lab Code: CEIMIC Case No.: 3933 SAS No.: _____ SDG No.: W-SB-13

Matrix: (soil/water) SOIL Lab Sample ID: 920323-11

Sample wt/vol: 30.4 (g/mL) G Lab File ID: J2355

Level: (low/med) LOW Date Received: 06/19/92

% Moisture: 10 decanted: (Y/N) N Date Extracted: 06/23/92

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 07/15/92

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 30.4

Number TICs found: 18

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	4.17	1100	J
2. 123422	2-Pentanone, 4-hydroxy-4-met	4.70	22000	ABJN
3.	Unknown	7.01	400	J
4.	Unknown	12.37	690	J
5.	Methylphenanthrene isomer	19.33	73	J
6.	Unknown	19.51	110	J
7.	Unknown	22.22	180	J
8.	Unknown	22.80	73	J
9.	Unknown	22.93	73	J
10.	Unknown aliphatic aldehyde	23.10	180	J
11.	C20H12 isomer	24.90	290	J
12.	Unknown	24.96	620	J
13.	C20H12 isomer	25.12	400	J
14.	Aliphatic hydrocarbon	25.81	370	J
15.	Unknown	26.02	370	J
16.	Unknown	26.49	260	J
17.	C22H12 isomer	26.89	510	J
18.	Unknown	29.68	400	J

SS-08-18

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

W-SS-03

Lab Name: CEIMIC CORP Contract: NUS

Lab Code: CEIMIC Case No.: 3933 SAS No.: _____ SDG No.: W-SB-19

Matrix: (soil/water) SOIL Lab Sample ID: 920328-07

Sample wt/vol: 30.1 (g/mL) G Lab File ID: J2337

Level: (low/med) LOW Date Received: 06/23/92

% Moisture: 17 decanted: (Y/N) N Date Extracted: 06/25/92

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 07/13/92

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.9

Number TICs found: 11

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
~~1. 000000~~	~~Unknown~~	~~4.25~~	~~1400~~	~~BJ~~
~~2. 123422~~	~~2-Pentanone, 4-hydroxy-4-met~~	~~4.87~~	~~26000~~	~~ABJN~~
3.	Unknown	6.15	320	J
4.	Unknown	7.30	360	J
5.	Unknown	12.07	160	J
6.	Unknown	13.23	80	J
7.	Unknown	27.85	80	J
8.	Aliphatic hydrocarbon	30.34	120	J
9.	Unknown	30.44	80	J
10.	Unknown	31.56	160	J
11.	Aliphatic hydrocarbon	33.65	200	J

080

SB-08-05

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-05

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-03

Sample wt/vol: 1.0 (g/mL) G Lab File ID: C0957

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 13 Date Analyzed: 10/07/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Aliphatic hydrocarbon	20.21	220	J
2.	Aliphatic hydrocarbon	20.83	29	J
3.	C4-Benzene isomer	21.43	170	J
4.	Unknown	21.71	69	J

SB-08-06

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

WH-8SB-06

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-04

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0985

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 13 Date Analyzed: 10/08/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SB-08-07

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-07

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-06

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0925

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 16 Date Analyzed: 10/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SB-08-08

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

WH-8SB-08

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-08

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0942

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 15 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SB-08-09

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-09

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-09

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0923

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: not dec. 15 Date Analyzed: 10/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SB-08-15

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-15

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-10

Sample wt/vol: 5.0 (g/mL) G Lab File ID: C0946

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: not dec. 17 Date Analyzed: 10/06/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TP01-08-01

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

S8-TP01-01

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: TP0101

Matrix: (soil/water) SOIL Lab Sample ID: 950892-01

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP595

Level: (low/med) LOW Date Received: 10/31/95

% Moisture: not dec. 15 Date Analyzed: 11/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TP01-08-02

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

S8-TP01-02

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: TP0101

Matrix: (soil/water) SOIL Lab Sample ID: 950892-02

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP596

Level: (low/med) LOW Date Received: 10/31/95

% Moisture: not dec. 19 Date Analyzed: 11/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TP02-08-03

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

S8-TP02-01

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: TP0101

Matrix: (soil/water) SOIL Lab Sample ID: 950892-03

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP597

Level: (low/med) LOW Date Received: 10/31/95

% Moisture: not dec. 13 Date Analyzed: 11/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____(uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TP02-08-04

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

S8-TP02-10

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: TP0101

Matrix: (soil/water) SOIL Lab Sample ID: 950892-04

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP600

Level: (low/med) LOW Date Received: 10/31/95

% Moisture: not dec. 13 Date Analyzed: 11/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

TP-02-08-05

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

S8-TP02-02

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: TP0101

Matrix: (soil/water) SOIL Lab Sample ID: 950892-05

Sample wt/vol: 5.0 (g/mL) G Lab File ID: CP601

Level: (low/med) LOW Date Received: 10/31/95

% Moisture: not dec. 18 Date Analyzed: 11/05/95

GC Column: HP-624 ID: 0.530 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

SB-08-01

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SB-01

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-18

Sample wt/vol: 30.5 (g/mL) G Lab File ID: DI138

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 9 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.2

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	5.35	5400	AJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	6.07	3100	ABJN
3. 000000	Unknown	7.80	180	BJ
4.	Unknown	9.47	180	J

SB-08-02

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE :

WH-8SB-02

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-20

Sample wt/vol: 30.5 (g/mL) G Lab File ID: DI140

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 11 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 5.7

Number TICs found: 10

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	6.12	5200	ABJN
2. 000000	Unknown	8.02	410	BJ
3. 100527	Benzaldehyde	8.16	180	JN
4.	Unknown	8.82	290	J
5. 98862	Acetophenone	9.77	700	JN
6. 65850	Benzoic acid	11.41	3700	JN
7.	Unknown	12.60	150	J
8. 134316	Ethanedione, diphenyl-	18.53	180	JN
9. 120467	1,3-Propanedione, 1,3-diphen	20.07	1100	JN
10.	Unknown aromatic	23.60	220	J

SD-08-03

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SB-03

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-19

Sample wt/vol: 30.5 (g/mL) G Lab File ID: DI139

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 10 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.2

Number TICs found: 8

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	6.11	4400	ABJN
2.	Unknown	7.83	620	J
3.	Unknown	8.00	290	J
4.	Unknown	10.69	110	J
5.	Phenol,-fluoro,-nitro isomer	10.93	180	J
6.	Phenol,-fluoro,-nitro isomer	13.12	110	J
7.	Unknown	13.19	150	J
8.	Unknown	14.41	110	J

SB-08-04

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE N

WH-8SB-04

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: WHRB09

Matrix: (soil/water) SOIL Lab Sample ID: 950743-21

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DI142

Level: (low/med) LOW Date Received: 09/29/95

% Moisture: 12 decanted: (Y/N) N Date Extracted: 10/02/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.0

Number TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	6.12	5300	ABJN
2. 000000	Unknown	7.82	760	BJ
3.	Unknown	8.02	720	J
4.	Unknown	9.49	380	J
5. 65850	Benzoic acid	11.07	340	JN
6. 120467	1,3-Propanedione, 1,3-diphen	20.08	230	JN
7.	Aliphatic hydrocarbon	20.42	380	J
8.	Unknown	20.66	300	J
9.	Unknown	21.10	420	J
10.	Unknown	21.29	490	J
11.	Unknown amide	21.35	300	J
12.	Unknown adipate	21.44	450	J
13.	Unknown	21.62	530	J
14.	Unknown	21.87	530	J
15.	Unknown	22.28	380	J
16.	Unknown alkene	22.48	270	J
17.	Unknown	22.55	270	J
18.	Unknown	22.82	380	J
19.	Unknown	23.12	340	J
20.	Unknown	23.34	450	J
21.	Unknown	23.67	380	J

SB-08-05

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SB-05

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-03

Sample wt/vol: 30.2 (g/mL) G Lab File ID: JF100

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 12 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.63	4000	ABJN
2.	Unknown	6.79	490	J
3.	Unknown	6.96	150	J
4.	Unknown	16.43	150	J

SB-08-05 (RE)

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE N

WH-8SB-05RE

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-03RE

Sample wt/vol: 30.2 (g/mL) G Lab File ID: JF118

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 12 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/19/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.61	2400	ABJN
2.	Unknown	6.76	560	J
3.	Unknown	6.94	150	J
4.	Unknown	16.40	150	J

SB-08-06

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SB-06

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-04

Sample wt/vol: 30.0 (g/mL) G Lab File ID: JF098

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 15 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.7

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 123422	2-Pentanone, 4-hydroxy-4-met	4.64	6000	ABJN
2.	Unknown	6.59	350	J
3.	Unknown	6.82	240	J
4.	Unknown	6.96	120	J
5.	Unknown amide	16.39	120	J

SB-08-07

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE N.

WH-8SB-07

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-06

Sample wt/vol: 30.2 (g/mL) G Lab File ID: JF103

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 15 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	3.80	6000	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	4.64	3700	ABJN
3.	Unknown	6.66	120	J
4.	Unknown	6.95	160	J
5.	Unknown	16.41	120	J

SB-08-08

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE N

WH-8SB-08

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-08

Sample wt/vol: 30.0 (g/mL) G Lab File ID: JF102

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 18 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 6 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	3.80	7900	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	4.69	5200	ABJN
3.	Unknown	6.67	120	J
4.	Unknown	6.90	120	J
5.	Aliphatic hydrocarbon	15.84	120	J
6.	Unknown	16.42	160	J

SB-08-09

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO

WH-8SB-09

Lab Name: CEIMIC CORP Contract: BROWN_ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-09

Sample wt/vol: 30.0 (g/mL) G Lab File ID: JF101

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 13 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 6

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	3.80	8300	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	4.62	4100	ABJN
3.	Unknown	6.61	230	J
4.	Unknown	15.83	110	J
5.	Unknown amide	16.39	310	J
6.	Unknown	16.54	77	J

SB-08-10

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE

WH-8SB-10

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB0929

Matrix: (soil/water) SOIL Lab Sample ID: 950784-10

Sample wt/vol: 30.1 (g/mL) G Lab File ID: JF099

Level: (low/med) LOW Date Received: 09/30/95

% Moisture: 13 decanted: (Y/N) N Date Extracted: 10/09/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/18/95

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.1

Number TICs found: 5 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	3.80	7800	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	4.64	4300	ABJN
3.	Unknown	6.83	230	J
4.	Unknown	6.96	110	J
5.	Unknown	16.42	110	J

SB-08-11

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-11

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-06

Sample wt/vol: 30.3 (g/mL) G Lab File ID: DI240

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 11 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.66	6700	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.43	5900	ABJN
3. 000000	Unknown	7.13	370	BJ
4.	Unknown	7.33	220	J
5.	Unknown	8.05	74	J

SB-08+12

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-12

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-07

Sample wt/vol: 30.2 (g/mL) G Lab File ID: DI233

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 14 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.2

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.63	6500	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.40	5400	ABJN
3. 000000	Unknown	7.12	380	BJ
4.	Unknown	7.31	150	J

SB-OB-13

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-13

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-08

Sample wt/vol: 30.5 (g/mL) G Lab File ID: DI234

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 7 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.9

Number TICs found: 4

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.63	6000	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.40	4600	ABJN
3. 000000	Unknown	7.12	280	BJ
4.	Unknown	13.90	71	J

SB-08-14

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-14

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-09

Sample wt/vol: 30.3 (g/mL) G Lab File ID: DI235

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 11 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.6

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.64	5200	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.38	3300	ABJN
3. 000000	Unknown	7.13	700	BJ
4.	Unknown	8.80	110	J
5. 57103	Hexadecanoic acid	18.49	110	JN

SB-08-15

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-15

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-10

Sample wt/vol: 30.4 (g/mL) G Lab File ID: DI237

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 13 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.8

Number TICs found: 6

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.59	4200	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.36	3000	ABJN
3. 000000	Unknown	7.11	300	BJ
4.	Unknown alkene	19.54	150	J
5.	Unknown amide	20.80	230	J
6.	Unknown	22.64	190	J

SB-08-16

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-16

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 950802-11

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DI238

Level: (low/med) LOW Date Received: 10/04/95

% Moisture: 19 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.3

Number TICs found: 5

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.65	6200	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.40	4500	ABJN
3. 000000	Unknown	7.14	660	BJ
4.	Unknown	8.79	210	J
5. 57103	Hexadecanoic acid	18.49	120	JN

SB-08-17

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

WH-8SB-17

Lab Name: CEIMIC CORP Contract: BROWN ROOT

Lab Code: CEIMIC Case No.: 1412 SAS No.: _____ SDG No.: RB1003

Matrix: (soil/water) SOIL Lab Sample ID: 590802-14

Sample wt/vol: 30.0 (g/mL) G Lab File ID: DI239

Level: (low/med) LOW Date Received: 10/05/95

% Moisture: 13 decanted: (Y/N) N Date Extracted: 10/19/95

Concentrated Extract Volume: 500.0 (uL) Date Analyzed: 10/25/95

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 5.3

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 141797	3-Penten-2-one, 4-methyl-	4.63	3600	ABJN
2. 123422	2-Pentanone, 4-hydroxy-4-met	5.37	2600	ABJN
3.	Unknown	8.42	420	J
4.	Aliphatic hydrocarbon	8.81	880	J
5. 493027	Naphthalene, decahydro-, tra	8.97	570	JN
6.	Unknown	10.85	420	J
7.	Aliphatic hydrocarbon	10.98	770	J
8.	Unknown alcohol	11.18	380	J
9.	Unknown	11.51	500	J
10.	Aliphatic hydrocarbon	11.72	1300	J
11.	Alicyclic hydrocarbon	12.00	570	J
12.	Aliphatic hydrocarbon	12.19	500	J
13.	Aliphatic hydrocarbon	12.45	500	J
14.	Alicyclic hydrocarbon	12.65	840	J
15.	Unknown	12.81	420	J
16.	Unknown	13.08	420	J
17.	Aliphatic hydrocarbon	13.23	570	J
18.	Aliphatic hydrocarbon	13.29	840	J
19.	Unknown	13.57	570	J
20.	Unknown	13.69	460	J
21.	Aliphatic hydrocarbon	13.86	1300	J
22.	Unknown	14.09	610	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SB-08-21

08-SB01

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-02

Sample wt/vol: 30 (g/ml) G Lab File ID: L0312011.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 20 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/12/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.1

CONCENTRATION UNITS:

Number TICs found: 14 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.13	91	J
2.	unknown aldol condensate	6.53	120	JA B
3.	unknown aldol condensate	7.19	90	JA
4.	unknown aldol condensate	7.93	12000	JA B
5.	unknown aldol condensate	8.13	180	JA B
6.	unknown ketone	10.14	100	J
7.	unknown ketone	12.86	88	J
8.	unknown	13.34	170	J B
9.	unknown biphenyl isomer	27.97	110	J
10.	unknown	36.26	96	J
11.	unknown	36.99	110	J
12.	unknown	37.44	93	J
13. 000538-23-8	Glycerol tricaprylate	38.44	190	JN
14.	unknown	40.09	180	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SB-08-22

08-SB02

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: VA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-04

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316003.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 20 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

CONCENTRATION UNITS:

Number TICs found: 12 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.34	380	J
2.	unknown aldol condensate	7.41	130	JA B
3.	unknown aldol condensate	8.05	100	JA B
4.	unknown aldol condensate	8.76	11000	JA B
5.	unknown aldol condensate	9.02	120	JA B
6.	unknown	14.26	130	J B
7.	unknown	17.06	100	J
8.	unknown	38.51	150	J
9. 000538-23-8	Glycerol tricaprylate	39.51	390	JN
10.	unknown	41.41	350	J
11.	unknown	43.78	97	J
12.	unknown sterol type	44.63	89	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SB-08-23

08-SB03

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-06

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316005.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 16 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.4

Number TICs found: 12 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.33	290	J
2.	unknown aldol condensate	7.38	140	JAB
3.	unknown aldol condensate	8.02	100	JAB
4.	unknown aldol condensate	8.78	13000	JAB
5.	unknown aldol condensate	9.00	140	JAB
6.	unknown	14.26	120	JB
7.	unknown phthalate	35.87	96	J
8.	unknown	37.84	370	J
9.	unknown	38.51	100	J
10.	unknown	39.52	2300	J
11.	unknown	41.43	1900	J
12.	unknown	43.78	520	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SB-08-24

08-SB04

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: A001

Matrix: (soil/water) SOIL Lab Sample ID: 9903273-08

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316007.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 12 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.3

Number TICs found: 13 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.43	140	J
2.	unknown aldol condensate	7.44	140	JA B
3.	unknown aldol condensate	8.05	100	JA B
4.	unknown aldol condensate	8.82	13000	JA B
5.	unknown aldol condensate	9.05	150	JA B
6.	unknown alcohol	13.31	110	J
7.	unknown ketone	13.74	79	J
8.	unknown	14.26	190	J B
9.	unknown	35.73	92	J
10.	unknown	35.87	110	J
11.	unknown	38.50	120	J
12.	unknown	39.50	290	J
13.	unknown	41.41	230	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SB-08-24

08-SB04

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-08

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316007.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 12 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.3

Number TICs found: 1

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	38.10	120	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-52

08-SS01

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: VA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-01

Sample wt/vol: 30 (g/ml) G Lab File ID: L0313012.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 24 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/13/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7

Number TICs found: 11 CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown aldol condensate	6.50	130	JA B
2.	unknown aldol condensate	7.16	95	JA
3.	unknown aldol condensate	7.89	12000	JA B
4.	unknown aldol condensate	8.10	110	JA B
5.	unknown	10.12	92	J
6.	unknown	38.07	890	J
7.	unknown	40.00	150	J
8.	unknown	40.11	400	J
9.	unknown	40.85	170	J
10.	unknown	42.12	240	J
11.	unknown sterol type	44.82	180	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-52

08-SS01

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-01

Sample wt/vol: 30 (g/ml) G Lab File ID: L0313012.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 24 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/13/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7

Number TICs found: 6

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	34.17	150	J
2.	unknown alkane	36.14	200	J
3.	unknown alkane	37.07	290	J
4.	unknown alkane	37.98	1100	J
5.	unknown alkane	39.70	1400	J
6.	unknown alkane	41.73	710	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-53

08-SS02

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-03

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316009.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 21 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 2.0

GPC Cleanup: (Y/N) Y pH: 7.3

CONCENTRATION UNITS:

Number TICs found: 18 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown aldol condensate	8.69	13000	JA B
2.	unknown aldol condensate	8.99	180	JA B
3.	unknown	10.52	220	J
4.	unknown	14.26	320	J
5.	unknown	17.06	370	J
6.	unknown	18.93	550	J
7.	unknown	26.86	280	J
8.	unknown organic acid	28.96	400	J
9.	unknown organic acid	29.07	260	J
10.	unknown	31.35	250	J
11.	unknown	32.00	170	J
12.	unknown	38.54	1700	J
13.	unknown	39.09	1600	J
14.	unknown PAH	39.45	190	J
15.	unknown aldehyde	40.44	330	J
16.	unknown	41.42	400	J
17.	unknown	44.44	270	J
18.	unknown	44.69	300	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-53

08-SS02

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-03

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316009.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 21 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 2.0

GPC Cleanup: (Y/N) Y pH: 7.3

Number TICs found: 6

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	37.19	320	J
2.	unknown alkane	37.74	240	J
3.	unknown alkane	38.12	240	J
4.	unknown alkane	39.04	700	J
5.	unknown alkane	40.95	1200	J
6.	unknown alkane	43.36	610	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-54

08-SS03

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-05

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316004.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 18 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.2

Number TICs found: 7

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	35.19	110	J
2.	unknown alkane	37.18	160	J
3.	unknown alkane	38.12	96	J
4.	unknown alkane	39.02	320	J
5.	unknown alkane	40.43	82	J
6.	unknown alkane	40.93	360	J
7.	unknown alkane	43.33	210	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-55

08-SS04

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-07

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316006.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 23 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.5

CONCENTRATION UNITS:

