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Mattawoman Creek Study

Indian Head Division
Naval Surface Warfare Center
Indian Head, Maryland

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Engineering Field Activity Chesapeake
Naval Facilities Engineering Command

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MATTAWOMAN CREEK STUDY

INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
ARCS	Assessment and Remediation of Contaminated Sediment
ASTM	American Society for Testing and Materials
AVS	Acid-Volatile Sulfide
AWQC	Ambient Water Quality Criteria
BAP	Benzo(a)pyrene
BI	Biotic Index
BTAG	Biological Technical Assistance Group
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response Compensation and Liability Act (Superfund)
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
C_{max}	Maximum Concentration
COC	Chemical of Concern
COPC	Chemical of Potential Concern
C_{range}	Range of Concentration
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
CTO	Contract Task Order
CWA	Clean Water Act
DA_{event}	Absorbed Dose per Event
DDD	p,p' - Dichlorodiphenyldichloroethane
DDE	p,p' - Dichlorodiphenyldichloroethylene
DDT	p,p' - Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DQO	Data Quality Objective
DRO	Diesel Range Organics
EEQ	Ecological Effects Quotient
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency (U.S.)
EPC	Exposure Point Concentration
EqP	Equilibrium Partitioning

ERA	Ecological Risk Assessment
ERED	Environmental Residue-Effects Database
ER-L	Effects Range-Low
ER-M	Effects Range-Median
FOD	Frequency of Detection
FTRV	Fish Tissue Residue Value
GPS	Global Positioning System
GRO	Gasoline Range Organics
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HMW	High Molecular Weight
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient
HSD	Tukey Honestly Significantly Different Test
ICR	Incremental Cancer Risk
IEUBK	U.S. EPA Integrated Exposure Uptake Biokinetic
IHDIV-NSWC	Indian Head Division, Naval Surface Warfare Center
IHIRT	Indian Head Installation Restoration Team
IR	Installation Restoration
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
KOC	Organic Carbon-Water Partition Coefficient
KOW	Octanol-Water Partition Coefficient
LC	Lethal Concentration
LEL	Lowest Effects Level
LMW	Low Molecular Weight
LOAEL	Lowest-Observed-Adverse Effect Level
LOEC	Lowest-Observed-Effect Concentration
MCL	Maximum Contaminant Level
MTBE	Methyl Tert-Butyl Ether
NAVEODTECHDIV	Naval Explosive Ordnance Disposal Technology Division
NAVSCOLEOD	Naval School Explosive Ordnance Disposal
NCEA	National Center for Environmental Assessment
NOAEL	No-Observable-Adverse-Effect Level
NOEC	No-Observable-Effect Concentration
NPDES	National Pollution Discharge Elimination System

OC	Organic Carbon
ORNL	Oak Ridge National Laboratory
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSWER	Office of Solid Waste and Environmental Response
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEC	Probable Effects Concentration
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RBCfish	Risk-Based Concentration for Fish
RBCres-soil	Risk-Based Concentration for Residential Soil
RBCtap	Risk-Based Concentration for Tap Water
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SAV	Submerged Aquatic Vegetation
SDWA	Safe Drinking Water Act
SEL	Severe Effects Level
SEM	Simultaneously Extracted Metals
SERA	Screening-Level Ecological Risk Assessment
SMDP	Scientific Management Decision Point
SOP	Standard Operating Procedure
SPAWAR	Space and Naval Warfare Systems Center
SQG	Sediment Quality Guideline
SSL	Soil Screening Level
SVOC	Semi-Volatile Organic Compound
SWSL	Surface Water Screening Level
TAL	Target Analyte List
TCE	Trichloroethylene
TCL	Target Compound List
TDS	Total Dissolved Solids
TEC	Threshold Effects Concentration