Number TICs found: 23 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.28	370	J
2.	unknown aldol condensate	7.36	160	JAB
3.	unknown aldol condensate	8.76	15000	JAB
4.	unknown aldol condensate	10.51	280	JAB
5.	unknown	14.24	190	JB
6.	unknown	28.84	180	J
7.	unknown	28.95	300	J
8.	unknown organic acid	29.07	290	J
9.	unknown	29.62	150	J
10.	unknown	31.34	340	J
11.	unknown	31.98	160	J
12.	unknown aldehyde	38.54	2700	J
13.	unknown	39.10	4500	J
14.	unknown PAH	39.43	160	J
15.	unknown aldehyde	40.42	740	J
16.	unknown alcohol	41.07	1100	J
17.	unknown	41.42	510	J
18. 000057-88-5	Cholesterol	41.94	670	JN
19.	unknown alcohol	42.73	310	J
20.	unknown	43.56	400	J
21.	unknown	43.79	550	J
22.	unknown sterol type	44.65	880	J
23.	unknown sterol type	44.86	250	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-55

08-SS04

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-07

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316006.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 23 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 6.5

Number TICs found: 5

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	37.18	320	J
2.	unknown alkane	38.11	260	J
3.	unknown alkane	40.95	1900	J
4.	unknown alkane	42.06	160	J
5.	unknown alkane	43.34	1400	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-56

08-SS05

Lab Name: Laucks Testing Labs Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-09

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316008.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 23 decanted: (Y/N) N Date Extracted: 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.2

Number TICs found: 5

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown alkane	37.19	160	J
2.	unknown alkane	38.13	170	J
3.	unknown alkane	39.04	820	J
4.	unknown alkane	40.95	890	J
5.	unknown alkane	43.35	390	J

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO. SS-08-56

08-SS05

Lab Name: Laucks Testing Labs Contract:

Lab Code: Case No.: SAS No.: SDG No.: WA001

Matrix: (soil/water) SOIL Lab Sample ID: 9903279-09

Sample wt/vol: 30 (g/ml) G Lab File ID: L0316008.D

Level: (low/med) LOW Date Received: 03/10/99

% Moisture: 23 decanted: (Y/N) N Date Extracted. 03/11/99

Concentrated Extract Volume: 500 (uL) Date Analyzed: 03/16/99

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) Y pH: 7.2

CONCENTRATION UNITS:

Number TICs found: 23 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	unknown	4.21	9000	J
2.	unknown aldol condensate	7.41	120	JAB
3.	unknown aldol condensate	8.03	93	JAB
4.	unknown aldol condensate	8.73	9200	JAB
5.	unknown aldol condensate	9.02	120	JAB
6.	unknown organic acid	27.23	88	J
7.	unknown	28.84	120	J
8.	unknown	28.96	230	J
9.	unknown organic acid	29.08	190	J
10.	unknown	29.63	130	J
11.	unknown	31.36	280	J
12.	unknown	32.00	120	J
13.	unknown PAH	32.70	110	J
14.	unknown	35.20	110	J
15.	unknown	38.29	210	J
16.	unknown aldehyde	38.54	1600	J
17.	unknown	39.10	1200	J
18.	unknown PAH	39.44	120	J
19.	unknown aldehyde	40.42	260	J
20.	unknown	41.41	90	J
21.	unknown	42.41	100	J
22.	unknown	43.77	120	J
23.	unknown	44.69	140	J

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FORM I SV-TIC

APPENDIX G

RISK ASSESSMENT SUPPORTING INFORMATION

APPENDIX G – PART I

TABLES G-1 AND G-2
DATA USEABILITY WORKSHEET
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE AND SUBSURFACE SOIL

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	No sampling problems or unusual field conditions were reported.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs. composite, filtered vs. non-filtered, low flow, etc.)?	Analytical data were obtained for surface soils and subsurface soils to a depth of 9 feet. Data are representative of receptor exposures.
Assess the effect of field QC results on data useability.	Overall, the trip, field, and rinseate blanks were generally non-detect for VOCs and SVOCs with the exception of low levels of commonly reported laboratory contaminants (methylene chloride, acetone, and phthalates). 1,2,4-Trichlorobenzene was detected in two blanks and dichlorobenzenes were detected once. Chloromethane was detected once. Several of the metals were qualified "B" due to the presence of the metals in the blank samples. None of these problems affected the majority of samples for chemicals that were candidate COPCs.
Summarize the effect of field sampling issues on the risk assessment	No major issues.

TABLES G-1 AND G-2
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE AND SUBSURFACE SOIL

Activity	Comment
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment	Yes. SW-846 methods were used for VOCs, SVOCs, PCBs, and metals.
Were detection limits adequate?	Generally, yes. For most detected chemicals in surface and subsurface soil, the method detection limits were less than the associated RBC values. The exceptions were 2 PAH compounds that have very low RBCs (below method quantitation limits), 3 PAH compounds in isolated samples that required dilution, 3 dioxin/furan isomers in certain samples having higher noise level, and pentachlorophenol in isolated samples that required dilution.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	No effect.

TABLES G-1 AND G-2
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE AND SUBSURFACE SOIL

Activity	Comment
Data Quality Objectives	
Precision - How were the duplicates handled?	Duplicate samples are averaged together and considered as one result. For duplicates, where one result is positive and the other result is a non-detect, the problem of calculating an average result arose whenever half the detection limit (of the non-detect value) exceeds the positive result. It was considered undesirable for the average to exceed the positive result; therefore, the positive result is used to represent the non-detect in such cases. The true maximum is used in the comparison of Max Value vs. 95%UCL to select the EPC. The true maximum and minimums are also displayed in the applicable column listing range of detection in Table 2's and Table 3's.
Accuracy - How were the split samples handled?	No split samples were obtained. Use of standardized QA/QC protocols, data validation, and certified laboratories ensures accuracy.
Representativeness - indicate any problems associated with data representativeness (e.g. trip blank or rinsate blank contamination, chain of custody problems, etc.)	No problems. B-qualifiers were added to some data based on blank analysis. ["B" qualified data was rejected for use in the quantitative risk assessment].
Completeness - indicate any problems associated with data completeness (e.g. incorrect sample analysis, incomplete sample records, problems with field procedures, etc.)	No problems. Overall, a very low percentage of data points were rejected. For antimony, 7 out of 45 results were rejected. For 15 other chemicals, a single value was rejected (less than 3 percent of associated sample results).
Comparability - indicate any problems associated with data comparability.	No problems. The data were generally comparable.
Were the DQOs specified in the QAPP satisfied?	Yes, based on data comparability, representativeness, and completeness.
Summarize the effect of DQO Issues on the risk assessment, if applicable.	No effect, if useable data are obtained from the latest round of additional sampling.

TABLES G-1 AND G-2
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE AND SUBSURFACE SOIL

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	100% data validation.
What method or guidance was used to validate the data?	EPA Region III modifications to the National Functional Guidelines.
Was the data validation method consistent with guidance? Discuss and discrepancies.	Yes. The National Functional Guidelines were used in conjunction with method specific criteria.
Were all the qualifiers defined? Discuss those which were not.	Yes. P qualifier for pesticides indicates the percent difference exceeds 25 percent. N qualifier indicates that spike recovery was poor for metals. Data would be considered estimated for these reasons.
Which qualifiers represent useable data?	J, K, L, U, UL.
Which qualifiers represent unuseable data?	B (blank contamination) and R represent unuseable data.
How are tentatively identified compounds handled.	Not used in risk assessment.
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable	No effect.
Additional Notes.	None.

TABLE G-3
DATA USEABILITY WORKSHEET
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE WATER

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	No sampling problems or unusual field conditions were reported.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs. composite, filtered vs. non-filtered, low flow, etc.)?	Surface water samples are representative of receptor exposures.
Assess the effect of field QC results on data useability.	No field quality control blanks resulted in data qualification.
Summarize the effect of field sampling issues on the risk assessment	No major issues.

TABLE G-3
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE WATER

Activity	Comment
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment	Yes. SW-846 methods were used for metals.
Were detection limits adequate?	Generally, yes. All method detection limits were less than the associated RBC values.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	No effect.

TABLE G-3
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE WATER

Activity	Comment
Data Quality Objectives	
Precision - How were the duplicates handled?	No field duplicates were included from Area C in the data set.
Accuracy - How were the split samples handled?	No split samples were obtained. Use of standardized QA/QC protocols, data validation, and certified laboratories ensures accuracy.
Representativeness - indicate any problems associated with data representativeness (e.g. trip blank or rinsate blank contamination, chain of custody problems, etc.)	No problems. No data were qualified as a result of field quality control blanks.
Completeness - indicate any problems associated with data completeness (e.g. incorrect sample analysis, incomplete sample records, problems with field procedures, etc.)	No problems. No data points were rejected.
Comparability - indicate any problems associated with data comparability.	No problems. The data were generally comparable.
Were the DQOs specified in the QAPP satisfied?	Yes, based on data comparability, representativeness, and completeness.
Summarize the effect of DQO Issues on the risk assessment, if applicable.	No effect.

TABLE G-3
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SURFACE WATER

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	100% data validation.
What method or guidance was used to validate the data?	EPA Region III modifications to the National Functional Guidelines.
Was the data validation method consistent with guidance? Discuss and discrepancies.	Yes. The National Functional Guidelines were used in conjunction with method specific criteria.
Were all the qualifiers defined? Discuss those which were not.	Yes.
Which qualifiers represent useable data?	J, K, L, U, UL.
Which qualifiers represent unuseable data?	B (blank contamination) and R represent unuseable data. (Did not occur in this data set.)
How are tentatively identified compounds handled.	Not applicable to surface water sample analysis fractions (metals only).
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable	No effect.
Additional Notes.	None.

TABLE G-4
DATA USEABILITY WORKSHEET
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SEDIMENT

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	No sampling problems or unusual field conditions were reported.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs. composite, filtered vs. non-filtered, low flow, etc.)?	Sediment samples are representative of receptor exposures.
Assess the effect of field QC results on data useability.	Calcium, magnesium, potassium, and sodium results were qualified based on field and/or laboratory blank contamination. These compounds are common minerals were not selected as COPCs.
Summarize the effect of field sampling issues on the risk assessment	No major issues.

TABLE G-4
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SEDIMENT

Activity	Comment
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment	Yes. SW-846 methods were used for SVOCs and metals.
Were detection limits adequate?	Generally, yes. For most detected chemicals in surface and subsurface soil, the method detection limits were less than the associated RBC values. The exceptions were 2 PAH compounds that have very low RBCs (in the same range or below method quantitation limits), and arsenic, which has an RBC at a level which is less than one-tenth of naturally occuring levels.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	No effect.

TABLE G-4
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SEDIMENT

Activity	Comment
Data Quality Objectives	
Precision - How were the duplicates handled?	Duplicate samples are averaged together and considered as one result. For duplicates, where one result is positive and the other result is a non-detect, the problem of calculating an average result arose whenever half the detection limit (of the non-detect value) exceeds the positive result. It was considered undesirable for the average to exceed the positive result; therefore, the positive result is used to represent the non-detect in such cases. The true maximum is used in the comparison of Max Value vs. 95%UCL to select the EPC. The true maximum and minimums are also displayed in the applicable column listing range of detection in Table 2's and Table 3's.
Accuracy - How were the split samples handled?	No split samples were obtained. Use of standardized QA/QC protocols, data validation, and certified laboratories ensures accuracy.
Representativeness - indicate any problems associated with data representativeness (e.g. trip blank or rinsate blank contamination, chain of custody problems, etc.)	No problems. B-qualifiers were added to some data based on blank analysis. ["B" qualified data was rejected for use in the quantitative risk assessment].
Completeness - indicate any problems associated with data completeness (e.g. incorrect sample analysis, incomplete sample records, problems with field procedures, etc.)	No problems. No data points were rejected.
Comparability - indicate any problems associated with data comparability.	No problems. The data were generally comparable.
Were the DQOs specified in the QAPP satisfied?	Yes, based on data comparability, representativeness, and completeness.
Summarize the effect of DQO Issues on the risk assessment, if applicable.	No effect.

TABLE G-4
DATA USEABILITY WORKSHEET (CONTINUED)
SITE 8
NAWC WARMINSTER, PENNSYLVANIA
MEDIUM: SEDIMENT

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	100% data validation.
What method or guidance was used to validate the data?	EPA Region III modifications to the National Functional Guidelines.
Was the data validation method consistent with guidance? Discuss and discrepancies.	Yes. The National Functional Guidelines were used in conjunction with method specific criteria.
Were all the qualifiers defined? Discuss those which were not.	Yes.
Which qualifiers represent useable data?	J, K, L, U, UL.
Which qualifiers represent unuseable data?	B (blank contamination) and R represent unuseable data.
How are tentatively identified compounds handled.	Not used in risk assessment.
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable	No effect.
Additional Notes.	None.

APPENDIX G – PART II

TABLE G-5
BACKGROUND COMPARISON TESTS - SURFACE SOIL DATA FOR SITE 8 (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq: Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:	Site Freq. > Back.Freq. ?				Site Maximum > UTL for Background Data ?							Majority are Site?				Ranks of Site > Back?				Site Mean > Back. Mean ?					Site Standard Deviation >Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/lo					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back.	Site	P	YN	Back.	Std.Dev	t	L,N	Back.	Site	YN	r	k	P	YN	P	Test	Used	YN	Back.	Site	t	t	YN	Back.	Site	Std.Dev	Std.Dev	F	F	YN
Substance	Freq.	Freq.	Value		Mean@	Back.@	Value	Q	UTL	Max.				Value		Value				Mean@	Mean@	Value	Table		Distrib.	Distrib.	Back.@	Site@	Value	Table	
1,2,3,4,6,7,8-HpCDD	NA	0/0	7/13		NA					3.6	NA				NA				NA		0.317			NA							NA
1,2,3,4,6,7,8-HpCDF	NA	0/0	2/4		NA					0.1755	NA				NA				NA		0.345			NA							NA
1,2,3,4,7,8-HxCDF	NA	0/0	3/10		NA					0.007	NA				NA				NA		0.0161			NA							NA
OCDD	NA	0/0	13/13		NA					22	NA				NA				NA		2.04			NA							NA
OCDF	NA	0/0	1/3		NA					0.0379	NA				NA				NA		0.736			NA							NA
Aluminum	N	29/29	16/16		NA	13200			Q	18000	16300	N	30	9	0.9229	N	0.9583			N	13200	12300			NA	nonpar.	lognor.					NA
Arsenic	Y	25/29	38/38		NA	3.92			Q	9.65	13.9	Y	47	33	0.0008	Y	0.0004	Geha	Test	Y	3.92	6.08			NA	nonpar.	lognor.					NA
Barium	Y	25/27	16/16	0.3887	N	3.99	0.52	1.7056	L	134	124	N	24	13	0.0105	Y	0.0111			Y	3.99	4.25	2.0224	1.6839	Y	lognor.	lognor.	0.52	0.306	4.5950	3.8423	N
Beryllium	N	25/29	12/12	0.2345	N	-0.302	0.336	1.7011	L	1.32	1.1	N				NA	0.4600	Geha	Test	N	-0.302	-0.25	0.6891	1.6860	N	lognor.	lognor.	0.336	0.154	7.0652	3.8436	N
Cadmium	N	0/29	8/15		NA					6.3	NA	2	2	0.1110	N				NA		1.65			NA							NA
Calcium	Y	23/27	15/15	0.1568	N	6.4	0.48	1.7056	L	1390	19500	Y	17	13	<.0001	Y	<.0001			Y	676	4770			NA	lognor.	nonpar.					NA
Chromium	Y	29/29	16/16		NA	2.92	0.317	1.7011	L	32	46.1	Y	3	2	0.2847	N	0.6075			N	2.92	2.93	0.1268	1.6811	N	lognor.	lognor.	0.317	0.324	0.0090	3.8422	Y
Cobalt	N	25/28	14/14	0.2854	N	2.01	0.537	1.7033	L	18.9	12.3	N	28	11	0.2109	N	0.3060			N	2.01	2.13	1.0933	1.6860	N	lognor.	lognor.	0.537	0.216	0.644	3.8428	N
Copper	Y	27/29	16/16	0.4101	N	2.35	0.482	1.7011	L	24.2	92.8	Y	7	6	0.0054	Y	0.1511			N	2.35	2.74	1.6471	1.7247	N	lognor.	lognor.	0.482	0.879	7.3315	3.8422	N
Iron	N	29/29	16/16		NA	33700			Q	225000	25800	N	31	10	0.8470	N	0.9583			N	33700	17700			NA	nonpar.	lognor.					NA
Lead	Y	29/29	41/41		NA	12			Q	60	732	Y	49	38	<.0001	Y	<.0001			Y	12	119			NA	nonpar.	nonpar.					NA
Magnesium	Y	25/29	15/15	0.1750	N	1960	960	1.7011	N	3620	12100	Y	15	10	0.0017	Y	0.0002			Y	1960	4390			NA	normal	nonpar.					NA
Manganese	N	29/29	16/16		NA	425			Q	1360	722	N	22	10	0.1480	N	0.2240			N	425	433			NA	nonpar.	lognor.					NA
Mercury	N	1/27	2/14	0.2646	N	0.0443					0.1	NA				NA	0.2360	Geha	Test	N	0.0443	0.0425			NA	nonpar.	nonpar.					NA
Nickel	N	18/25	11/11		NA	10.1	4.78	1.7109	N	18.4	15.7	N				NA	0.4722	Geha	Test	N	10.1	11			NA	normal	lognor.					NA
Potassium	Y	25/27	15/15	0.4077	N	6.27	0.821	1.7056	L	2200	1840	N	4	3	0.1220	N	0.1086			N	6.27	6.64	1.9379	1.6849	Y	lognor.	lognor.	0.821	0.431	6.1578	3.8426	N
Selenium	NA	0/20	2/16		NA						0.72	NA				NA				NA		0.417			NA							NA
Sodium	Y	4/18	5/5		NA	108					1110	NA	1	1	0.2174	N	0.0009	Geha	Test	Y	108	418			NA	nonpar.	normal					NA
Vanadium	Y	29/29	20/20		NA	29.4	8.55	1.7011	N	44.1	45.8	Y	34	15	0.3503	N	0.4514			N	3.33	3.38	0.5301	1.6779	N	lognor.	lognor.	0.317	0.217	2.9571	3.8416	Y
Zinc	Y	25/27	16/16	0.3887	N	3.22	0.457	1.7056	L	55.2	455	Y	13	9	0.0062	Y	0.0047			Y	27.4	92.3			NA	lognor.	nonpar.					NA
4,4'-DDD	N	1/20	1/14	0.6613	N	2.7					4.7	NA	2	1	0.6613	N	0.4319	Geha	Test	N	2.7	2.03			NA	nonpar.	nonpar.					NA
4,4'-DDT	N	1/20	3/14	0.1786	N	73.9					23	NA	4	3	0.1786	N	0.0946	Geha	Test	N	73.9	3.92			NA	nonpar.	nonpar.					NA
Aldrin	NA	0/20	1/14		NA						3.2	NA				NA				NA		1.08			NA							NA
Aroclor-1254	N	1/20	3/14		NA	39.5					83	NA				NA	0.2033	Geha	Test	N	39.5	24.6			NA	nonpar.	nonpar.					NA
Endrin	NA	0/20	1/14		NA						6.7	NA				NA				NA		2.11			NA							NA
1,4-Dichlorobenzene	NA	1/11	1/14		NA	184					43	NA				NA				NA	184	251			NA	nonpar.	nonpar.					NA
2-Methylnaphthalene	N	0/11	1/18	0.6207	N						130	NA				NA				NA		207			NA							NA
Anthracene	NA	0/11	1/18		NA						590	NA				NA				NA		285			NA							NA
Benz(a)anthracene	Y	0/11	10/18	0.0022	Y						980	NA	6	6	0.0391	Y				NA		215			NA							NA
Benzo(a)pyrene	Y	0/11	10/18	0.0022	Y						930	NA	7	7	0.0204	Y				NA		228			NA							NA
Benzo(b)fluoranthene	Y	1/11	10/18	0.0148	Y	185					1600	NA	8	8	0.0102	Y	0.0056	Geha	Test	Y	185	311			NA	nonpar.	nonpar.					NA
Benzo(g,h,i)perylene	N	0/11	8/18	0.0102	Y						410	NA	2	2	0.3768	N				NA		167			NA							NA
Benzo(k)fluoranthene	Y	1/11	9/18	0.0289	Y	184					270	NA	4	4	0.1288	N	0.0377	Geha	Test	Y	184	156			NA	nonpar.	nonpar.					NA
Bis(2-ethylhexyl)phthalate	NA	0/0	1/10		NA						1800	NA				NA				NA		350			NA							NA
Butylbenzylphthalate	NA	0/0	1/2		NA						600	NA				NA				NA		350			NA							NA
Carbazole	NA	0/11	1/18		NA						310	NA				NA				NA		270			NA							NA
Chrysene	Y	1/11	10/18	0.0148	Y	185					980	NA	7	7	0.0204	Y	0.0095	Geha	Test	Y	185	250			NA	nonpar.	nonpar.					NA
Di-n-butylphthalate	NA	0/0	2/5		NA						54	NA				NA				NA		137			NA							NA
Dibenz(a,h)anthracene	NA	0/11	3/18		NA						120	NA				NA				NA		242			NA							NA
Fluoranthene	Y	1/11	10/18	0.0148	Y	188					2000	NA	10	10	0.0022	Y	0.0017	Geha	Test	Y	188	338			NA	nonpar.	nonpar.					NA
Fluorene	NA	0/11	1/18		NA						540	NA				NA				NA		282			NA							NA

TABLE G-5
BACKGROUND COMPARISON TESTS - SURFACE SOIL DATA FOR SITE 8 (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq: Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:	Site Freq. > Back Freq.?				Site Maximum > UTL for Background Data ?							Majority are site?				Ranks: Site > Back?				Site Mean > Back Mean ?					Site Standard Deviation > Background Std.Dev.?						
Assumptions Valid:	#ND & Pos >=5 or use Fisher				Back lognorm or norm If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/lo					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN		Back	Site	P	YN	Back	Std Dev	t	L,N	Back	Site	YN	r	k	P	YN	P	Test	Used	YN	Back.	Site	t	t	YN	Back.	Site	Std.Dev	Std.Dev	F	F	YN
Substance		Freq.	Freq.	Value		Mean@	Back.@	Value	Q	UTL	Max.				Value		Value				Mean@	Mean@	Value	Table		Distrib.	Distrib.	Back.@	Site@	Value	Table	
Indeno(1,2,3-cd)pyrene	N	0/11	7/18	0.0204	Y						410	NA	1	1	0.6207	N				NA		185			NA							NA
Naphthalene	N	0/11	2/18	0.3768	N						56	NA				NA				NA		195			NA							NA
Pentachlorophenol	N	0/11	1/14	0.5600	N						43	NA				NA				NA		442			NA							NA
Phenanthrene	N	1/11	10/18	0.0148	Y	185					2100	NA	3	3	0.2233	N	0.0703	Geha	Test	N	185	275			NA	nonpar.	nonpar.					NA
Pyrene	Y	1/11	10/18	0.0148	Y	189					1600	NA	9	9	0.0049	Y	0.0033	Geha	Test	Y	189	314			NA	nonpar.	nonpar.					NA
Methylene Chloride	NA	0/13	2/6		NA						7	NA				NA				NA		6.25			NA							NA
Tetrachloroethene	NA	0/19	1/13		NA						3	NA				NA				NA		5.77			NA							NA
Toluene	N	3/19	5/13		NA	44.6					3	NA				NA	0.0766	Geha	Test	N	44.6	4.69			NA	nonpar.	nonpar.					NA

Notes:

Units are mg/kg for inorganics, ug/kg for organics.

A statistical significance level (P value) of 0.05 is used for all tests that directly compare site to background. A two-sided significance level of 0.1 is used for Bartlett's test for equal variance.

UTL is the expected value for the upper 95 % quantile of the background population; there is an equal chance of the population's true 95 % quantile being either below or above this estimate.

For each test, a YES or NO decision is presented only if all assumptions are met. The overall decision (is site > background) for each chemical appears at the left and is based on four criteria:

(1) Overall decision is YES if any one of the UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is YES, regardless of other test results.

(2) Overall decision is NO if at least one of UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is NO, and none of the aforementioned tests are YES.

(3) Overall decision is YES/NO if Z/Fisher Test is YES/NO, respectively, and other tests are NA. Z-test is treated as lowest priority since it relies on detection frequency, not magnitude of results.

(4) Overall decision is NA if all tests are NA. (Chemicals assigned NA are still included in human health risk-based screening and/or risk assessment.)

Abbreviations:

# NDs or # Pos.	Number of non-detected (ND) or positive (Pos.) results in data set, not including rejected data or blank-qualified data.
# s or # b	Number of site (s) or background (b) samples, not including rejected data or blank-qualified data.
s = b	Standard deviation of site results must not be different from the standard deviation of background results.
P value	Probability or significance level is defined as the chance of a false positive. If P <= 0.05 then test determines site > background with 95 % confidence.
L, N, or Q	UTL is based on 95 % upper limit (using t-value) when data are lognormal (L) or normal (N). Otherwise, an upper 95 % quantile (Q) is used if there are > 18 back. points.
% ND	Mann-Whitney test used if < 40% of data Non-Detected and detect. limits uniformly below the range of positive values. If not, the Gehan Test is used.
@	*Mean and standard deviations are shown of log-transformed data when distributions are of this type; ie., if an (L) code appears for the UTL test* or if site and background distributions both match lognormal, and both T-test and Bartlett's test are applicable. (Arithmetic mean and normal standard deviation are shown only for illustration in the event that these tests are NA.)
r,k	The upper ranks test calculates the probability that k or more samples from the top r ranks of the combined site and background data set are comprised of site data if both populations are in fact equal.

TABLE G-6
BACKGROUND COMPARISON TESTS - SUBSURFACE SOIL DATA FOR SITE 8 (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:		Detection Freq: Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks Test				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Assumptions Valid:		#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/lo					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:		P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back?	YN	Back. Freq.	Site Freq	P Value	YN	Back. Mean@	Std Dev Back.@	t Value	L,N Q	Back. UTL	Site Max.	YN	r	k	P Value	YN	P Value	Test	Used	YN	Back. Mean@	Site Mean@	t Value	t Table	YN	Back. Distrib.	Site Distrib.	Std.Dev Back.@	Std.Dev Site@	F Value	F Table	YN
Substance																																
OCDD	NA	0/0	1/4		NA						4.4	NA				NA				NA		2.71			NA							NA
Aluminum	N	29/29	23/23		NA	13200			Q	18000	18000	N	6	3	0.5473	N	0.9532			N	13200	11200			NA	nonpar.	lognor.					NA
Antimony	N	1/21	1/17	0.7013	N	3.8					14.9	NA	1	1	0.4474	N	0.4397	Geha	Test	N	3.8	4.72			NA	nonpar.	nonpar.					NA
Arsenic	N	25/29	22/22		NA	3.92			Q	9.65	6.6	N	34	14	0.7584	N	0.8271	Geha	Test	N	3.92	3.1			NA	nonpar.	lognor.					NA
Barium	N	25/27	23/23	0.2865	N	3.99	0.52	1.7056	L	134	113	N	11	5	0.6469	N	0.9963			N	3.99	3.6	-2.4958	1.6772	N	lognor.	lognor.	0.52	0.595	0.4228	3.8414	Y
Beryllium	Y	25/29	21/21	0.1031	N	-0.302	0.336	1.7011	L	1.32	2.2	Y	1	1	0.4200	N	0.9932	Geha	Test	N	-0.302	-0.522	-1.7165	1.6939	N	lognor.	lognor.	0.336	0.51	4.0557	3.8415	N
Calcium	Y	23/27	22/22	0.0828	N	6.4	0.48	1.7056	L	1390	10110	Y	2	2	0.1964	N	0.0418	Geha	Test	Y	676	1260			NA	lognor.	nonpar.					NA
Chromium	N	29/29	23/23		NA	2.92	0.317	1.7011	L	32	26.1	N	6	2	0.8425	N	0.9977			N	2.92	2.64	-3.0488	1.6759	N	lognor.	lognor.	0.317	0.335	0.0676	3.8413	Y
Cobalt	Y	25/28	23/23	0.1573	N	2.01	0.537	1.7033	L	18.9	22.6	Y	11	7	0.1463	N	0.2244			N	2.01	2.19	1.3284	1.6766	N	lognor.	lognor.	0.537	0.412	1.6370	3.8414	Y
Copper	Y	27/29	22/22	0.3184	N	2.35	0.482	1.7011	L	24.2	353.65	Y	21	13	0.0238	Y	0.0219			Y	11.7	30.6			NA	lognor.	nonpar.					NA
Iron	N	29/29	22/23	1.0000	N	33700			Q	225000	27450	N	11	3	0.9499	N	0.9986			N	33700	14800			NA	nonpar.	lognor.					NA
Lead	N	29/29	28/28		NA	12			Q	60	26.7	N	8	5	0.3326	N	0.9483			N	12	7.52			NA	nonpar.	lognor.					NA
Magnesium	Y	25/29	22/22	0.0950	N	1960	960	1.7011	N	3620	6975	Y	6	4	0.2115	N	0.6541	Geha	Test	N	1960	2140			NA	normal	lognor					NA
Manganese	N	29/29	23/23		NA	425			Q	1360	1230	N	6	5	0.0529	N	0.0631			N	425	533			NA	nonpar.	lognor.					NA
Mercury	N	1/27	1/23	0.7135	N	0.0443					0.1	NA				NA	0.7196	Geha	Test	N	0.0443	0.0301			NA	nonpar	nonpar					NA
Nickel	N	18/25	10/10		NA	10.1	4.78	1.7109	N	18.4	17.1	N				NA	0.5083	Geha	Test	N	10.1	10.9			NA	normal	normal					NA
Potassium	Y	25/27	21/22	0.5779	N	6.27	0.821	1.7056	L	2200	2270	Y	2	1	0.7015	N	0.8198			N	6.27	6.15	-0.5444	1.6779	N	lognor.	lognor.	0.821	0.659	1.0732	3.8415	Y
Selenium	NA	0/20	1/23		NA						0.63	NA				NA				NA		0.32			NA							NA
Sodium	Y	4/18	14/14		NA	108					1470	NA	1	1	0.4375	N	<.0001	Geha	Test	Y	108	186			NA	nonpar.	nonpar.					NA
Thallium	N	3/29	2/22		NA	0.374					9.1	NA	1	1	0.4314	N	0.0829	Geha	Test	N	0.374	0.691			NA	nonpar	nonpar					NA
Vanadium	Y	29/29	27/27		NA	29.4	8.55	1.7011	N	44.1	52.5	Y	3	3	0.1055	N	0.9413			N	3.33	3.14	-1.7195	1.6811	N	lognor.	lognor	0.317	0.5	5.4221	3.8411	N
Zinc	N	25/27	22/22	0.2985	N	3.22	0.457	1.7056	L	55.2	47.6	N	5	2	0.7552	N	0.9970			N	3.22	2.76	-2.9885	1.6779	N	lognor.	lognor.	0.457	0.613	1.9581	3.8415	Y
Endosulfan I	NA	0/20	1/7		NA						0.71	NA				NA				NA		0.722			NA							NA
Gamma-Chlordane	NA	0/20	1/7		NA						2	NA				NA				NA		0.801			NA							NA
2-Nitrophenol	N	0/11	1/19	0.6333	N						42	NA				NA				NA		181			NA							NA
4-Nitrophenol	N	0/11	1/19	0.6333	N						38	NA				NA				NA		435			NA							NA
Benz(a)anthracene	N	0/11	1/23	0.6765	N						120	NA				NA				NA		188			NA							NA
Benzo(a)pyrene	N	0/11	1/23	0.6765	N						140	NA	1	1	0.6765	N				NA		188			NA							NA
Benzo(b)fluoranthene	N	1/11	1/23	0.9020	N	185					190	NA	1	1	0.6765	N	0.2647	Geha	Test	N	185	191			NA	nonpar.	lognor.					NA
Benzo(g,h,i)perylene	N	0/11	1/23	0.6765	N						80	NA				NA				NA		186			NA							NA
Benzo(k)fluoranthene	N	1/11	1/23	0.9020	N	184					110	NA				NA	0.5000	Geha	Test	N	184	187			NA	nonpar.	nonpar.					NA
Chrysene	N	1/11	1/23	0.9020	N	185					170	NA	1	1	0.6765	N	0.2647	Geha	Test	N	185	190			NA	nonpar.	lognor.					NA
Fluoranthene	N	1/11	1/23	0.9020	N	188					320	NA	1	1	0.6765	N	0.2647	Geha	Test	N	188	196			NA	nonpar.	nonpar.					NA
Indeno(1,2,3-cd)pyrene	N	0/11	1/23	0.6765	N						94	NA				NA				NA		186			NA							NA
Phenanthrene	N	1/11	1/23	0.9020	N	185					180	NA	1	1	0.6765	N	0.2647	Geha	Test	N	185	190			NA	nonpar.	lognor.					NA
Phenol	N	0/11	1/19	0.6333	N						920	NA	1	1	0.6333	N				NA		227			NA							NA
Pyrene	N	1/11	1/23	0.9020	N	189					290	NA	1	1	0.6765	N	0.2647	Geha	Test	N	189	195			NA	nonpar.	nonpar.					NA

Notes:

Units are mg/kg for inorganics, ug/kg for organics.

A statistical significance level (P value) of 0.05 is used for all tests that directly compare site to background. A two-sided significance level of 0.1 is used for Bartlett's test for equal variance.

UTL is the expected value for the upper 95 % quantile of the background population; there is an equal chance of the population's true 95 % quantile being either below or above this estimate.

For each test, a YES or NO decision is presented only if all assumptions are met. The overall decision (is site > background) for each chemical appears at the left and is based on four criteria:

(1) Overall decision is YES if any one of the UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is YES, regardless of other test results.

(2) Overall decision is NO if at least one of UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is NO, and none of the aforementioned tests are YES.

(3) Overall decision is YES/NO if Z/Fisher Test is YES/NO, respectively, and other tests are NA. Z-test is treated as lowest priority since it relies on detection frequency, not magnitude of results.

(4) Overall decision is NA if all tests are NA. (Chemicals assigned NA are still included in human health risk-based screening and/or risk assessment.)

TABLE G-6
BACKGROUND COMPARISON TESTS - SUBSURFACE SOIL DATA FOR SITE 8 (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq: Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed: >>	Site Freq. > Back.Freq.?				Site Maximum > UTL for Background Data ?							Majority are site?				Ranks of Site > Back?				Site Mean > Back. Mean ?					Site Standard Deviation >Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/lo					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back Freq.	Site Freq.	P Value	YN	Back. Mean@	Std.Dev Back.@	t Value	L,N Q	Back. UTL	Site Max.	YN	r	k	P Value	YN	P Value	Test	Used	YN	Back. Mean@	Site Mean@	t Value	t Table	YN	Back. Distrib.	Site Distrib.	Std.Dev Back.@	Std.Dev Site@	F Value	F Table	YN
Substance																															
(4)	Overall decision is NA if all tests are NA. (Chemicals assigned NA are still included in human health risk-based screening and/or risk assessment.)																														

Abbreviations:

# NDs or # Pos.	Number of non-detected (ND) or positive (Pos.) results in data set, not including rejected data or blank-qualified data.
# s or # b	Number of site (s) or background (b) samples, not including rejected data or blank-qualified data.
s = b	Standard deviation of site results must not be different from the standard deviation of background results.
P value	Probability or significance level is defined as the chance of a false positive. If P <= 0.05 then test determines site > background with 95 % confidence.
L, N, or Q	UTL is based on 95 % upper limit (using t-value) when data are lognormal (L) or normal (N). Otherwise, an upper 95 % quantile (Q) is used if there are > 18 back. points.
% ND	Mann-Whitney test used if < 40% of data Non-Detected and detect. limits uniformly below the range of positive values. If not, the Gehan Test is used.
@	Mean and standard deviations are shown of log-transformed data when distributions are of this type; ie., if an (L) code appears for the UTL test or if site and background distributions both match lognormal, and both T-test and Bartlett's test are applicable. (Arithmetic mean and normal standard deviation are shown only for illustration in the event that these tests are NA.)
r,k	The upper ranks test calculates the probability that k or more samples from the top r ranks of the combined site and background data set are comprised of site data if both populations are in fact equal.

APPENDIX G – PART III

TABLE G-7

SURFACE AREAS AND BODY WEIGHTS USED FOR EXPOSURE ASSESSMENT - SITE 8 (POST-REMOVAL)

NAWC WARMINSTER, PENNSYLVANIA

50 Percentile Surface Areas, Body Weights, and Ratios

Children, Various Ages

						Surface Areas Divided by Body Weight				Percent of Total Surface Area by Body Part (1,2)				
AGE	Male Surf. Area (1)	Male Body Wt. (1)	Female Surf. Area (1)	Female Body Wt. (1)	SA/BW AVE(M+F)	H+LL+F (7)	H + F (6)	FA+FC+H+LL+F (3)	WHOLE	% TOT SA FOREARMS (1,2)*	% TOT SA FACE (2)	% TOT SA HANDS (1,2)	% TOT SA LOWER LEGS (1,2)**	% TOT SA FEET (1,2)
1-2	---	11.8	---	10.8	617	134.599	78.822	189.018	617	5.12	3.7	5.89	9.04	6.885
2-3	6030	13.6	5790	13.0	444.383	94.365	53.481	132.048	444.383	4.98	3.5	5.15	9.2	6.885
3-4	6640	15.7	6490	14.9	429.25	100.659	56.618	139.034	429.250	5.54	3.4	5.885	10.26	7.305
4-5	7310	17.8	7060	17.0	412.984	97.567	53.874	131.928	412.984	5.42	2.9	5.6	10.58	7.445
5-6	7930	19.8	7790	19.6	398.977	94.258	52.047	127.453	398.977	5.42	2.9	5.6	10.58	7.445
6-7	8660	23.0	8430	22.1	378.985	87.868	46.255	122.658	378.985	5.38	3.8	4.955	10.98	7.25
7-8	9360	25.1	9170	24.7	372.082	86.267	45.413	120.424	372.082	5.38	3.8	4.955	10.98	7.25
8-9	10000	28.2	10000	27.9	356.516	82.658	43.513	115.386	356.516	5.38	3.8	4.955	10.98	7.25
9-10	10700	31.1	10600	31.9	338.17	81.634	43.421	112.814	338.170	5.42	3.8	5.25	11.3	7.59
10-11	11800	36.4	11700	36.1	324.138	80.159	42.430	107.711	324.138	5.2	3.3	5.3	11.64	7.79
11-12	12300	40.3	13000	41.8	308.108	76.596	39.623	103.648	308.108	5.48	3.3	5.345	12	7.515
12-13	13400	44.2	14000	46.4	302.446	75.324	38.970	99.792	302.446	5.79	2.3	5.295	12.02	7.59
13-14	14700	49.9	14800	50.9	292.678	74.808	38.751	97.550	292.678	5.47	2.3	5.155	12.32	8.085
14-15	16100	57.1	15500	54.8	282.404	72.182	37.390	93.843	282.404	5.47	2.2	5.155	12.32	8.085
15-16	17000	61.0	15700	55.1	288.71	127.841	36.175	95.072	288.710	5.5	2.2	5.365	12.7	7.165
16-17	17600	67.1	16000	58.1	268.841	67.829	33.686	88.529	268.841	5.5	2.2	5.365	12.7	7.165
BW (kg) = 16.6		6 yrs exposure	1 through 6 yr	SUM =	2682	609	341	842	2682					
BW (kg) = 43.4		10 yrs exposur	7 through 16 yr	SUM =	3134	825	399	1035	3134					
BW (kg) = 32.5		6 yrs exposure	7 through 12 yr	SUM =	2001	483	253	660	2001					

50 Percentile Surface Areas

Adults

					Total Surface Area by Body Part				
SEX	H+LL+F (4)	H+F	FA+FC+H+LL+F (5)	WHOLE	TOT SA FOREARMS (1)	TOT SA FACE (1)***	TOT SA HANDS (1)	TOT SA LOWER LEGS (1)	TOT SA FEET (1)
MALE	4860	2300	6820	19400	1310	650	990	2560	1310
FEMALE	4137	1957	6002	16900	NA	555	817	2180	1140
AVE.	4499	2129	6411	18150					

(1) EPA, 1997. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

(2) EPA, 1985. Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development. Table 3-3. Percent of Total Body Surface Area or Parts by Sex and Age of Japanese Students.

(3) Casual User and Residential Child & Pre-Adolescent/Adolescent Age-Adjusted Surface Areas used in the HHRA.

(4) Industrial Adult Surface Area used in the HHRA.

(5) Casual User and Residential Adult Surface Areas used in the HHRA.