TEF	Toxicity Equivalence Factor
TIE	Toxicity Identification Evaluation
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
TSS	Total Suspended Solids
TtNUS	Tetra Tech NUS, Inc.
TV	Tolerance Value
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
U.S. Navy	United States Navy
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UVF	Ultraviolet Flourescence
VIMS	Virginia Institute of Marine Science
VOC	Volatile Organic Compound
WQC	Water Quality Criteria
WQG	Water Quality Guideline
WWTP	Waste Water Treatment Plant
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

This document was prepared by Tetra Tech NUS, Inc. (TtNUS) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298, Contract Task Order (CTO) 803. It describes the data collected and the data evaluation performed for a study of the Mattawoman Creek, which is adjacent to the Indian Head Division, Naval Surface Warfare Center (IHDIV-NSWC), Indian Head, Maryland. The study included a baseline ecological risk assessment (ERA) and human health risk assessment (HHRA) of chemical concentrations detected in surface water and sediment samples collected within the study area.

DATA COLLECTION

The risk assessments developed in this document were supported by a database established by collecting and analyzing environmental samples as described in a previously published work plan (TtNUS, August 2001). The work plan described the samples to be collected and the analyses to be completed. Environmental data from samples collected from Mattawoman Creek during other studies were incorporated into the work to improve the overall understanding of the environmental conditions in the study area.

Field sampling directly related to this study included field screening conducted in August 2001 by the Space and Naval Warfare Systems Center (SPAWAR), followed in September 2001 by a TtNUS field sampling event. The SPAWAR field screening included the collection of 48 sediment samples for chemical analysis. The TtNUS field-sampling event included collection of 32 sediment, 32 surface water, seven vegetation, and 33 fish samples for chemical analysis. Benthic invertebrate and sediment toxicity studies were performed on 23 and 28 sediment samples, respectively.

Remedial investigations of Installation Restoration (IR) Sites 11 (Caffee Road Landfill), 17 (Discarded Metal Parts Area), and 39/41 (Organics Plant/Scrap Yard), all located along the northern Mattawoman Creek shore, provided additional analytical data from a total of 18 surface water and 18 sediment samples from Mattawoman Creek. The analytical data from a previous sediment toxicity study were also considered during data evaluation.

ECOLOGICAL RISKS

Following the evaluation of environmental data, the relative risk to benthic invertebrates was evaluated to be "high", "moderate", "slight", or "negligible" based on a weight-of-evidence approach which is described in detail in Section 5.6.1.3 of this report. The results of the ERA are summarized below.

- **Benthic Invertebrates:** Metals are the most likely cause of toxicity to benthic invertebrates. Sediment from one sample location near IR Site 28 (Original Burning Ground) was identified as having high risk. Sediment sample locations near IR Sites 11, 17, and 39/41 were identified as having moderate risk. Other sediment sample locations exhibited negligible to slight risk.

- **Wildlife:** The concentrations of chemicals detected in environmental media were found to present a low risk to piscivorous birds and mammals and to herbivorous birds and mammals.

- **Fish:** The risk to fish from chemicals in the fish tissue samples is expected to be negligible.

- **Vegetation:** Zinc was the only parameter detected in hydrilla at concentrations greater than background or reference samples. The maximum detected concentration of zinc was only marginally higher than the maximum concentration detected in the background and reference samples. Additionally, hydrilla is found in increasing abundance in Mattawoman Creek. Consequently, risks to hydrilla and other aquatic vegetation are expected to be negligible.

- **Aquatic Organisms:** Cadmium was the only chemical detected in the surface water samples that may be causing an increased risk to aquatic organisms. However, because cadmium was detected less frequently and at lower concentrations in non-filtered surface water samples than in filtered surface water samples (the reverse of the expected result), there is uncertainty regarding the analytical results.

HUMAN HEALTH RISKS

The results of the HHRA are summarized in Table ES-1. As shown on the table, human health risks exceeded acceptable ranges only for the risk scenarios addressing adolescent and adult recreation users who consume fish. However, uncertainties connected with the data may have caused the risk assessment to be overly conservative. The uncertainties are discussed below:

Regarding uncertainties, the fish fillet background data set consisted of three samples and was not large enough for statistical comparison of the study area dataset to the background dataset. As a result, chemicals (e.g., arsenic) were not eliminated as chemicals of potential concern on the basis of their presence in background.