(6) Recreational Pre-Adolescent Surface Area used in the HHRA for Sediment Exposure

(7) Recreational Pre-Adolescent Surface Area used in the HHRA for Surface Water Exposure.

Note = (1,2) Percent Surface Area is an Average of EPA (1997) and EPA (1985) values

* = Forearms for children are estimated from the assumption that the ratio of forearm to arm in a child is the same as the ratio in an adult (Approx = 40%; EPA, 1997).

** = Lower Legs for children are estimated from the assumption that the ratio of lower leg to leg in a child is the same as the ratio in an adult (Approx = 40%; EPA, 1997).

*** - Assummed to be 50% of head.

NA = Not Available

APPENDIX G – PART IV

APPENDIX G, PART 4

RISK ASSESSMENT EXAMPLE CALCULATIONS

The example calculations listed in this appendix are presented in order to verify the approaches taken and calculations used to estimate risk at Site 8. The example calculations are all based on RME exposure. Examples are shown for representative receptors for surface soil, sediment, and surface water media exposure. Surface soil risks for the casual user and residential receptors exposed to surface soil are not shown here, however, they would be estimated following the same pattern. Additionally, a subsurface soil exposure example is not shown here, but subsurface soil exposure would also follow the same pattern as surface soil.

Surface Soil Exposure

Three potential exposure routes are associated with direct exposure to surface soil at Site 8. These exposure routes include ingestion, dermal absorption, and inhalation of fugitive dust.

Ingestion of COPCs in Surface Soil:

Ingestion of arsenic in surface soil at Site 8 for a current/future industrial adult under an RME scenario was evaluated using the following equation (EPA, 1989a):

$$IngestionDose(mg/kg/day) = \frac{CS * IR_{soil} * FI * CF * EF * ED}{BW * AT}$$

Where:

Carc-Ingestion Dose	= 2.35E-6	= Carcinogenic Ingestion exposure dose (mg/kg/day)
Noncarc-Ingestion Dose	= 6.59E-6	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

CS	= 6.73 mg/kg	= Arsenic concentration in surface soil
IR_{soil}	= 100 mg/day	= Ingestion rate
FI	= 100%	= Fraction Ingested
CF	= 1E-06 kg/mg	= Conversion Factor
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 9125 days	= Averaging time for noncarcinogens (365 d/yr x 25 yrs)

The RME cancer risk for a current/future industrial adult from ingestion of arsenic in surface soil at Site 8 is estimated as follows:

CA = Ingestion Dose x SF

CA	= 3.53E-6	= Incremental cancer risk
SF	= 1.5 $(mg/kg/day)^{-1}$	= Oral slope factor
Carc-Ingestion Dose	= 2.36E-5	= Carcinogenic Ingestion exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future industrial adult from ingestion of arsenic in surface soil at Site 8 is estimated as follows:

NC = Ingestion Dose / RfD

NC	= 2.20E-2	= Noncarcinogenic risk
RfD	= 0.0003 mg/kg/day	= Oral reference dose
Noncarc-Ingestion Dose	= 6.59E-6	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

Dermal Absorption of COPCs in Surface Soil:

Dermal absorption of arsenic in surface soil at Site 8 for a current/future industrial adult under an RME scenario was evaluated using the following equations (EPA, 1992e):

$$DermalDose(mg/kg/day) = \frac{DA_{event} * SA * EV * EF * ED}{BW * AT}$$

$$DA_{event} = CS * AF * ABS_{dermal} * CF$$

Where:

Carc-Dermal Dose	= 6.77E-7	= Carcinogenic Dermal exposure dose (mg/kg/day)
Noncarc-Dermal Dose	= 1.90E-6	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

DA_{event}	= 4.31E-8 mg/cm^2-event	= Dose absorbed per unit area per event
SA	= 4499 cm^2/day	= Skin surface area available for contact
EV	= 1 event/day	= Event frequency
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 9125 days	= Averaging time for noncarcinogens (365 d/yr x 25 yrs)
CS	= 6.73 mg/kg	= Arsenic concentration in surface soil
AF	= 0.2 mg/cm^2	= Soil-to-skin adherence factor
ABS_{derm}	= 0.032	= Absorption fraction
CF	= 1E-06 kg/mg	= Conversion Factor

The RME cancer risk for a current/future recreational adult from dermal absorption of arsenic in surface soil at Site 8 is estimated as follows:

CA = Dermal Dose x SF

CA	= 1.02E-6	= Incremental cancer risk
SF	= 1.5 (mg/kg/day)$^{-1}$	= Dermal slope factor = (SF_{oral}/GI Factor; [1.5/1.0])
Carc-Dermal Dose	= 6.77E-7	= Carcinogenic Dermal exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future recreational adult from dermal absorption of arsenic in surface soil at Site 8 is estimated as follows:

NC = Dermal Dose / RfD

NC	= 6.65E-3	= Noncarcinogenic risk
RfD	= 0.000285 mg/kg/day	= Dermal reference dose = (RfD_{Oral}*GI Factor; [0.0003*0.95])
Noncarc-Dermal Dose	= 1.90E-6	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

Inhalation of COPCs in Fugitive Dust:

Inhalation of arsenic in surface soil (via fugitive dust) at Site 8 for a current/future industrial adult under an RME scenario was evaluated using the following equations (EPA, 1992e):

$$InhalationDose(mg/kg/day) = \frac{CS/_{PEF} * IR_{air} * ET * EF * ED}{BW * AT}$$

****Note:** Arsenic doesn't have an available inhalation reference dose, therefore only a example calculation based on carcinogenic risk is presented for inhalation of COPCs by a current/future recreational pre-adolescent.

Where

Carc-Inhalation Dose	= 2.14E-10	= Carcinogenic Inhalation exposure dose (mg/kg/day)
CS	= 6.73 mg/kg	= Arsenic concentration in surface soil
PEF	= 1.32E+9 m^3/kg	= Particulate emission factor
IR_{air}	= 1.5 m^3/hr	= Inhalation rate
ET	= 8 hr/day	= Exposure time
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)

The RME cancer risk for a current/future industrial adultfrom inhalation of arsenic in fugitive dust in surface soil at Site 8 is estimated as follows:

CA = Inhalation Dose x SF

CA	= 3.23E-9	= Incremental cancer risk
SF	= 15.1 $(mg/kg/day)^{-1}$	= Inhalation slope factor
Carc-Inhalation Dose	= 2.14E-10	= Carcinogenic Inhalation exposure dose (mg/kg/day)

Sediment Exposure

Two potential exposure routes are associated with direct exposure to sediment at off-site areas near Site 8. These exposure routes include ingestion and dermal absorption.

Ingestion of COPCs in Sediment:

Ingestion of arsenic in sediment at off-site areas near Site 8 for a current/future recreational pre-adolescent (age 7-12) under an RME scenario was evaluated using the following equation (EPA, 1989a):

$$IngestionDose(mg/kg/day) = \frac{CS * IR_{Sed} * FI * CF * EF * ED}{l \quad BW * AT}$$

Where:

Carc-Ingestion Dose	= 4.25E-8	= Carcinogenic Ingestion exposure dose (mg/kg/day)
Noncarc-Ingestion Dose	= 4.96E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)
CS	= 4.2 mg/kg	= Arsenic concentration in sediment
IR_{soil}	= 200 mg/day	= Ingestion rate
FI	= 100%	= Fraction Ingested
CF	= 1E-06 kg/mg	= Conversion Factor
EF	= 7 days/yr	= Exposure frequency
ED	= 6 yr	= Exposure duration

BW	= 32.5 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 2190 days	= Averaging time for noncarcinogens (365 d/yr x 25 yrs)

The RME cancer risk for a current/future recreational pre-adolescent (age 7-12) from ingestion of arsenic in sediment at off-site areas near Site 8 is estimated as follows:

CA = Ingestion Dose x SF

CA	= 6.37E-8	= Incremental cancer risk
SF	= 1.5 $(mg/kg/day)^{-1}$	= Oral slope factor
Carc-Ingestion Dose	= 4.25E-8	= Carcinogenic Ingestion exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future recreational pre-adolescent (age 7-12) from ingestion of arsenic in sediment at off-site areas near Site 8 is estimated as follows:

NC = Ingestion Dose / RfD

NC	= 1.65E-3	= Noncarcinogenic risk
RfD	= 0.0003 mg/kg/day	= Oral reference dose
Noncarc-Ingestion Dose	= 4.96E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

Dermal Absorption of COPCs in Sediment:

Dermal absorption of arsenic in sediment at off-site areas near Site 8 for a current/future recreational pre-adolescent (age 7-12) under an RME scenario was evaluated using the following equations (EPA, 1992e):

$$DermalDose(mg/kg/day) = \frac{DA_{event} * EF * EV}{AT} * AgeAdj$$

$$AgeAdj = \sum_{i=m}^{n} \frac{SA_i * ED_i}{BW_i}$$

$$DA_{event} = CS * AF * ABS_{dermal} * CF$$

Where:

Carc-Dermal Dose	= 1.86E-9	= Carcinogenic Dermal exposure dose (mg/kg/day)
Noncarc-Dermal Dose	= 2.17E-8	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

DA_{event}	= 2.69E-8 mg/cm^2-event	= Dose absorbed per unit area per event
EV	= 1 event/day	= Event frequency
AgeAdj	= 253 cm^2-yr/kg	= Age adjusted surface area (Derived in Appendix G)
SA_i	= Varying (cm^2)	= Surface area varies with age
ED_i	= 1 yr Increments	= One year increments
BW_i	= Varying (kg)	= Body weight varies with age
EF	= 7 days/yr	= Exposure frequency
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 2190 days	= Averaging time for noncarcinogens (365 d/yr x 8 yrs)
CS	= 4.2 mg/kg	= Arsenic concentration in sediment
AF	= 0.2 mg/cm^2	= Soil-to-skin adherence factor
ABS_{derm}	= 0.032	= Absorption fraction
CF	= 1E-06 kg/mg	= Conversion Factor

The RME cancer risk for a current/future recreational pre-adolescent (age 7-12) from dermal absorption of arsenic in sediment at off-site areas near Site 8 is estimated as follows:

CA = Dermal Dose x SF

CA	= 2.94E-9	= Incremental cancer risk
SF	= 1.58 $(mg/kg/day)^{-1}$	= Dermal slope factor = (SF_{oral}/GI Factor; [1.5/0.95])
Carc-Dermal Dose	= 1.86E-9	= Carcinogenic Dermal exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future recreational pre-adolescent (age 7-12) from dermal absorption of arsenic in sediment at off-site areas near Site 8 is estimated as follows:

NC = Dermal Dose / RfD

NC	= 7.63E-5	= Noncarcinogenic risk
RfD	= 0.0003 mg/kg/day	= Dermal reference dose = (RfD_{Oral}*GI Factor; [1.5*0.95])
Noncarc-Dermal Dose	= 2.17E-8	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

Surface Water Exposure

Two potential exposure routes are associated with direct exposure to surface water (both total and dissolved) sediment at off-site areas near Site 8. These exposure routes include ingestion and dermal absorption.

Ingestion of Surface Water:

Ingestion of manganese (total) in surface water at off-site areas near Site 8 for a current/future recreational pre-adolescent (age 7-12) under an RME scenario was evaluated using the following equation (EPA, 1989a):

$$IngestionDose = \frac{CW * IR_{surfacewater} * CF_1 * ET * EF * ED}{BW * AT}$$

Where:

Noncarc-Ingestion Dose = 1.88E-5 = Noncarcinogenic Ingestion exposure dose (mg/kg/day)

CW	= 159 ug/L	= manganese concentration in surface water
CF_1	= 1 mg/10^3 ug	= conversion factor
$IR_{surfH2O}$	= 0.2 L/hour	= Ingestion rate
EF	= 7 days/yr	= Exposure frequency
ED	= 6 yr	= Exposure duration
BW	= 32.5 kg	= Body weight
ET	= 2.6 hours/day	= Exposure Time
AT	= 2190 days	= Averaging time for noncarcinogens (365 d/yr x 6 yrs)

The RME cancer risk for a current/future recreational pre-adolescent (age 7-12) from ingestion of manganese in surface water (total inorganics) is not estimated because manganese does not have an EPA derived quantitative carcinogenic toxicity value.

The RME noncarcinogenic risk for a current/future recreational pre-adolescent (age 7-12) from ingestion of manganese in surface water at off-site areas near Site 8 is estimated as follows:

NC = Ingestion Dose/RfD

NC	= 7.82E-4	= Noncarcinogenic risk
RfD	= 2.4E-02 (mg/kg/day)	= Oral reference dose
Noncarc-Ingestion Dose	= 1.88E-5	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

Dermal Absorption of Surface Water:

Dermal absorption of manganese (total) in surface water at off-site areas near Site 8 for a current/future recreational pre-adolescent (age 7-12) under an RME scenario was evaluated using the following equation (EPA, 1992e):

$$DermalDose(mg/kg/day) = \frac{DA_{event} * EF * EV}{AT} * AgeAdj$$

$$AgeAdj = \sum_{i=m}^{n} \frac{SA_i * ED_i}{BW_i}$$

$$DA_{event} = CW * PC_{event} * CF_1 * CF_2$$

For Inorganics (Steady State Approach):

$$PC_{event} = K_{pw-inorg} * t_{event}$$

Where:

Noncarc-Ingestion Dose	= 6.38E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)
DA_{event}	= 4.13E-7 mg/cm^2/event	= Dose absorbed per unit area per event
EV	= 1 event/day	= Event frequency
EF	= 7 days/yr	= Exposure frequency
AgeAdj	= 483 cm^2-yr/kg	= Age adjusted surface area
SA_i	= Varying (cm^2)	= Surface area varies with age
ED_i	= 1 yr Increments	= One year increments
BW_i	= Varying (kg)	= Body weight varies with age
AT	= 2190 days	= Averaging time for carcinogens (365 d/yr x 6 yrs)
PC_{event}	= 0.0026 cm/event	= Diffusion depth per event (cm/event)
CW	= 159 ug/L	= manganese concentration in surface water
CF_1	= 1 mg/10^3 ug	= Conversion Factor
CF_2	= 1 L/10^3 cm^3	= Conversion Factor
$K_{pw-inorg}$	= 0.001 cm/hr	= permeability coefficient from water
t_{event}	= 2.6 hr/event	= Duration of event

The RME cancer risk for a current/future recreational pre-adolescent (age 7-12) from dermal absorption of manganese in surface water (total inorganics) is not estimated because manganese does not have an EPA derived quantitative carcinogenic toxicity value.

The RME noncarcinogenic risk for a current/future recreational pre-adolescent (age 7-12) from dermal absorption of manganese in surface water at off-site areas near Site 8 is estimated as follows:

NC = Dermal Dose/RfD

NC	= 2.66E-5	= Noncarcinogenic risk
RfD	= 2.4E-02 (mg/kg/day)	= Dermal slope factor = (RfD_{oral}*GI Factor; [2.4E-2*1.0])
Noncarc-Ingestion Dose	= 6.38E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

APPENDIX G – PART V

LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 4.00 ug Pb/L DEFAULT
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	119.0	119.0
1-2	119.0	119.0
2-3	119.0	119.0
3-4	119.0	119.0
4-5	119.0	119.0
5-6	119.0	119.0
6-7	119.0	119.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

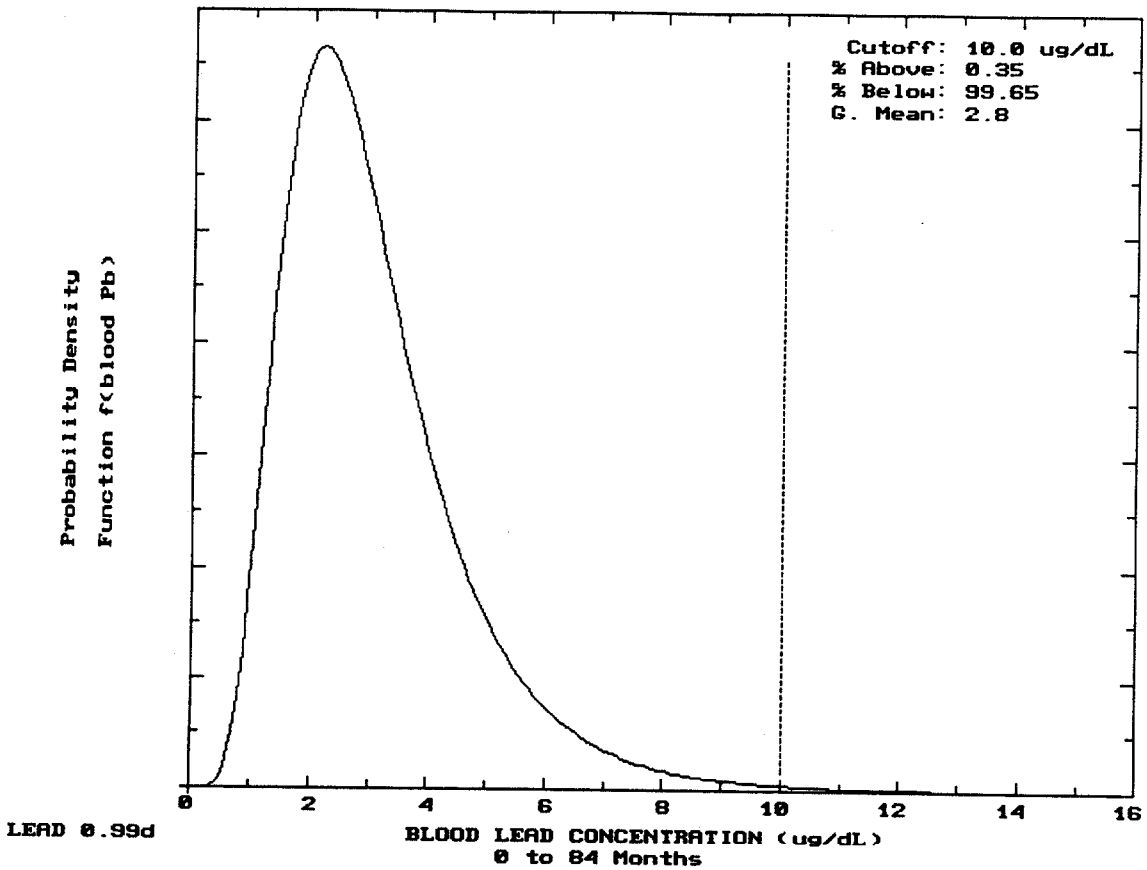
MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.2	5.82	2.84
1-2:	3.4	8.15	4.49
2-3:	3.2	8.60	4.52
3-4:	3.0	8.59	4.57
4-5:	2.6	7.44	3.43
5-6:	2.3	7.37	3.10
6-7:	2.1	7.56	2.94

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)

0.5-1:	2.59	0.37	0.00	0.02
1-2:	2.69	0.93	0.00	0.03
2-3:	3.04	0.98	0.00	0.06
3-4:	2.96	1.00	0.00	0.07
4-5:	2.89	1.06	0.00	0.07
5-6:	3.06	1.12	0.00	0.09
6-7:	3.39	1.14	0.00	0.09


Cutoff: 10.0 ug/dL
% Above: 0.35
% Below: 99.65
G. Mean: 2.8
Probability Density
Function f(blood Pb)
0
2
4
6
8
10
12
14
16
LEAD 0.99d
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 84 Months

APPENDIX H

ACTION MEMORANDUM FOR SITE 8 SOILS

MEMORANDUM

FROM: Orlando J. Monaco, Remedial Project Manager, NORTHNAVFACENGCOM

TO: Thomas C. Ames, BRAC Environmental Coordinator

SUBJECT: Request for a Removal Action at Site 8
Naval Air Warfare Center (NAWC) National Priorities List (NPL) Site
Warminster, Bucks County, Pennsylvania

I. PURPOSE

The purpose of this Action Memorandum is to request and document approval of the proposed removal action in and around the vicinity described as Site 8 at the Naval Air Warfare Center (NAWC) National Priorities List (NPL) Site, Warminster, Bucks County, Pennsylvania. An assessment performed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300, has identified a threat to human health and the environment due to the presence of hazardous substances in surface soils around Site 8. These substances pose threats to nearby human populations and future land use plans. As a result of these conditions, a removal action is needed at the Site pursuant to Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. Section 9604.

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

The Site is situated mostly in the Township of Warminster, Bucks County, Pennsylvania, in a heavily populated suburban area. Private homes, several commercial and industrial enterprises, and a golf course surround the facility, which encompasses approximately 840 acres. On-base areas include various buildings and other complexes connected by paved roads, the former runway

and ramp area, mowed fields, and a small wooded area. The longest runway, which is no longer active, is generally located along the topographically highest area at the facility. Many of the primary facility buildings are located west of Jacksonville Road. A housing development for military enlisted personnel is within the southeastern portion of the site.

NAWC Warminster was disestablished on 30 September 1996, and is now known as the North American Technology Center. The military enlisted personnel living at the facility are the nearest population center. These personnel work primarily at the Naval Air Station Joint Reserve Base Willow Grove, PA. NAS/JRB Willow Grove manages the military housing complex. The closest off-base home is about 200 feet from the base property line. Residential development is located along the length of the southern property line and, to a lesser extent, along the northern property line. Industrial development is found along the western and northwestern perimeters of the base.

B. Site Background

The former NAWC Warminster was originally the location of Brewster Aeronautical Corporation, a manufacturer of military aircraft. In 1944, the Navy assumed full control of the Brewster plant. The Naval Air Modification Unit was installed at the base to add design modifications to military aircraft produced at other locations. After World War II, activities at the base were altered; in 1949, the facility was designated the Naval Air Development Center (NADC), and its main mission, research, development, testing, and evaluation for Naval aircraft systems, was established. NAWC Warminster also conducted studies in anti-submarine warfare systems and software development. The facility name was changed from NADC to Naval Air Warfare Center, Aircraft Division, on January 1, 1992. The future use of the facility is detailed in a Reuse Plan approved by the Federal Lands Reuse Authority of Bucks County (FLRA) in 1997. The Reuse

Plan consists of multiple uses including parks and recreation, business campus/industrial and residential. The FLRA's Reuse Plan was presented to each of the three municipalities (Ivyland Borough, Warminster Township and Northampton) in 1997. Each board of elected officials gave unanimous concurrence to the FLRA's Reuse Plan. The Site 8 reuse is included in the FLRA's Economic Development Conveyance (EDC) application as business campus/industrial. The realignment has resulted in the relocation of NAWC Warminster activities to Patuxent River, Maryland and the closure of the base. Navy family housing assets have been transferred to Commanding Officer, Joint Reserve Base, Willow Grove, PA and will remain in place.

Historically, wastes at the facility were generated during aircraft maintenance and repair, pest control, firefighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludge from industrial wastewater treatment, and waste oils.

To date, at least eight sites on current NAWC Warminster property have been identified as sites used for the disposal of wastes containing hazardous substances. None of the sites are currently used for waste disposal. Any hazardous substance releases from the eight sites identified to date and from other unidentified sites potentially affect the Stockton Formation aquifer, which provides water for more than 100,000 people within the vicinity of the facility. Local surface water bodies are used for recreational and industrial purposes.

For investigative purposes, Sites 1, 2 and 3 have been grouped into Area A. Sites 5, 6 and 7 have been grouped into Area B; Sites 4 and 8 comprise Area C; and Area D consists of potential sources and hazardous substance releases west of the main building complex at the base.

C. Physical Location and Description

Site 8 is defined as two distinct, but related, operations that took place adjacent to each other - the fire-fighting training area and a temporary structure identified as S1.

The fire-fighting training area was in an open grassy area north of the main airstrip at the northeastern end of an abandoned runway, 500 feet from the fence line and 1000 feet from base housing. A cement drainage culvert receives runoff from the site and discharges to the north. Scattered single-family homes are located northeast of Werner Park. A footbridge connects the homes directly to Werner Park, indicating that exposure could occur in the unnamed creeks in this area.

The training area consisted of a 75- by 75-foot portion of the runway surrounded on three sides by a double berm. The berms were approximately 3 to 5 feet high. The site was used for fire training exercises from 1961 to 1988. Typically, flammable liquids were poured onto the runway, ignited, and extinguished to simulate fire-fighting procedures. In the past, surface water (about 6 to 12 inches) was observed to collect within this area. Aviation fuel, scrapped cars and aircraft and other debris were reportedly stored and burned within the area.

The temporary structure, S1, was also on the abandoned runway. It was a corrugated metal structure located to the south of the fire-fighting training area and was used to test the durability of flight suits. The floor of the structure contained water on top of which was placed a flammable liquid. Once ignited, a flight suit, attached to a mechanical arm, was passed through the flames in order to test the suit's ability to withstand fire. Temporary Structure S1 was dismantled and removed in 1997 by Navy Caretaker Site Office personnel after the Federal Lands Reuse Authority advised the Navy that the structure was not suitable for reuse. The temporary structure was dismantled and the

materials placed in dumpsters. The contents of the dumpsters were disposed of off-site.

By 1988, the soil berms had been removed. NAWC Warminster personnel reported that these berms, along with residue, trapped liquids, and soil from eroded areas, had been analyzed and removed. The removed material was deposited in an area adjacent to Site 8, and the site regraded.

D. Quantities and Types of Hazardous Substances Present

Remedial Investigations conducted to date has consisted of soil gas surveys, surface water, sediment sampling and analysis, surface and subsurface sampling and analysis, wetlands assessment and a geophysical survey. A summary of these findings are presented in the draft Phase III RI Report by Brown & Root Environmental dated November 1996. Results of subsequent investigations were presented in a letter from Tetra Tech NUS, Inc dated October 20, 1998. The results of these findings indicated the possibility of metals contamination, principally lead and arsenic, in the surface soils along the western edge of the former Site 8 location.

Lead levels above the State's direct contact value of 1000 mg/kg for non-residential land use were detected in 5 out of 17 surface soil samples ranging from 1000 to 3130 mg/kg. The highest concentrations were identified in surface samples collected at SS-08-21, located about 70 feet from the former Structure S1. None of the samples contained arsenic levels greater that the State's direct contact value for non-residential land use. Samples collected from the entrance to the drainage channel northwest of Site 8 did not reveal any significant metal levels.

The volume of contaminated soils at Site 8 is estimated to be 330 cubic yards. The approximate area of contamination is 4500 square feet. Based on site characterization information,

contaminated soils have not significantly migrated from Site 8. This conclusion is supported by the lack of significant metals contamination in groundwater in the vicinity of the Site, along with the lack of subsurface contamination. The final Record of Decision for Operable Unit 3 addresses groundwater contamination from Area C, which includes Site 8.

E. NPL Status

EPA officially recognized the waste disposal locations at NAWC Warminster as possibly needing investigation in September 1979. On October 4, 1989, NAWC Warminster was placed on the final NPL. That same year, EPA submitted a draft Interagency Agreement to the Navy for formalizing and scheduling remedial activities. The contents of this agreement were negotiated in 1990.

To date, the NAWC Warminster sites are being addressed by the Navy in four long-term remedial phases. Four remedial investigations (RI) (Phase I, Phase II, focused RI for groundwater, and Phase III) have been conducted at the base since October 1989.

Phase I was performed between October 1989 and April 1991. Phase I involved mapping volatile organic compounds (VOCs) in soil gas and detecting magnetic and conductive anomalies through electromagnetic surveys. Approximate site boundaries were identified and confirmation of site contamination was made through soil borings, installation of monitoring wells, and groundwater sampling and analysis. In addition, test pits were excavated, local wells were inventoried, and a fracture-trace analysis was conducted.

Phase II was performed between May 1992 and April 1993. This phase helped determine the nature and extent of groundwater contamination, evaluate groundwater flow and add to the hydrogeologic database, and ascertain possible remedial

alternatives. Phase II involved installing additional overburden and shallow bedrock monitoring wells, sampling and analyzing groundwater, and evaluating aquifer characteristics through water-level monitoring and a pumping test. Four off-base wells were also sampled. At the end of Phases I and II, the Navy and EPA selected a remedy for Operable Unit 1 (OU-1), which is contaminated shallow groundwater attributable to Areas A and B at the base. This was the first clean-up plan selected for NAWC Warminster.

Focused RI activities for other groundwater contamination at the base began in October 1993 for Area B, January 1994 for Area C, and February 1994 for Areas A and D. The RI field work for Area C groundwater was completed in May 1994. During this investigation, the Navy addressed groundwater contamination associated with Site 4 that was not completely evaluated during the earlier studies. The Navy prepared RI and FS reports addressing the results of this investigation and evaluating remedial alternatives for shallow groundwater contamination in the vicinity of Area C. Both reports were completed in August 1994. In March 1995, the Navy and EPA selected a remedy for OU-3, which is contaminated groundwater attributable to Area C. The Navy combined this remedy with the remedy for OU-1. The OU-3 remedial action has been operational since July 1996.

The Phase III RI/FS began in January 1995 and will identify the full nature and extent of contamination, both on and off base, for the rest of the facility. Additional removal or remedial actions are being proposed to support the selection of a remedy for a particular medium or group of media.

F. Other Actions to Date

After the Phase II RI was completed, the Navy initiated other environmental investigations to more fully determine the nature and extent of groundwater contamination attributable to NAWC

Warminster. In April 1993, the Navy, in coordination with EPA, initiated a well testing program in the vicinity of the base to assess the impact of contaminated groundwater possibly attributable to NAWC Warminster. Between April and August 1993, the Navy sampled more than 250 off-base residential, commercial, and municipal wells. The test results indicated that the levels of some VOCs found in residential wells exceeded federal drinking water standards [i.e., Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act]. To address these levels, the Navy conducted a CERCLA removal action, installing a water treatment system in each residence where either EPA Removal Action Levels or MCLs had been exceeded.

The Navy and EPA determined that this off-base groundwater contamination constituted an imminent threat to human health. Therefore, the Navy and EPA conducted additional CERCLA removal action work by connecting residences affected by groundwater contamination in the vicinity of Casey Village and Kirk Road to a public water-supply system between June and December 1994. As such, OU-2 consists of contaminated groundwater associated with residential wells located on Kirk Road north of Area C and residential wells in the vicinity of the Casey Village area southeast of Area B.

In addition to the work being performed under CERCLA, the Navy has undertaken environmental baseline survey work to help identify and prioritize parcels of land at NAWC Warminster that can be transferred to the Federal Lands Reuse Authority - Bucks County (FLRA-BC). The proposed removal action for Site 8 will help to support the transfer of property to the community by identifying the most appropriate response option to mitigate potential exposure to Site 8 contaminants.

G. State and Local Authorities' Roles

The Department of Defense (DOD), as part of President Clinton's five part program to speed economic recovery at communities where military bases are closing, has established a BRAC Cleanup Team (BCT) to implement "Fast Track" cleanup initiatives. The BCT consists one representative from DOD, one representative from the U.S. Environmental Protection Agency Region III (EPA) and one representative from the Pennsylvania Department of Environmental Protection (PADEP). The BCT acts as the primary forum in which issues affecting the execution of the cleanup to facilitate reuse are addressed. A Restoration Advisory Board (RAB), which consists of representatives of the Navy, the United States Environmental Protection Agency (EPA), PADEP, the Bucks County Health Department, the Northampton Township Municipal Authority, the Warminster Township Municipal Authority, and Upper Southampton Township, local businesses and concerned citizens has assisted in the planning and review of these activities.

As part of the nationwide BRAC legislation, NAWC Warminster has pledged to give top priority to early re-use of the base's land and buildings. FLRA-BC is responsible for recommending strategies for reuse of the base to best utilize the resources of NAWC Warminster and its people to the greatest benefit of surrounding communities.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT AND STATUTORY AND REGULATORY AUTHORITIES

The conditions at Site 8 warrant a removal action. Field investigation results indicate unacceptable levels of hazardous substances in surface soils at Site 8. Present military control restricts access to Site 8. However, upon lease and/or transfer to the community as part of the closure process for NAWC, the property including Site 8 may potentially be used for non-residential purposes.

Section 300.415 of the NCP identifies the factors that must be considered when determining the appropriateness of a removal action. Paragraphs (b) (2) (i), (ii), (iv), and (vii) of Section 300.415 directly apply as follows to Site 8 conditions:

A. Section 300.415 (b) (2) (i) "Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants."

Potential human and environmental exposure pathways identified under current or future land use scenarios for Site 8 include dermal, incidental ingestion, and fugitive dust inhalation exposure to soil contaminants.

B. Section 300.415 (b) (2) (ii) "Actual or potential contamination of drinking water supplies or sensitive ecosystems."

B. Section 300.415 (b) (2) (ii) "Actual or potential contamination of drinking water supplies or sensitive ecosystems."

B. Section 300.415 (b) (2) (ii) "Actual or potential contamination of drinking water supplies or sensitive ecosystems."

Groundwater downgradient of Site 8 may potentially be used for private and public water supply purposes. Although the present remedy provided by OU-3 indicates that VOC contamination levels in groundwater are improving, it is possible that lead contaminants from surface soils near Site 8 may result in groundwater contamination in the future. Contaminated groundwater attributable to releases within an area which includes Site 8 (i.e., Area C) is being addressed by a pump and treat system which went into operation during Spring 1996.

C. Section 300.415 (b) (2) (vii) "The availability of other appropriate federal or state response mechanisms to respond to the release."

The availability of response mechanisms can be met through the Navy's IR Program.

D. Section 300.415 (b) (2) (viii) "Other situations or factors that may pose threats to public health or welfare or the environment."

The presence of contaminated soils at Site 8 will hinder future land use for this area, including non-residential land use, when the Navy turns over this property to the community.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from Site 8, if not addressed by the response action selected in this Action Memorandum, may present an endangerment to public health, welfare, or the environment.

V. PROPOSED ACTION AND ESTIMATED COSTS

A. Actions

The action proposed for Site 8 is to excavate contaminated soils and dispose of these material without treatment at a waste landfill. Landfilling is a cost-effective alternative for addressing the buried soil and wastes at Site 8. Municipal waste landfills are engineered to provide controls for protecting human health and the environment. If necessary, any soils or buried wastes that cannot be disposed in a municipal landfill will be disposed in a hazardous waste landfill.

The contaminated soils are present along the western edge of the Site. Available information suggests that these materials are confined to the area described above. The proposed action would excavate these surface soils.

At this time, it is estimated that the entire project will be completed within 12 months and under the $2 million ceiling for removal actions, barring any unforeseen circumstances or disposal restrictions.

B. Estimated Costs

The Navy estimates that $30,000 will be needed to carry out the recommended removal action at Site 8, excluding annual operation and maintenance (O&M) costs.

C. Contribution to Remedial Performance

Per the Federal Facility Agreement signed by the Navy and EPA, this removal action shall, to the extent practicable, contribute to the efficient performance of any long term remedial action with respect to the release or release(s) or threatened release(s) of concern.

The proposed removal action will meet the following objectives:

- Prevent exposures (or potential exposures) to contaminated soils presenting unacceptable risks.

- Protect groundwater quality by reducing infiltration of water into and through contaminated soils of concern.

- Prevent the release of hazardous substances at Site 8 to nearby surface water, sensitive ecosystems, and other media.

The proposed removal action is consistent with accepted removal practices and is expected to abate the threats that meet the NCP removal criteria. The proposed removal is not expected to impede future remedial or removal actions contemplated for Site 8.

D. RECOMMENDATION

Because conditions at Site 8 meet the NCP Section 300.415 criteria for a non-time-critical removal action, I recommend approval of this request for $30,000. Please indicate your approval or disapproval by signing below. I recommend your approval to initiate response actions because of the nature of the threats described herein.

ORLANDO J. MONACO, P.E.
Remedial Project Manager

For U.S. Navy
Approved/~~Disapproved~~: Thomas C Ames
2/4/99 Date:

APPENDIX I

VERIFICATION SAMPLING AND ANALYSIS REPORT

Neil

TETRA TECH NUS, INC.
600 Clark Avenue, Suite 3 • King of Prussia, PA 19406-1433
(610) 491-9688 • FAX (610) 491-9645 • www.tetratech.com

C-51-2-9-37

February 19, 1999

Project Number 6883

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mail Stop No. 82
10 Industrial Highway
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N624272-D-1298
Contract Task Order (CTO) No. 252

Subject: Verification Sampling Analytical Results, Site 8
Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Monaco:

Tetra Tech NUS (TtNUS) collected 17 (including duplicate and quality assurance/control) samples from the Site 8 removal area on February 15, 1999. The removal area consists of an excavation that is oriented along the western edge of the runway extension. The excavation measured 131 feet in length, 20 feet in width, and 2 to 2.5 feet in depth. The eastern wall was excavated into the existing runway extension. This wall of the excavation consisted of gravel and crushed stone with little to no soil available for sampling. Also located on this wall was a concrete drainage pipe about 1.5 feet below ground surface. The pipe was visible the entire length of the excavation and appeared to be about 8 inches in diameter. No evidence of staining or the presence of any unusual soil characteristics was noted in the excavation walls or floor.

The Verification Sampling and Analysis Plan (VSAP) called for collecting a sample every 25 linear feet along the sidewalls. However, because of the lack of soil, the presence of gravel and crushed stone and asphalt, fewer samples were collected along the eastern wall adjacent to the runway extension. Only four samples were collected along this wall (see Attachment 1). These samples were collected in the areas that contained the highest proportion of soils by scraping the wall and segregating as much soil out of the stone and gravel as possible.

All samples were analyzed for Lead and Arsenic. Analytical results were provided on a quick-turn-around basis and have not undergone full data validation. Laboratory analytical results are presented in Attachment 2.

Lead was the only compound for which a clean-up goal was established, 500 mg/kg. This clean-up goal was selected based on protecting against unacceptable potential exposures under a residential scenario. Lead concentrations in the samples ranged from 18.4 mg/kg to 733 mg/kg.

Only one sample, VS-8-08, contained Lead above the target clean-up goal of 600 mg/kg. This sample was collected immediately above the drainage pipe from the eastern wall of the excavation and consisted of soil mixed with crushed asphalt, gravel and stone. As noted above, the excavation exposed the runway under-bedding along the entire length of the eastern wall. Little soil was evident in this area.

The analytical results were evaluated along with data from previous sampling at Site 8 to determine if the lead concentrations at Site 8 present an unacceptable risk. Sample results from the Phase III RI and supplemental Site 8 sampling were included with the verification sample data into one database. Attachment 3 presents the analytical data used in the evaluation along with a map showing the previous sampling locations.

The IEUBK Lead Model (V 0.99) was used to characterize risks from lead in soils for the hypothetical future child population (0 to 6 years) which is considered to be the most sensitive potential receptor group at NAWC Site 8. The simulated range of blood-lead values that might occur in a population as a result of exposures to lead was compared to a guideline of 10 micrograms per deciliter (ug/dl). Based on model results using the representative lead concentration (261 mg/kg, the UCL 95 % for site-wide surface soil data), 3.45 percent of residential children exposed under similar conditions might have blood-lead levels exceeding 10 ug/dl. This is below the EPA protective guideline of 5 percent.

Recommendation

Based on the verification sampling analytical data, the results of the evaluation of site-wide surface soil lead contamination and the fact that the removal action extends to the runway under-bedding, it is recommended that no further removal or sampling be performed in this area.