TABLE ES-1

SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

	Media		
	Surface Water	**Sediment**	**Fish Ingestion**
Contaminants of Potential Concern (i.e., contaminants subjected to the risk assessment process)	Benzene, ethylbenzene, trichloroethene, arsenic, iron, lead, and manganese	Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, thallium, and zinc	4-methylphenol and bis(2-ethylhexyl)phthalate, 4,4'-DDE, dieldrin, aroclor-1260, 1,3-dinitrobenzene, 2-amino-4,6-dinitrotoluene, arsenic, chromium, cyanide, manganese, mercury, and perchlorate
Construction Workers	Human health risks within acceptable ranges.	Human health risks within acceptable ranges.	Not assessed for construction workers
Adolescent Recreational User (including off-site resident)	Human health risks within acceptable ranges.	Human health risks within acceptable ranges.	Exceeds acceptable non-carcinogenic risk. Primary non-carcinogenic contributors are 2-amino-4,6-dinitrotoluene, and 4-methylphenol.
Adult Recreational User (including off-site resident)	Human health risks within acceptable ranges.	Human health risks within acceptable ranges.	Exceeds acceptable carcinogenic and non-carcinogenic risk ranges. Primary carcinogenic contributor is aroclor-1260. Primary non-carcinogenic contributor is 4-methylphenol.

1.0 INTRODUCTION

This document was prepared by Tetra Tech NUS, Inc. (TtNUS) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298, Contract Task Order (CTO) 803. It presents the data collection and evaluation conducted for the Mattawoman Creek Study, Indian Head Division, Naval Surface Warfare Center (IHDIV-NSWC), Indian Head, Maryland. The study included a baseline ecological risk assessment (ERA) and human health risk assessment (HHRA) of chemical concentrations detected in environmental media (i.e., surface water and sediment) and biota samples (e.g., fish tissue) collected within the study area.

1.1 DESCRIPTION OF THE INSTALLATION

IHDIV-NSWC is located in Charles County, Maryland, 30 miles south of Washington, D.C. The facility is positioned along the Potomac River at the confluence of the Mattawoman Creek as shown on Figure 1-1. The facility is comprised of about 3,500 acres. The Main Area, on the Cornwallis Neck Peninsula, is approximately 2,500 acres. The Stump Neck Annex is approximately 1,000 acres and is separated from the Main Area by the Mattawoman Creek. IHDIV-NSWC has been active since 1890 and assumed its current name in 1992.

Five major military tenant commands are resident at IHDIV-NSWC. The Naval Ordnance Safety and Security Activity; the Naval Explosive Ordnance Disposal Technology Division; the U.S. Marine Corps Chemical and Biological Incident Response Force; the Naval Sea Logistics Center Detachment Atlantic; and the Joint Interoperability Test Command. Although these tenant commands have different missions, they share a common focus with IHDIV-NSWC to meet our nation's military requirements.

IHDIV-NSWC operations are primarily located on the Main Area. The principal mission on the Main Area of the Station is to:

- Provide services in energetics for all warfare centers through engineering, fleet and operational support, manufacturing technology, limited production, and industrial base support.

- Provide research, development, testing, and evaluation of energetic materials, ordnance devices and components, and other related ordnance engineering standards, including chemicals, propellants and their propulsion systems, explosives, pyrotechnics, warheads, and simulators.

- Provide support to all warfare centers, military departments, and the ordnance industry for special weapons, explosive safety, and ordnance environmental issues.

The Stump Neck Annex of IHDIV-NSWC is primarily occupied by tenant commands. Until recently, the Stump Neck Annex had been occupied by two tenant commands, the Naval School Explosive Ordnance Disposal (NAVSCOLEOD) and the Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV). The mission of NAVSCOLEOD was the training of active military personnel in performing explosive ordnance disposal (EOD) operations. In 1998, most operations at NAVSCOLEOD were relocated to Eglin Air Force Base in Florida. Currently, NAVEODTECHDIV remains as the primary tenant command at the Stump Neck Annex. The mission of NAVEODTECHDIV is as follows:

- Provide EOD technology and logistics management.
- Develop war-essential elements of intelligence, equipment, and procedures to counter munitions, both U.S. and foreign, as required to support Department of Defense components and the peacetime security needs of other agencies.

1.2 STUDY OBJECTIVES

The Mattawoman Creek Study was conducted to assess the potential ecological and human health risks associated with facility-related contaminants in Mattawoman Creek. The assessments developed and presented in this document are based on abiotic and biotic environmental samples collected from Mattawoman Creek. The data generated from these samples and the risk assessments developed in this document will ultimately be used to determine the most appropriate course of risk management for Mattawoman Creek. A brief overview of the ERA and the HHRA approaches are discussed in the following sections.

1.3 ECOLOGICAL RISK ASSESSMENT APPROACH

Based on a previously prepared approach document for the Mattawoman Creek Study (TtNUS, 2000) and discussions during an August 31, 2000, Indian Head Installation Restoration Team (IHIRT) meeting, attended by the IHIRT and the U.S. Environmental Protection Agency EPA Region 3 Biological Technical Assistance Group (BTAG) members, it was determined that a baseline ERA would be conducted rather than a screening-level ERA. For the Mattawoman Creek Study, the screening-level ERA was viewed as redundant since a previous remedial investigation report for Site 39/41, Organics Plant/Scrap Yard, had included a screening-level ERA based on samples from Mattawoman Creek and determined that a baseline ERA for Mattawoman Creek was appropriate. Consequently, proceeding directly to a baseline ERA, which includes the collection of chemical, biological, and toxicological data, was considered a more comprehensive and expeditious approach for the Mattawoman Creek Study. The decision to proceed directly to the baseline ERA was considered to be the scientific management decision point (SMDP) for this step in the ERA process (USEPA, June 1997). The ERA was conducted according to the Navy

Guidance for Conducting Ecological Risk Assessments (5090 Ser N453E/9U595355) (U.S. Navy, April 1999). The approach for the ERA is discussed in more detail in Section 5.

The first step in the baseline ERA process was the construction of the project problem formulation, which results in a list of data requirements necessary to complete the ERA and meet the goals of the study. The problem formulation document was published as Appendix A to the Mattawoman Creek Work Plan (TtNUS, August 2001).

The problem formulation contained several elements used to ultimately identify data requirements including aquatic and semi-aquatic habitats and receptors and a list of chemicals of potential concern (COPCs). COPCs were identified based on data from previous investigations and information on historical and current waste management practices, including Installation Restoration Program (IRP) site information and documented historical spills. The COPCs included inorganics, semi-volatile organics (SVOCs) (including polynuclear aromatic hydrocarbons [PAHs]), pesticides, polychlorinated biphenyls (PCBs), and energetics. The site ecological information was combined with toxicity and fate and transport information for the COPCs to develop a conceptual model that diagrammatically depicts the sources of chemicals, their fate and transport, receptors potentially at risk, and their exposure pathways. After the conceptual model was completed for Mattawoman Creek, a series of risk questions were developed. The risk questions were ultimately defined by the conceptual model and represented the “big picture” in terms of the potential risks that needed to be addressed.

From these risk questions, the most appropriate endpoints were selected for the Mattawoman Creek Study. An assessment endpoint is defined as “an explicit expression of actual environmental values that are to be protected” (EPA, June 1997). The assessment endpoints support the risk questions. Finally, measurement endpoints, also known as “measures of effects”, which represent “measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoints” (EPA, June 1997), were selected for the Mattawoman Creek ERA. Specifically, they provide analyses to investigate the assessment endpoints and ultimately answer the project risk questions. The measurement endpoints and their attendant data quality objectives (DQOs) essentially comprise the data needs for the ERA, including sampling media, types of samples for each media, and analytes.