Respectfully;

Garth Glenn
Project Manager

GG/ejc

C: Tom Ames (NAVFACENGCOM)
Tim McAntee (NAVFACENGCOM)
Darius Ostrauskas (EPA Region III)
April Flipse (PADEP)
Neil Teamerson (TtNUS)
Jeff Orient (TtNUS)

Enclosures

ATTACHMENT 1

SAMPLE LOG SHEET

Page _____ of _____

Halliburton NUS CORPORATION

- ☐ Spring
- ☐ Lake
- ☐ Stream
- ☐ Lagoon/Pond
- ☐ Other_____

Case No. _____

By _____

Project Site Name NAWC. WARMINSTER Project Site Number 6883

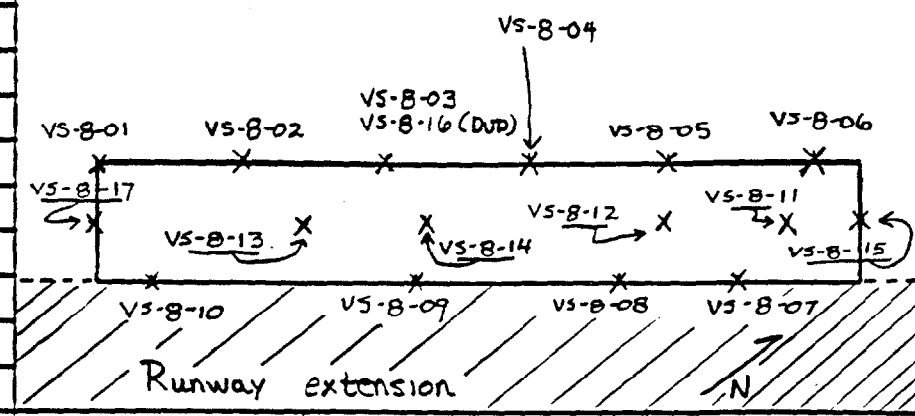
HNUS Source No. SITE 8 Source Location _____

Sample Method:	Composite Sample Data		
	Sample	Time	Color/Description
Depth Sampled:			
Sample Date & Time:			
Sampled By:			
Signature(s):			
Type of Sample			
☐ Low Concentration			
☐ High Concentration			
☐ Grab			
☐ Composite			
☐ Grab - Composite			

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc)

Analysis:

Observation/Notes



	Organic	Inorganic
Traffic Report No.		
Tag No.		
AB No.		
Date Shipped		
Time Shipped		
Laboratory		
Volume		

ATTACHMENT 2

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc
NAWC WARMINSTER, PENNSYLVANIA
Project Number: CTO NO. 0252

Lot #: C9B160142 Date Reported: 2/18/99

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: ~~VS-8-01~~ SS-08-31					
Sample #: 001 Date Sampled: 02/15/99 09:15 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	5.9	1.2	mg/kg	SW846 6010B	
Lead	131	0.37	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	80.6		%	MCAWW 160.3 MOD	
Client Sample ID: ~~VS-8-02~~ SS-08-32					
Sample #: 002 Date Sampled: 02/15/99 09:20 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.3	1.2	mg/kg	SW846 6010B	
Lead	27.8	0.37	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	81.6		%	MCAWW 160.3 MOD	
Client Sample ID: ~~VS-8-03~~ SS-08-33					
Sample #: 003 Date Sampled: 02/15/99 09:25 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	5.5	1.2	mg/kg	SW846 6010B	
Lead	24.3	0.35	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc

Lot #: C9B160142 NAWC WARMINSTER, PENNSYLVANIA Date Reported: 2/18/99

Project Number: CTO NO. 0252

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: VS-8-03 SS-08-33					
Sample #: 003 Date Sampled: 02/15/99 09:25 Date Received: 02/16/99 Matrix: SOLID					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	86.1		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-04 SS-08-34					
Sample #: 004 Date Sampled: 02/15/99 09:25 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.6	1.3	mg/kg	SW846 6010B	
Lead	93.6	0.39	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	76.4		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-05 SS-08-35					
Sample #: 005 Date Sampled: 02/15/99 09:30 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	5.9	1.2	mg/kg	SW846 6010B	
Lead	64.2	0.36	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	83.2		%	MCAWW 160.3 MOD	

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc

Lot #: C9B160142 NAWC WARMINSTER, PENNSYLVANIA Date Reported: 2/18/99

Project Number: CTO NO. 0252

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: VS-8-06 SS-08-36					
Sample #: 006 Date Sampled: 02/15/99 09:32 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					**Reviewed**
Arsenic	7.4	1.3	mg/kg	SW846 6010B	
Lead	44.3	0.39	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					**Reviewed**
Total Residue as Percent Solids	77.5		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-07 SS-08-37					
Sample #: 007 Date Sampled: 02/15/99 09:45 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					**Reviewed**
Arsenic	7.3	1.1	mg/kg	SW846 6010B	
Lead	102	0.34	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					**Reviewed**
Total Residue as Percent Solids	88.1		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-08 SS-08-38					
Sample #: 008 Date Sampled: 02/15/99 09:50 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					**Reviewed**
Arsenic	9.0	1.2	mg/kg	SW846 6010B	
Lead	733	0.70	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc
NAWC WARMINSTER, PENNSYLVANIA
Project Number: CTO NO. 0252

Lot #: C9B160142 Date Reported: 2/18/99

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: VS-~~8~~-08 SS-08-38					
Sample #: 008 Date Sampled: 02/15/99 09:50 Date Received: 02/16/99 Matrix: SOLID					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	86.0		%	MCAWW 160.3 MOD	
Client Sample ID: VS-~~8~~-10 SS-08-40					
Sample #: 009 Date Sampled: 02/15/99 10:05 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	4.7	1.1	mg/kg	SW846 6010B	
Lead	63.2	0.33	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	92.0		%	MCAWW 160.3 MOD	
Client Sample ID: VS-~~8~~-11 SS-08-41					
Sample #: 010 Date Sampled: 02/15/99 10:13 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.5	1.3	mg/kg	SW846 6010B	
Lead	20.2	0.40	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	74.9		%	MCAWW 160.3 MOD	

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc
NAWC WARMINSTER, PENNSYLVANIA
Project Number: CTO NO. 0252

Lot #: C9B160142 Date Reported: 2/18/99

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: VS-8-12 SS-08-42					
Sample #: 011 Date Sampled: 02/15/99 10:17 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.8	1.4	mg/kg	SW846 6010B	
Lead	18.4	0.42	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	70.9		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-13 SS-08-43					
Sample #: 012 Date Sampled: 02/15/99 10:27 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	8.2	1.5	mg/kg	SW846 6010B	
Lead	115	0.44	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	67.9		%	MCAWW 160.3 MOD	
Client Sample ID: VS-8-14 SS-08-44					
Sample #: 013 Date Sampled: 02/15/99 10:25 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	7.5	1.3	mg/kg	SW846 6010B	
Lead	475	0.40	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc
NAWC WARMINSTER, PENNSYLVANIA
Project Number: CTO NO. 0252

Lot #: C9B160142 Date Reported: 2/18/99

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: VS~~-8-14~~ SS-08-44					
Sample #: 013 Date Sampled: 02/15/99 10:25 Date Received: 02/16/99 Matrix: SOLID					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	74.6		%	MCAWW 160.3 MOD	
Client Sample ID: VS~~-8-15~~ SS-08-45					
Sample #: 014 Date Sampled: 02/15/99 10:40 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	8.3	1.3	mg/kg	SW846 6010B	
Lead	181	0.38	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	78.5		%	MCAWW 160.3 MOD	
Client Sample ID: VS~~-8-16~~ SS-08-46 - Duplicate of ~~VS-8-03~~ SS-08-23					
Sample #: 015 Date Sampled: 02/15/99 09:25 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	5.1	1.2	mg/kg	SW846 6010B	
Lead	34.8	0.36	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	82.6		%	MCAWW 160.3 MOD	

(Continued on next page)

QUANTERRA INCORPORATED

PRELIMINARY DATA SUMMARY

The results shown below may still require additional laboratory review and are subject to change. Actions taken based on these results are the responsibility of the data user.

Tetra Tech NUS, Inc
NAWC WARMINSTER, PENNSYLVANIA
Project Number: CTO NO. 0252

Lot #: C9B160142 Date Reported: 2/18/99

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD	
Client Sample ID: ~~VS-8-17~~ SS-08-47					
Sample #: 016 Date Sampled: 02/15/99 10:41 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.2	1.2	mg/kg	SW846 6010B	
Lead	69.4	0.35	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	85.7		%	MCAWW 160.3 MOD	
Client Sample ID: ~~VS-8-09~~ SS-08-39					
Sample #: 017 Date Sampled: 02/15/99 10:00 Date Received: 02/16/99 Matrix: SOLID					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	6.4	1.1	mg/kg	SW846 6010B	
Lead	131	0.34	mg/kg	SW846 6010B	
Results and reporting limits have been adjusted for dry weight.					
Inorganic Analysis					Reviewed
Total Residue as Percent Solids	87.2		%	MCAWW 160.3 MOD	
Client Sample ID: FB-0215 BLANK					
Sample #: 018 Date Sampled: 02/15/99 11:00 Date Received: 02/16/99 Matrix: WATER					
Trace Inductively Coupled Plasma (ICP) Metals					Reviewed
Arsenic	ND	10.0	ug/L	SW846 6010B	
Lead	ND	3.0	ug/L	SW846 6010B	

ATTACHMENT 3

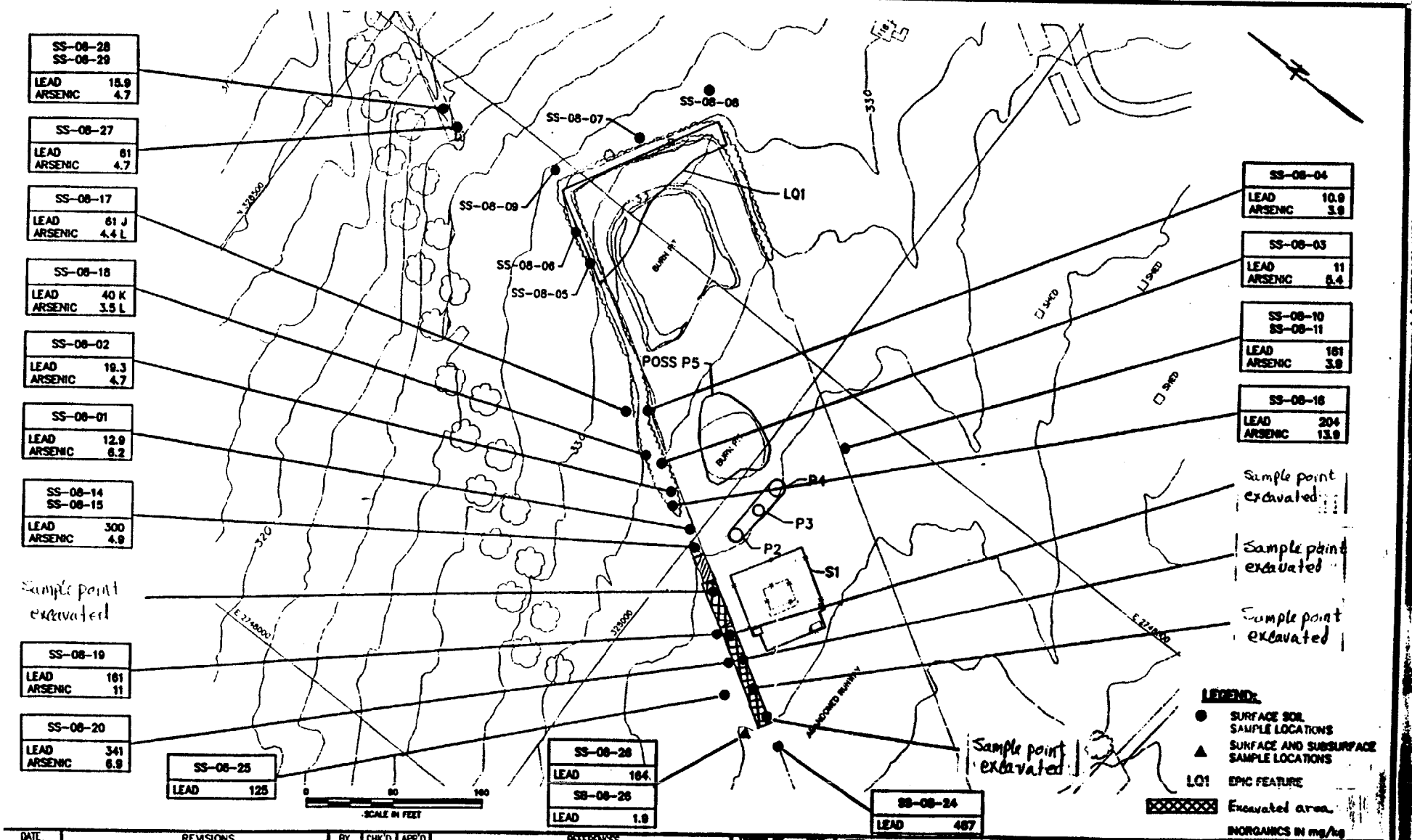
ATTACMENT 3

Lead Results, Site 8
NAWC, Warminster

Sample Number	Lead mg/kg
VS-8-01	131
VS-8-02	27.8
VS-8-03	29.55
VS-8-04	93.6
VS-8-05	64.2
VS-8-06	44.3
VS-8-07	102
VS-8-08	733
VS-8-09	131
VS-8-10	63.2
VS-8-11	20.2
VS-8-12	18.4
VS-8-13	115
VS-8-14	475
VS-8-15	181
VS-8-17	69.4
SS-08-28	15.9
SS-08-27	61
SS-08-17	61
SS-08-18	40
SS-08-02	19.3
SS-08-01	12.9
SS-08-14	300
SS-08-19	161
SS-08-20	341
SS-08-25	125
SS-08-04	10.9
SS-08-03	11
SS-08-10	161
SS-08-16	204
SS-08-26	164
SS-08-24	487

Note: concentration for VS-8-03 is average between duplicate samples (VS-8-03 and VS-8-16)

Average lead concentration = 140 mg/kg
UCL 95 % (based on lognormal data distribution) = 261 mg/kg



DATE	REVISIONS	BY	CHK'D	APP'D
2/19/99	Hand anotation for verification sample results for C-151-2-9-37	GG	✓	✓
1/29/99	EXCAVATION AREA REVISED	LDL		

REFERENCES

NO SCALE - ORIGINAL WAS REDUCED

DRAWN BY EEH DATE 8/25/98
CHECKED BY N. TEAMERSON
COST/SCHED.-AREA
SCALE 1" = 50'

TETRA TECH NUS, INC.

SITE 8 REMOVAL AREA AND PHASE III AND SUPPLEMENTAL SAMPLING RESULTS

AREA C – NEAR SITE 8
FORMER NAWC, WARMINSTER, PA

CONTRACT NO. N63472-90-D-1298
ORDER NO. 1412
APPROVED BY N. TEAMERSON TEA DATE 1/29/99
APPROVED BY GG DATE 2/19/99
DRAWING NO. ATTACHMENT 1.3
REV. 1

APPENDIX J

TOXICITY PROFILES

Toxicological Profiles

I.1 Arsenic

I.1.1 Pharmacokinetics

Several studies confirm that soluble inorganic arsenic compounds and organic arsenic compounds are almost completely (>90 percent) absorbed from the GI tract in both animals and humans (Ishinishi et al. 1986). The absorption efficiency of insoluble inorganic arsenic compounds depends on particle size and stomach pH. Initial distribution of absorbed arsenic is to the liver, kidneys, and lungs, followed by redistribution to hair, nails, teeth, bone, and skin, which are considered tissues of accumulation. Arsenic has a longer half-life in the blood of rats, compared with other animals and humans, because of firm binding to the hemoglobin in erythrocytes.

Metabolism of inorganic arsenic includes reversible oxidation-reduction so that both arsenite (valence of 3) and arsenate (valence of 5) are present in the urine of animals treated with arsenic of either valence (Ishinishi et al. 1986). Arsenite is subsequently oxidized and methylated by a saturable mechanism to form mono- or dimethylarsenate; the latter is the predominant metabolite in the urine of animals or humans. Organic arsenic compounds (arsenilic acid, cacodylic acid) are not readily converted to inorganic arsenic. Excretion of organic or inorganic arsenic is largely via the urine, but considerable species variation exists. Continuously exposed humans appear to excrete 60 to 70 percent of their daily intake of arsenate or arsenite via the urine.

I.1.2 Non-carcinogenic Toxicity

A lethal dose of arsenic trioxide in humans is 70 to 180 mg (approximately 50 to 140 mg arsenic; Ishinishi et al. 1986). Acute oral exposure of humans to high doses of arsenic produce liver swelling, skin lesions, disturbed heart function, and neurological effects. The only non-carcinogenic effects in humans clearly attributable to chronic oral exposure to arsenic are dermal hyperpigmentation and keratosis, as revealed by studies of several hundred Chinese exposed to naturally occurring arsenic in well water (Tseng 1977; Tseng et al. 1968; EPA 1999a). Similar effects were observed in persons exposed to high levels of arsenic in water in Utah and the northern part of Mexico (Cebrian et al. 1983; Southwick et al. 1983). Occupational (predominantly inhalation) exposure is also associated with neurological deficits, anemia, and cardiovascular effects (Ishinishi et al. 1986), but concomitant exposure to other chemicals cannot be ruled out. EPA (1999a) derived an RfD of 0.0003 mg/kg/day for chronic oral exposure, based on an NOAEL of 0.0008 mg/kg/day for skin lesions from the Chinese data. An uncertainty of 3 is applied to account for both the lack of data to preclude reproductive toxicity as a critical effect and to account for some of the uncertainty in whether the NOAEL of the critical study accounts for all sensitive individuals. The principal target organ for arsenic appears to be the skin. The nervous system and cardiovascular systems appear to be less significant target organs. Inorganic arsenic may be an essential nutrient, exerting beneficial effects on growth, health, and feed conversion efficiency (Underwood 1977). EPA (1999a) has not published an RfC for arsenic.

I.1.3 Carcinogenicity

Inorganic arsenic is clearly a carcinogen in humans. EPA (1999a) listed an oral slope factor of 1.5 per mg/kg/day. Inhalation exposure is associated with increased risk of lung cancer in persons employed as smelter workers, in arsenical pesticide applicators, and in a population residing near a pesticide manufacturing plant (EPA 1999a). Oral exposure to high levels in well water is associated with increased risk of skin cancer (Tseng 1977; EPA 1999a). Extensive animal testing with various forms of arsenic given by many routes of exposure to several species, however, has not demonstrated the carcinogenicity of arsenic (International Agency for Research on Cancer [IARC] 1980). EPA (1999a) classifies inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen), and recommends an oral unit risk of 0.00005 ug/L in drinking water, based on the incidence of skin cancer in the Tseng (1977) study. EPA (1999a) notes that the uncertainties associated with the oral unit risk are considerably less than those for most carcinogens, so that the unit risk might be reduced an order of magnitude. An inhalation unit risk of 0.0043 per ug/m^3 was derived for inorganic arsenic from the incidence of lung cancer in occupationally exposed men (EPA 1999a).

I.2 Chromium

I.2.1 Non-carcinogenic Toxicity

In nature, chromium (III) predominates over chromium (VI) (Langård and Norseth 1986). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Chromium (III) is considered a nutritionally essential trace element and is considerably less toxic than chromium (VI). No effects were observed in rats consuming 1800 mg chromium (III)/kg/day in the diet for over two years (EPA 1999a). The NOEL of 1800 mg/kg/day and an uncertainty factor of 1,000 was the basis for a verified chronic oral RfD of 1 mg/kg/day (EPA 1998a). The same NOEL and an uncertainty factor of 100 was the basis for a provisional subchronic oral RfD of 10 mg/kg/day (EPA 1999a). A target organ was not identified for chromium (III).

Acute oral exposure of humans to high doses of chromium (VI) induced neurological effects, GI hemorrhage and fluid loss, and kidney and liver effects. Parenteral dosing of animals with chromium (VI) is selectively toxic to the kidney tubules. An NOAEL of 2.4 mg chromium (VI)/kg/day in a one-year drinking water study in rats was the basis of a verified RfD of 0.003 mg/kg/day for chronic oral exposure (EPA 1999a). An uncertainty factor of 300 represents two 10-fold decreases in dose

to account for both the expected interhuman and interspecies variability in the toxicity of the chemical in lieu of specific data and an additional factor of 3 to compensate for the less-than-lifetime exposure duration of the study (EPA 1999a). The kidney may be the principal target organ for repeated oral dosing with chromium (VI), but effects seen in the principal RfD study were increased levels of chromium (VI) in kidneys, livers, and femurs of test subjects.

EPA (1999a) established an inhalation RfC of 0.0004 mg/m^3 based on a BMD of 0.016 mg/m^3 in a rat subchronic study. Critical effects seen were lactate dehydrogenase in bronchioalveolar lavage fluid. An uncertainty factor of 300 was also applied to the inhalation RfC based on a accounting for pharmacodyna differences not accounted for, and a 10-fold factor to account for the less than lifetime exposure and a 10-fold factor to account for variation in the human population (EPA 1988).

I.2.2 Carcinogenicity

Data were not located regarding the carcinogenicity of chromium (III). EPA (1999a) classifies chromium (VI) in cancer weight-of-evidence Group D (not classifiable regarding human carcinogenicity), via the oral route of exposure. EPA (1999a) classifies chromium (VI) in cancer weight-of-evidence Group A (human carcinogen), via inhalation exposure based on the consistent observation of increased risk of lung cancer in occupational studies of workers in chromate production or the chrome pigment industry. Parenteral dosing of animals with chromium (VI) compounds consistently induced injection-site tumors. inhalation unit risk of 0.012 per ug/m^3, equivalent to 42 per mg/kg/day (EPA 1999a), assuming humans inhale 20 m^3/day and weigh 70 kg, was based on increased risk of lung cancer deaths in chromate production workers.