Section 5 contains the methodologies used to evaluate potential site-specific ecological risks for the Mattawoman Creek Study area. The risk assessment includes an evaluation of the chemical concentrations in abiotic and biotic samples, as well as an interpretation of the toxicity studies results.

1.4 HUMAN HEALTH RISK ASSESSMENT

The objective of a HHRA is to determine whether detected concentrations of chemicals pose a significant threat to potential human receptors under current and/or future land use scenarios. The potential risks to human health for the site were estimated based on the assumption that no actions will be taken to control chemical releases. Section 6 contains the methodologies to be used to evaluate potential site-specific human health risks at the site. The HHRA was conducted according to the Navy's Human Health Risk Assessment Policy (5090 Ser N453/IUI595168) (U.S. Navy, February 2001).

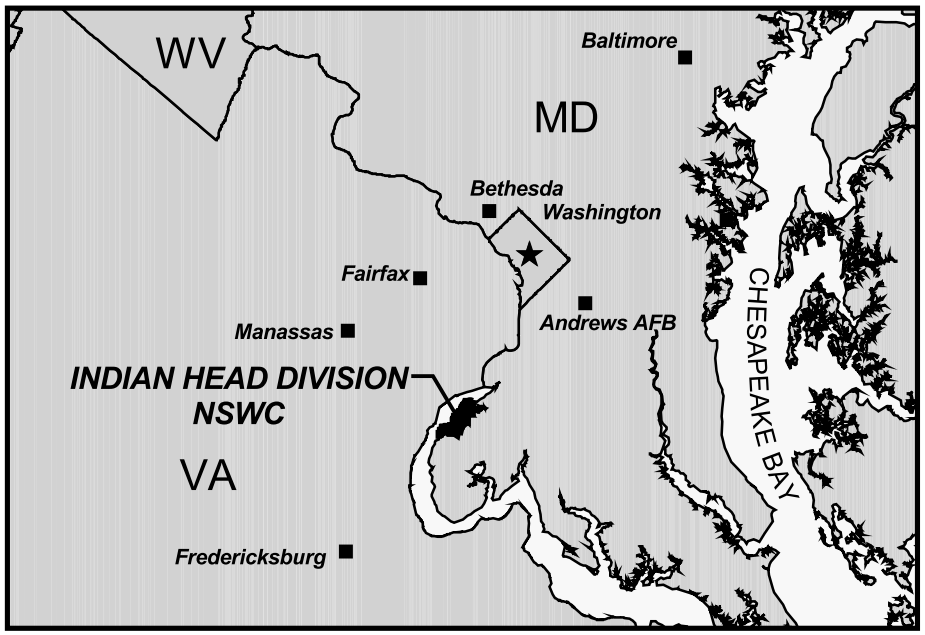
The risk assessment was structured and reported according to the guidelines of the Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (EPA, January 1998). In addition, the methodology presented in this document is consistent with the methodology used for the HHRAs presented in the various Remedial Investigation/Resource Conservation and Recovery Act (RCRA) Facility Investigation (RIs/RFIs) (TtNUS, July 2000, July 1999) that have been conducted at IHDIV-NSWC.

A HHRA consists of five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. The human health risk assessment process is discussed in more detail in Section 6.

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in environmental media; the contaminants must be released by either natural processes or by human action; potential exposure points must exist; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without one of the factors listed above, there is no risk.