I.3 Copper

I.3.1 Noncancer Toxicity

Copper is a nutritionally essential element that functions as a cofactor in several enzyme systems (Aaseth and Norseth 1986). Acute exposure to large oral doses of copper salts was associated with GI disturbances, hemolysis, and liver and kidney lesions. Chronic oral toxicity in humans has not been reported. Chronic oral exposure of animals was associated with an iron-deficiency type of anemia, hemolysis, and lesions in the liver and kidneys. Occupational exposure may induce metal fume fever, and, in cases of chronic exposure to high levels, hemolysis and anemia (ACGIH 1991). The target organs for copper are the erythrocyte, liver, and kidney, and, for inhalation exposure, the

lung. An oral RfD of 0.04 mg/kg/day was presented for copper (EPA, 1997). A RfC value was not located for copper.

I.3.2 Carcinogenicity

Copper is classified in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans) (EPA 1997). Quantitative risk estimates are not derived for Group D chemicals.

I.4 **Dioxins**

Specific congeners and homologues of these classes of interest at this site include 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin and octachlorodibenzo-p-dioxin.

I.4.1 Noncancer Toxicity

Of the members of these classes, the toxicity of 2,3,7,8-TCDD has been studied most extensively. The only effect in humans clearly attributable to 2,3,7,8-TCDD was chloracne (ATSDR 1989e). The data, however, also associated exposure to 2,3,7,8-TCDD with hepatotoxicity and neurotoxicity in humans. In animals, toxicity of 2,3,7,8-TCDD is most commonly manifested as a wasting syndrome with thymic atrophy, terminating in death, with a large number of organ systems showing nonspecific effects. Chronic treatment of animals with 2,3,7,8-TCDD or a mixture of two isomers of hexachlorodibenzo-p-dioxin resulted in liver damage. Immunologic effects may be among the more sensitive endpoints of exposure to the PCDDs in animals. In animals 2,3,7,8-TCDD is a developmental and reproductive toxicant. No verified or provisional noncancer toxicity values were located for any of the chemicals of interest in these classes (EPA 1999b, 1997).

I.4.2 Carcinogenicity

Data regarding the carcinogenicity of 2,3,7,8-TCDD to humans, obtained from epidemiologic studies of workers exposed to pesticides or to other chlorinated chemicals known to be contaminated with 2,3,7,8-TCDD, are conflicting (ATSDR 1989e). The interpretation of these studies is not clear because exposure to 2,3,7,8-TCDD was not quantified, multiple routes of exposure (dermal, inhalation, oral) were involved, and the workers were exposed to other potentially carcinogenic compounds. In animals, however, 2,3,7,8-TCDD is clearly carcinogenic, inducing thyroid, lung, and liver tumors in orally treated rats and mice (EPA 1985). Similarly, oral treatment with a mixture of two hexachlorodibenzo-p-dioxin isomers induced liver tumors in rats and mice. On the basis of the

animal data, 2,3,7,8-TCDD and the hexachlorodibenzo-p-dioxins were assigned to EPA cancer weight-of-evidence Group B2 (probable human carcinogen). Although the other PCDDs and PCDFs were not formally classified as to carcinogenicity to humans, for regulatory purposes they are treated as probable human carcinogens.

The EPA (1997) presents provisional oral and inhalation slope factors for 2,3,7,8-TCDD of 150,000 per mg/kg/day, based on the incidence of liver and lung tumors in an oral study in rats (Kociba et al. 1978).

Much less is known about the toxicity of other CDD and CDF congeners. Based on available toxicity data, EPA has developed a method for expressing toxicities of these compounds in terms of equivalent amounts of 2,3,7,8-TCDD. "Toxicity equivalency factors", or TEFs, are used to convert the concentration of a given CDD/CDF into an equivalent concentration of 2,3,7,8-TCDD.

I.5 **Iron**

I.5.1 Non-carcinogenic Toxicity

Iron is potentially toxic in all forms and by all routes of exposure. Inorganic iron is a poison by the intraperitoneal route. The inhalation of large amounts of iron dust may result in iron pneumoconiosis or arc welders lung. Chronic exposure to excess levels of iron (>50-100 mg Iron/day) can result in pathological deposition of iron in tissues. The target organs are the pancreas and liver (Sax and Lewis 1989).

Iron compounds are of varying toxicity. Iron oxides are a potential risk in all industrial settings. In general, ferrous compounds are more toxic than ferric compounds. Acute exposure to excessive levels of ferrous compounds can cause liver and kidney damage, altered respiratory rates and convulsions (Sax and Lewis 1989). An oral RfD of 0.3 mg/kg/day has been published for iron by EPA (NCEA). No inhalation RfC is available for iron (EPA 1999a).

I.5.2 Carcinogenicity

Some iron compounds are suspected human carcinogens. Iron dust is an experimental neoplastigen and an increased incidence of lung cancer has been associated with exposure to iron dust. Iron oxide is an experimental tumorigen and a suspected human carcinogen. (Sax and Lewis 1989). EPA (1999a) has not published oral or inhalation slope factors for iron.

I.6 Lead

I.6.1 Pharmacokinetics

Studies in humans indicate that an average of 10 percent of ingested lead is absorbed, but estimates as high as 40 percent were obtained in some individuals (Tsuchiya 1986). Nutritional factors have a profound effect on GI absorption efficiency. Children absorb ingested lead more efficiently than adults; absorption efficiencies up to 53 percent were recorded for children three months to eight years of age. Similar results were obtained for laboratory animals; absorption efficiencies of 5 to 10 percent were obtained for adults and 50 percent were obtained for young animals. The deposition rate of inhaled lead averages approximately 30 to 50 percent, depending on particle size. All lead deposited in the lungs is eventually absorbed.

Approximately 95 percent of the lead in the blood is located in the erythrocytes (EPA 1991a). Lead in the plasma exchanges with several body compartments, including the internal organs, bone, and several excretory pathways. In humans, lead concentrations in bone increase with age (Tsuchiya 1986). About 90 percent of the body burden of lead is located in the skeleton. Neonatal blood concentrations are about 85 percent of maternal concentrations. Excretion of absorbed lead is principally through the urine, although GI secretion, biliary excretion, and loss through hair, nails, and sweat are also significant.

I.6.2 Non-carcinogenic Toxicity

The non-carcinogenic toxicity of lead to humans has been well characterized through decades of medical observation and scientific research (EPA 1999a). The principal effects of acute oral exposure are colic with diffuse paroxysmal abdominal pain (probably due to vagal irritation), anemia, and, in severe cases, acute encephalopathy, particularly in children (Tsuchiya 1986). The primary effects of long-term exposure are neurological and hematological. Limited occupational data indicate that long-term exposure to lead may induce kidney damage. The principal target organs of lead toxicity are the erythrocyte and the nervous system. Some of the effects on the blood, particularly changes in levels of certain blood enzymes, and subtle neurologic behavioral changes in children, appear to occur at levels so low as to be considered non-threshold effects.

EPA (1999a) presents no inhalation RfC for lead, but referred to the National Ambient Air Quality Standard (NAAQS) for lead. The NAAQSs are based solely on human health considerations and

are designed to protect the most sensitive subgroup of the human population. The NAAQS for lead is 1.5 ug/m^3, averaged quarterly (EPA 1999a).

EPA (1991a, 1999a) determined that it is inappropriate to derive an RfD for oral exposure to lead for several reasons. First, the use of an RfD assumes that a threshold for toxicity exists, below which adverse effects are not expected to occur; however, the most sensitive effects of lead exposure, impaired neurologic behavioral development in children and altered blood enzyme levels associated with anemia, may occur at blood lead concentrations so low as to be considered practically non-threshold in nature. Second, RfD values are specific for the route of exposure for which they are derived. Lead, however, is ubiquitous, so that exposure occurs from virtually all media and by all pathways simultaneously, making it practically impossible to quantify the contribution to blood lead from any one route of exposure. Finally, the dose-response relationships common to many toxicants, and upon which derivation of an RfD is based, do not hold true for lead. This is because the fate of lead within the body depends, in part, on the amount and rate of previous exposures, the age of the recipient, and the rate of exposure. There is, however, a reasonably good correlation between blood lead concentration and effect. Therefore, blood lead concentration is the appropriate parameter on which to base the regulation of lead.

EPA UBK lead model is an iterated set of equations that estimate blood lead concentration in children aged 0 to 7 years (EPA 1991a; 1991b). The biokinetic part of the model describes the movement of lead between the plasma and several body compartments and estimates the resultant blood lead concentration. The rate of the movement of lead between the plasma and each compartment is a function of the transition or residence time (i.e., the mean time for lead to leave the plasma and enter a given compartment, or the mean residence time for lead in that compartment). Compartments modeled include the erythrocytes, liver, kidneys, all the other soft tissue of the body, cortical bone, and trabecular bone. Excretory pathways and their rates are also modeled. These include the mean time for excretion from the plasma to the urine, from the liver to the bile, and from the other soft tissues to the hair, skin, sweat, etc. The model permits the user to adjust the transition and residence times.

EPA guidance establishes an interim soil cleanup level for lead of 400 parts per million (ppm) to be applied at Superfund sites. This value is considered by EPA to be protective for direct contact with lead-contaminated soils in residential settings. The guidance is to be followed when current or predicted land use is residential.

I.6.3 Carcinogenicity

EPA (1999a) classifies lead in cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate evidence of cancer in humans and sufficient animal evidence. The human data consist of several epidemiological occupational studies that yielded confusing results. All of the studies lacked quantitative exposure data and failed to control for smoking and concomitant exposure to other possibly carcinogenic metals. Rat and mouse bioassays showed statistically significant increases in renal tumors following dietary and subcutaneous exposure to several soluble lead salts. Various lead compounds were observed to induce chromosomal alterations in vivo and in vitro, sister chromatid exchange in exposed workers, and cell transformation in Syrian hamster embryo cells; to enhance simian adenovirus induction; and to alter molecular processes that regulate gene expression. EPA (1999a) declined to estimate risk for oral exposure to lead because many factors (e.g., age, general health, nutritional status, existing body burden and duration of exposure) influence the bioavailability of ingested lead, introducing a great deal of uncertainty into any estimate of risk.

I.7 **Manganese**

I.7.1 Non-carcinogenic Toxicity

Manganese is nutritionally required in humans for normal growth and health (EPA 1999a) Humans exposed to approximately 0.8 mg manganese/kg/day in drinking water exhibited lethargy, mental disturbances (1/16 committed suicide), and other neurologic effects. The elderly appeared to be more sensitive than children. Oral treatment of laboratory rodents induced biochemical changes in the brain, but rodents did not exhibit the neurological signs exhibited by humans. Occupational exposure to high concentrations in air induced a generally typical spectrum of neurological effects, and increased incidence of pneumonia (ACGIH 1986).

Very recently, a chronic oral RfD of 0.14 mg/kg/day (EPA 1999a) has been made available for manganese. The CNS is the primary target organ for manganese. EPA (1999a) presented a verified chronic inhalation RfC of 0.00005 mg/m3 based on an LOAEL for respiratory symptoms and psycho-motor distur-bances in occupationally exposed humans and an uncertainty factor of 1,000. EPA (1997) presented the same value as a subchronic inhalation RfC. The inhalation RfC is equivalent to 0.000014 mg/kg/day (EPA 1999a), assuming humans inhale 20 m3 of air/day and weigh 70 kg. The CNS and respiratory tract are target organs of inhalation exposure to manganese.

I.7.2 Carcinogenicity

EPA (1999a) classifies manganese in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans).

I.8 Polyaromatic Hydrocarbons (Carcinogenic)

Specific PAH compounds of interest at this site include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene.

I.8.1 Pharmacokinetics

Although quantitative absorption data for the PAHs were not located, benzo(a)pyrene was readily absorbed across the GI (Rees et al. 1971) and respiratory epithelia (Kotin et al. 1969; Vainich et al. 1976). The high lipophilicity of other compounds in this class suggests that other PAHs also would be readily absorbed across GI and respiratory epithelia.

Benzo(a)pyrene was distributed widely in the tissues of treated rats and mice, but primarily to tissues high in fat, such as adipose tissue and mammary gland (Kotin et al. 1969; Schlede et al. 1970a). Patterns of tissue distribution of other PAHs would be expected to be similar because of the high lipophilicity of the members of this class.

Studies of the metabolism of benzo(a)pyrene provide information relevant to other PAHs because of the structural similarities of all members of the class. Metabolism involves microsomal mixed function oxidase hydroxylation of one or more of the phenyl rings with the formation of phenols and dihydrodiols, probably via formation of arene oxide intermediates (EPA 1979a). The dihydrodiols may be further oxidized to diol epoxides, which, for certain members of the class, are known to be the ultimate carcinogens (LaVoie et al. 1982). Conjugation with glutathione or glucuronic acid, and reduction to tetrahydrotetrols are important detoxification pathways. Metabolism of naphthalene resulted in the formation of 1,2-naphthoquinone, which induced cataract formation and retinal damage in rats and rabbits.

Excretion of benzo(a)pyrene or dibenz(a,h)anthracene residues was reported to be rapid, although quantitative data were not located (EPA 1979b). Excretion occurred mainly via the feces, probably largely due to biliary secretion (Schlede et al. 1970a, 1970b). EPA (1980) concluded that accumulation in the body tissues of PAHs from chronic low level exposure would be unlikely.

I.8.2 Non-carcinogenic Toxicity

EPA (1997, 1999a) has not established oral RfDs or inhalation RfCs for the carcinogenic PAHs including benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

I.8.3 Carcinogenicity

The PAHs are ubiquitous, being released to the environment from anthropogenic as well as from natural sources (ATSDR 1987). Benzo(a)pyrene is the most extensively studied member of the class, inducing tumors in multiple tissues of virtually all laboratory species tested by all routes of exposure. Although epidemiology studies suggested that complex mixtures that contain PAHs (coal tar, soot's, coke oven emissions, cigarette smoke) are carcinogenic to humans, the carcinogenicity cannot be attributed to PAHs alone because of the presence of other potentially carcinogenic substances in these mixtures (ATSDR 1987). In addition, recent investigations showed that the PAH fraction of roofing tar, cigarette smoke, and coke oven emissions accounted for only 0.1 to 8 percent of the total mutagenic activity of the unfractionated complex mixture in Salmonella (Lewtas 1988). Aromatic amines, nitrogen heterocyclic compounds, highly oxygenated quinones, diones, and nitrooxygenated compounds, none of which would be expected to arise from in vivo metabolism of PAHs, probably accounted for the majority of the mutagenicity of coke oven emissions and cigarette smoke. Furthermore, coal tar, which contains a mixture of many PAHs, has a long history of use in the clinical treatment of a variety of skin disorders in humans (ATSDR 1987).

Because of the lack of human cancer data, assignment of individual PAHs to EPA cancer weight-of-evidence groups was based largely on the results of animal studies with large doses of purified compound. Frequently, unnatural routes of exposure, including implants of the test chemical in beeswax and trioctanoin in the lungs of female Osborne-Mendel rats, intratracheal instillation, and subcutaneous or intraperitoneal injection, were used. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were classified in Group B2 (probable human carcinogens) (EPA 1997, 1999a).

EPA (1999a) verified a slope factor for oral exposure to benzo(a)pyrene of 7.3 per mg/kg/day, based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates were available for the other PAHs in Group B2. EPA (1980) promulgated an ambient water quality criterion for "total carcinogenic PAHs," based on an oral slope factor derived from a study with benzo(a)pyrene, as being sufficiently protective for the class. Largely because of this precedent, the quantitative risk estimates for the other carcinogenic PAHs were based on benzo(a)pyrene when quantitative estimates were needed.

Recent reevaluations of the carcinogenicity and mutagenicity of the Group B2 PAHs suggest that there are large differences between individual PAHs in cancer potency (Krewski et al., 1989). Based

on the available cancer and mutagenicity data, and assuming that there is a constant relative potency between different carcinogens across different bioassay systems and that the PAHs under consideration have similar dose-response curves, Thorslund and Charnley (1988) derived relative potency values for several PAHs. A more recent Relative Potency Factor (RPF) scheme for the Group B2 PAHs was based only on the induction of lung epidermoid carcinomas in female Osborne-Mendel rats in the lung-implantation experiments (Clement International 1990).

Carcinogenic PAHs are related by chemical structure. All other carcinogenic PAHs except carbazole have SFs based on their potency relative to benzo(a)pyrene. These factors are published by EPA (Clement International 1990). The relative potency factors are as follows for the carcinogenic PAHs:

Constituent	Relative Potency Factor
Benzo(a)pyrene	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene)	0.1

EPA (1999b) presented an inhalation RfD of 3.1 per mg/kg/day from NCEA sources. The other carcinogenic PAHs do not have established inhalation RfDs and are not subjected to toxicity equivalency factors regarding inhalation criteria.

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APPENDIX K

SUPPORTING INFORMATION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
1875 New Hope Street
Norristown, PA 19401
215 270-1948

November 18, 1986

Lt. Commander Earl L. Smith
Public Works Office
U. S. Naval Air Development Center
Street and Jacksonville Roads
Warminster, PA

Re: Fire Training Area
Inspection 11/4/86

NOTICE OF VIOLATION

Dear Commander Smith:

Examination of the fire fighting training area at your facility revealed oil soaked soils, and stressed vegetation along a drainage way leading from the burn area. On an earlier visit by Thomas Sheehan from the Division of Emergency and Remedial Reponse he noted oily and contaminated water coming out of the ground and running on the surface. These conditions pose a threat to ground and surface water and should be remediated as soon as possible. They also constitute a violation of the Solid Waste Management Act 97 of 1980 Sections 301, 302(a)(b), 601, and 610.

You are hereby notified of the existence of these violations and the need for their correction. Toward this end you are requested to respond in writing with a plan for the correction of these violations, and to provide methods to prevent their reoccurance, within fourteen days after receipt of this letter.

This letter does not waive, either expressly or by implication, the power or authority of the Commonwealth of Pennsylvania to prosecute for any and all violations of law arising prior to or after the issuance of this letter or the conditions upon which the letter is based. This letter shall not be construed so as to waive or impair any rights of the Department of Environmental Resources, heretofore or hereafter existing.

This letter shall also not be construed as a final action of the Department of Environmental Resources.

Very truly yours,

Michael Pennella

MICHAEL PENNELLA
Waste Management Specialist

cc: Nancy Roncetti
George Danyliw
Frank Kurdziel (NADC)
Ron Springfield (NADC)
Everett Hoog (BCHD)
Re 30 7W317.5

7934
COPIER

DEPARTMENT OF THE NAVY
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PA. 18974

5090
Ser 8333/

13894
8 DEC 1986

Mr. Michael Pannella
Commonwealth of Pennsylvania
Department of Environmental Resources
1875 New Hope Street
Norristown, PA 19401

Dear Mr. Pennella:

We are in the process of correcting the discrepancies around the Fire Fighting Training Area cited in your 18 November 1986 letter. Currently, all activities at the site have been suspended. A course of action is being developed to accomplish final resolution of the finding.

Following the receipt of your letter, all training activities at the site have been suspended indefinitely. We will take soil samples to determine the extent of the contamination. The result will help us determine remedial efforts. Clean-up of the existing site will then be performed. A final decision on the future of the training site will be made at completion of the testing. We will either make improvements to the site to capture all contaminants before they leave the site and then dispose of them properly or close the site permanently.

We will keep you informed of our progress in accomplishing the above corrective measures and of our decision on the future of the site.

If you have any further questions concerning this matter, our point of contact is Mr. Ronald Springfield (215) 441-2710.

Sincerely,

EARL L. SMITH, JR.
LCDR, CEC, U.S. Navy
Public Works Officer
By direction of the Commander

Copy to:
COMDF
GF
83
[redacted]

R. Springfield (833) X2710 cs, 12/5/86

WARMINSTER CARETAKER SITE OFFICE

P.O. BOX 2609, WARMINSTER, PA 18974

FACSIMILE TRANSMISSION COVER SHEET

Date: 16 April 1999

From: Mike Hunter

Phone: (215) 441-7634

FAX: (215) 441-3066

To: Neil Teamerson

Agency: Tetra Tech NUS

Code:

Phone: (610) 491-9688

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Total number of pages (including cover sheet): 10

Comments: Site 8 test results from Dec '87. Let me know if you have a problem reading the forms. At times they don't transmit clearly.

Mike

ACCOUNT NO: W00432W

REPORT NUMBER : 88006787
REPORT DATE : 02/29/88

SAMPLE DATE : 12/22/87
SAMPLE TIME : 09:30AM
SAMPLE TEMP : NA F
SAMPLED BY : JF
COLLECTED BY : JF
ANALYSIS DATE : 12/23/87
P.O. NUMBER : N62269-88-
PWS-ID NUMBER :

QC Inc
1205 INDUSTRIAL HIGHWAY • P.O. BOX 514
SOUTHAMPTON, PA. 18966 • 215/355-3900

[redacted]

TEST NUMBER →	W0150-MGL	W0203-MGL	W0204-MGL	W0207-MGL	W0209-MGL	W0214-MGL	W0217-MGL	W0221-MGL	W0222-MGL	W0252-XXX	W0668-UG
TEST NAME →	PET HYDRO*	ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER	E.P. TOX *	BASE-SCAN
UNIT MEASURE →	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L		UG/L
SAMPLE/CONTAINER											
Berm Soil 566828	580	<0.005	0.12	<0.005	<0.005	<0.005	0.076	<0.005	<0.005		
[redacted]											
LOWER EROSION	28.	<0.005	<0.05	<0.005	<0.005	<0.005	0.084	<0.005	<0.005		* EE ATTCH
566829 QC SUPPLIED CONTAINER	50	<0.005	<0.05	<0.005	<0.005	<0.005	0.030	<0.005	<0.005		
[redacted]											
LOWER EROSION LEFT ↖ UPPER EROSION 566832	180.	<0.005	0.07	<0.005	<0.005	<0.005	0.034	<0.005	<0.005		* EE ATTCH
566831 QC SUPPLIED CONTAINER											
[redacted]											

* E.P. TOX = E.P. TOXICITY EXTRACTION

[redacted]

SAMPLED BY JAMES FLANAGAN

566828 ALL TESTING IS CONDUCTED IN ACCORDANCE WITH E.P.A. METHODOLOGY.

[redacted]

566829 ALL TESTING IS CONDUCTED IN ACCORDANCE WITH E.P.A. METHODOLOGY.
THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PRO-

[redacted]

THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PROCEDURE AS OUTLINED IN THE MAY 19,1980 FEDERAL REGISTER.

566831 ALL TESTING IS CONDUCTED IN ACCORDANCE WITH E.P.A. METHODOLOGY.
THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PROCEDURE AS OUTLINED IN THE MAY 19,1980 FEDERAL REGISTER.

Annotated by
N. Teameson
16 April 99

002
NAWC WARM PW
04/16/99 09:25 215 441 3066

ACCOUNT NO: W00432W

QC Inc

1205 INDUSTRIAL HIGHWAY • P.O. BOX 514
SOUTHAMPTON, PA. 18966 • 215/355-3900

[redacted]

REPORT NUMBER : 88006787
REPORT DATE : 02/29/88

SAMPLE DATE : 12/22/87
SAMPLE TIME : 09:30AM
SAMPLE TEMP : NA F
SAMPLED BY : JF
COLLECTED BY : JF
ANALYSIS DATE : 12/23/87
P.O. NUMBER : N62269-88-
PWS-ID NUMBER :

SAMPLE/CONTAINER			
TEST NUMBER →	W0151-MGL	W0610-UGL	
TEST NAME →	TOT SOLID*	V.O.SCAN	
UNIT MEASURE →	MG/L	UG/L	
BERM SOIL 566828	794000	SEE ATTACHED	
[redacted]			
LOWER EROSION	782000.	SEE ATTCHD	
566829 QC SUPPLIED CONTAINER	838000	SEE ATTCHD	
[redacted]			
LOWER EROSION LEFT	799000.	SEE ATTCHD	
566831 QC SUPPLIED CONTAINER 566830 UPPER EROSION			
[redacted]			

[redacted]

566828 ALL TESTING IS CONDUCTED IN ACCORDANCE WITH E.P.A. METHODOLOGY.
THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PRO-
[redacted]
THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PRO-
CEDURE AS OUTLINED IN THE MAY 19,1980 FEDERAL REGISTER.
[redacted]
CEDURE AS OUTLINED IN THE MAY 19,1980 FEDERAL REGISTER.

566831 ALL TESTING IS CONDUCTED IN ACCORDANCE WITH E.P.A. METHODOLOGY.
THE ANALYSIS OF THE ABOVE SAMPLE WAS CONDUCTED USING THE EPA EXTRACTION PRO-
CEDURE AS OUTLINED IN THE MAY 19,1980 FEDERAL REGISTER.

annotated by
N. Teamerson
16 Apr 99

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CUSTOMER: Navel Air Development Center
SAMPLE DATE: 12|22|87
SAMPLE IDENTIFICATION: soil
SAMPLE NUMBER: 566828
Berm Soil

LABORATORY: QC, INC
1205 Industrial Highway
Southampton, PA 18966

COMPOUND	CONCENTRATION UNITS UG/KG
bis(2-Chloroethyl) ether	< 330
1,3-Dichlorobenzene	< 330
1,4-Dichlorobenzene	< 330
1,2-Dichlorobenzene	< 330
bis-(2-Chloroisopropyl) ether	< 330
N-Nitroso-di-n-propylamine	< 330
Hexachloroethane	< 330
Nitrobenzene	< 330
Isophorone	< 330
bis (2-Chloroethoxy) methane	< 330
1,2,4-Trichlorobenzene	< 330
Naphthalene	< 330
Hexachlorobutadiene	< 330
2-Methylnaphthalene	< 330
Hexachlorocyclopentadiene	< 330
2-Chloronaphthalene	< 330
Dimethylphthalate	< 330
Acenaphthylene	< 330
2,6-Dinitrotoluene	< 330
Acenaphthene	< 330
2,4-Dinitrotoluene	< 330
Diethylphthalate	< 330
4-Chlorophenyl-phenylether	< 330
Fluorene	< 330
N-Nitrosodiphenylamine (1)	< 330
4-Bromophenyl-phenylether	< 330
Hexachlorobenzene	< 330
Phenanthrene	< 330
Anthracene	< 330
Di-n-butylphthalate	< 330
Fluoranthene	< 330
Pyrene	< 330
Butylbenzylphthalate	< 330
3,3'-Dichlorobenzidine	< 330
Benzo(a)anthracene	< 330
Chrysene	< 330
bis(2-Ethylhexyl)phthalate	610
Di-n-octylphthalate	< 330
Benzo(b)fluoranthene	< 330
Benzo(k)fluoranthene	< 330
Benzo(a)pyrene	< 330
Indeno(1,2,3-cd)pyrene	< 330
Dibenz(a,h)anthracene	< 330
Benzo(g,h,i)perylene	< 330

(1) - Cannot be separated from diphenylamine

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CUSTOMER: Navel Air Development Center
SAMPLE DATE: 12|22|87
SAMPLE IDENTIFICATION: soil
SAMPLE NUMBER: 566829
Lower Erosion

LABORATORY: QC, INC
1205 Industrial Highway
Southampton, PA 18966

COMPOUND	CONCENTRATION UNITS UG/KG
bis(2-Chloroethyl) ether	< 330
1,3-Dichlorobenzene	< 330
1,4-Dichlorobenzene	< 330
1,2-Dichlorobenzene	< 330
bis-(2-Chloroisopropyl) ether	< 330
N-Nitroso-di-n-propylamine	< 330
Hexachloroethane	< 330
Nitrobenzene	< 330
Isophorone	< 330
bis (2-Chloroethoxy) methane	< 330
1,2,4-Trichlorobenzene	< 330
Naphthalene	< 330
Hexachlorobutadiene	< 330
2-Methylnaphthalene	< 330
Hexachlorocyclopentadiene	< 330
2-Chloronaphthalene	< 330
Dimethylphthalate	< 330
Acenaphthylene	< 330
2,6-Dinitrotoluene	< 330
Acenaphthene	< 330
2,4-Dinitrotoluene	< 330
Diethylphthalate	< 330
4-Chlorophenyl-phenylether	< 330
Fluorene	< 330
N-Nitrosodiphenylamine (1)	< 330
4-Bromophenyl-phenylether	< 330
Hexachlorobenzene	< 330
Phenanthrene	< 330
Anthracene	< 330
Di-n-butylphthalate	< 330
Fluoranthene	< 330
Pyrene	< 330
Butylbenzylphthalate	< 330
3,3'-Dichlorobenzidine	< 330
Benzo(a)anthracene	< 330
Chrysene	< 330
bis(2-Ethylhexyl)phthalate	590
Di-n-octylphthalate	< 330
Benzo(b)fluoranthene	< 330
Benzo(k)fluoranthene	< 330
Benzo(a)pyrene	< 330
Indeno(1,2,3-cd)pyrene	< 330
Dibenz(a,h)anthracene	< 330
Benzo(g,h,i)perylene	< 330

(1) - Cannot be separated from diphenylamine

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CUSTOMER: Navel Air Development Center
SAMPLE DATE: 12|22|87
SAMPLE IDENTIFICATION: soil
SAMPLE NUMBER: 566830
Upper Erosion

LABORATORY: QC, INC
1205 Industrial Highway
Southampton, PA 18966

COMPOUND	CONCENTRATION UNITS UG/KG
bis(2-Chloroethyl) ether	< 330
1,3-Dichlorobenzene	< 330
1,4-Dichlorobenzene	< 330
1,2-Dichlorobenzene	< 330
bis-(2-Chloroisopropyl) ether	< 330
N-Nitroso-di-n-propylamine	< 330
Hexachloroethane	< 330
Nitrobenzene	< 330
Isophorone	< 330
bis (2-Chloroethoxy) methane	< 330
1,2,4-Trichlorobenzene	< 330
Naphthalene	< 330
Hexachlorobutadiene	< 330
2-Methylnaphthalene	< 330
Hexachlorocyclopentadiene	< 330
2-Chloronaphthalene	< 330
Dimethylphthalate	< 330
Acenaphthylene	< 330
2,6-Dinitrotoluene	< 330
Acenaphthene	< 330
2,4-Dinitrotoluene	< 330
Diethylphthalate	< 330
4-Chlorophenyl-phenylether	< 330
Fluorene	< 330
N-Nitrosodiphenylamine (1)	< 330
4-Bromophenyl-phenylether	< 330
Hexachlorobenzene	< 330
Phenanthrene	< 330
Anthracene	< 330
Di-n-butylphthalate	< 330
Fluoranthene	< 330
Pyrene	< 330
Butylbenzylphthalate	< 330
3,3'-Dichlorobenzidine	< 330
Benzo(a)anthracene	< 330
Chrysene	< 330
bis(2-Ethylhexyl)phthalate	610
Di-n-octylphthalate	< 330
Benzo(b)fluoranthene	< 330
Benzo(k)fluoranthene	< 330
Benzo(a)pyrene	< 330
Indeno(1,2,3-cd)pyrene	< 330
Dibenz(a,h)anthracene	< 330
Benzo(g,h,i)perylene	< 330

(1) - Cannot be separated from diphenylamine

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CUSTOMER: Navel Air Development Center
SAMPLE DATE: 12|22|87
SAMPLE IDENTIFICATION: soil
SAMPLE NUMBER: 566831
Lower Erosion Left

LABORATORY: QC, INC
1205 Industrial Highway
Southampton, PA 18966

COMPOUND	CONCENTRATION UNITS UG/KG
bis(2-Chloroethyl) ether	< 330
1,3-Dichlorobenzene	< 330
1,4-Dichlorobenzene	< 330
1,2-Dichlorobenzene	< 330
bis-(2-Chloroisopropyl) ether	< 330
N-Nitroso-di-n-propylamine	< 330
Hexachloroethane	< 330
Nitrobenzene	< 330
Isophorone	< 330
bis (2-Chloroethoxy) methane	< 330
1,2,4-Trichlorobenzene	< 330
Naphthalene	< 330
Hexachlorobutadiene	< 330
2-Methylnaphthalene	< 330
Hexachlorocyclopentadiene	< 330
2-Chloronaphthalene	< 330
Dimethylphthalate	< 330
Acenaphthylene	< 330
2,6-Dinitrotoluene	< 330
Acenaphthene	< 330
2,4-Dinitrotoluene	< 330
Diethylphthalate	< 330
4-Chlorophenyl-phenylether	< 330
Fluorene	< 330
N-Nitrosodiphenylamine (1)	< 330
4-Bromophenyl-phenylether	< 330
Hexachlorobenzene	< 330
Phenanthrene	< 330
Anthracene	< 330
Di-n-butylphthalate	< 330
Fluoranthene	< 330
Pyrene	< 330
Butylbenzylphthalate	< 330
3,3'-Dichlorobenzidine	< 330
Benzo(a)anthracene	< 330
Chrysene	< 330
bis(2-Ethylhexyl)phthalate	690
Di-n-octylphthalate	< 330
Benzo(b)fluoranthene	< 330
Benzo(k)fluoranthene	< 330
Benzo(a)pyrene	< 330
Indeno(1,2,3-cd)pyrene	< 330
Dibenz(a,h)anthracene	< 330
Benzo(g,h,i)perylene	< 330

(1) - Cannot be separated from diphenylamine

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

CUSTOMER: Navel Air Development Center
SAMPLE DATE: 12|22|87
SAMPLE IDENTIFICATION: soil
SAMPLE NUMBER: 566832
Background

LABORATORY: QC, INC
1205 Industrial Highway
Southampton, PA 18966

COMPOUND	CONCENTRATION UNITS UG/KG
bis(2-Chloroethyl) ether	< 330
1,3-Dichlorobenzene	< 330
1,4-Dichlorobenzene	< 330
1,2-Dichlorobenzene	< 330
bis-(2-Chloroisopropyl) ether	< 330
N-Nitroso-di-n-propylamine	< 330
Hexachloroethane	< 330
Nitrobenzene	< 330
Isophorone	< 330
bis (2-Chloroethoxy) methane	< 330
1,2,4-Trichlorobenzene	< 330
Naphthalene	< 330
Hexachlorobutadiene	< 330
2-Methylnaphthalene	< 330
Hexachlorocyclopentadiene	< 330
2-Chloronaphthalene	< 330
Dimethylphthalate	< 330
Acenaphthylene	< 330
2,6-Dinitrotoluene	< 330
Acenaphthene	< 330
2,4-Dinitrotoluene	< 330
Diethylphthalate	< 330
4-Chlorophenyl-phenylether	< 330
Fluorene	< 330
N-Nitrosodiphenylamine (1)	< 330
4-Bromophenyl-phenylether	< 330
Hexachlorobenzene	< 330
Phenanthrene	< 330
Anthracene	< 330
Di-n-butylphthalate	< 330
Fluoranthene	< 330
Pyrene	< 330
Butylbenzylphthalate	< 330
3,3'-Dichlorobenzidine	< 330
Benzo(a)anthracene	< 330
Chrysene	< 330
bis(2-Ethylhexyl)phthalate	500
Di-n-octylphthalate	< 330
Benzo(b)fluoranthene	< 330
Benzo(k)fluoranthene	< 330
Benzo(a)pyrene	< 330
Indeno(1,2,3-cd)pyrene	< 330
Dibenz(a,h)anthracene	< 330
Benzo(g,h,i)perylene	< 330

(1) - Cannot be separated from diphenylamine

EPA Method 625 Base/Neutral Extractables by GC/MS

Sample Number : Creek 566834
Client Name : NADC
Date Analyzed :
Instrument (Circle One) : 5100A 5100B 5100C

Analyst :
Prep Factor :
Comments :

No.	NAME	RESULTS PPB PPM	THREE-PEAK CRITERION YES/NO	CODE /COMMENTS
1	Bis(2-chloroethyl) Ether	<10		
2	1,2-Dichlorobenzene	<10		
3	1,4-Dichlorobenzene	<10		
4	1,3-Dichlorobenzene	<10		
5	Bis(2-chloroisopropyl) Ether	<10		
6	N-Nitrosodipropyl Amine	<10		
7	Hexachloroethane	<10		
8	Nitrobenzene	<10		
9	Isophorone	<10		
10	Bis(2-chloroethoxy) Methane	<10		
11	1,2,4-Trichlorobenzene	<10		
12	Naphthalene	<10		
13	Hexachlorobutadiene	<10		
14	Hexachlorocyclopentadiene	<10		
15	2-Chloronaphthalene	<10		
16	Dimethyl Phthalate	<10		
17	2,6-Dinitrotoluene	<10		
18	Acenaphthylene	<10		
19	Acenaphthene	<10		
20	2,4-Dinitrotoluene	<10		
21	Diethyl Phthalate	<10		
22	N-Nitrosodimethyl Amine	<10		
23	4-Chlorophenylphenyl Ether	<10		
24	Fluorene	<10		
25	Azobenzene	<10		
26	N-Nitrosodiphenyl Amine	<10		
27	4-Bromophenylphenyl Ether	<10		
28	Hexachlorobenzene	<10		
29	Phenanthrene	<10		
30	Anthracene	<10		
31	Dibutyl Phthalate	<10		
32	Fluoranthene	<10		
33	Benzidine	<50		
34	Pyrene	<10		
35	Butylbenzyl Phthalate	<10		
36	3,3'-Dichlorobenzidine	<20		
37	Benzo(A)Anthracene	<10		
38	Chrysene	<10		
39	Bis(2-ethylhexyl) Phthalate	31		
40	Dioctyl Phthalate	<10		
41	Benzo(K)Fluoranthene	<10		
42	Benzo(B)Fluoranthene	<10		
43	Benzo(A)Pyrene	<10		
44	Indeno(1,2,3-CD)Pyrene	<10		
45	Dibenzo(A,H)Anthracene	<10		
46	Benzo(GHI)Perylene	<10		

EPA Method 625 Base/Neutral Extractables by GC/MS

Sample Number : BERM LIQUID 566833
Client Name : NADC
Date Analyzed :
Instrument (Circle One) : 5100A 5100B 5100C

Analyst :
Prep Factor :
Comments :

No.	NAME	RESULTS PPB PPM	THREE-PEAK CRITERION YES/NO	CODE /COMMENTS
1	Bis(2-chloroethyl) Ether	<10		
2	1,2-Dichlorobenzene	<10		
3	1,4-Dichlorobenzene	<10		
4	1,3-Dichlorobenzene	<10		
5	Bis(2-chloroisopropyl) Ether	<10		
6	N-Nitrosodipropyl Amine	<10		
7	Hexachloroethane	<10		
8	Nitrobenzene	<10		
9	Isophorone	<10		
10	Bis(2-chloroethoxy) Methane	<10		
11	1,2,4-Trichlorobenzene	<10		
12	Naphthalene	<10		
13	Hexachlorobutadiene	<10		
14	Hexachlorocyclopentadiene	<10		
15	2-Chloronaphthalene	<10		
16	Dimethyl Phthalate	<10		
17	2,6-Dinitrotoluene	<10		
18	Acenaphthylene	<10		
19	Acenaphthene	<10		
20	2,4-Dinitrotoluene	<10		
21	Diethyl Phthalate	<10		
22	N-Nitrosodimethyl Amine	<10		
23	4-Chlorophenylphenyl Ether	<10		
24	Fluorene	<10		
25	Azobenzene	<10		
26	N-Nitrosodiphenyl Amine	<10		
27	4-Bromophenylphenyl Ether	<10		
28	Hexachlorobenzene	<10		
29	Phenanthrene	<10		
30	Anthracene	<10		
31	Dibutyl Phthalate	<10		
32	Fluoranthene	<10		
33	Benzidine	<50		
34	Pyrene	<10		
35	Butylbenzyl Phthalate	<10		
36	3,3'-Dichlorobenzidine	<20		
37	Benzo(A)Anthracene	<10		
38	Chrysene	<10		
39	Bis(2-ethylhexyl) Phthalate	20		
40	Dioctyl Phthalate	<10		
41	Benzo(K)Fluoranthene	<10		
42	Benzo(B)Fluoranthene	<10		
43	Benzo(A)Pyrene	<10		
44	Indeno(1,2,3-CD)Pyrene	<10		
45	Dibenzo(A,H)Anthracene	<10		
46	Benzo(GHI)Perylene	<10		