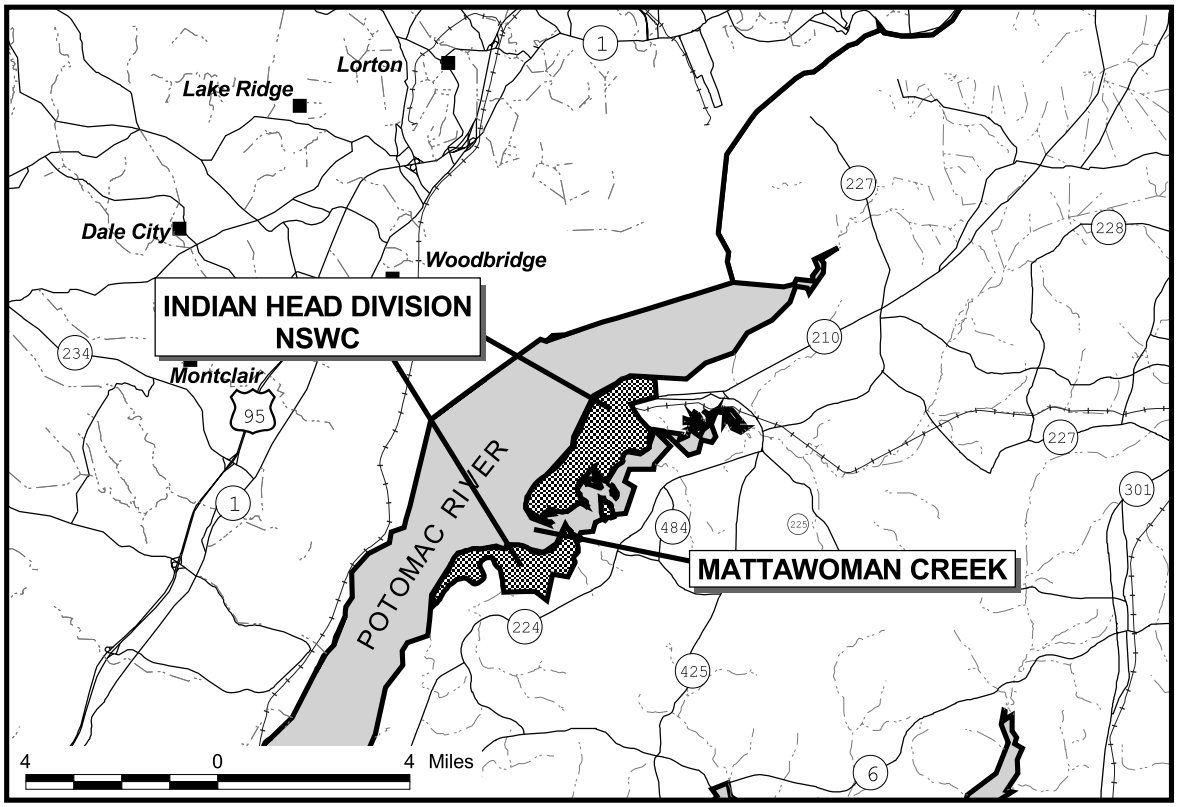
1.5 DOCUMENT ORGANIZATION

Section 1.0 of this report presents this introduction, objectives, and an overview of the ecological risk assessment and human health risk assessment. Section 2.0 presents the conceptual site model, including a detailed site description, a summary of previous investigations, and a summary of potential sources of contamination and chemicals of potential concern. Section 3.0 describes the field investigation procedures and observations. Section 4.0 describes the nature and extent of the field investigation results. Section 5.0 discusses the ecological risk assessment. Section 6.0 discusses the human health risk assessment. Section 7.0 provides the summary and conclusions.



LEGEND

- City
- Highway
- Railroad
- River



DRAWN BY K. PEILA	DATE 7/16/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NO.
CHECKED BY GJL	DATE 7/16/02	VICINITY MAP MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/16/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 / REV 0

P:\GIS\NSWC_INDIAN_HEAD\SITE_LOCATION.APR SITE LOCATION MAP 7/22/02 KMP

2.0 CONCEPTUAL SITE MODEL

This section of the report presents the conceptual site model (CSM) for Mattawoman Creek. The CSM establishes the complete exposure pathways that are evaluated in the human health and ecological risk assessments. In order to establish the CSM, the following items need to be determined:

- Site Setting
- Potential sources of contamination
- List of known contaminants
- Contaminant migration/transport pathways
- Potential exposure routes/receptors

Some of the above items were presented in the problem formulation portion of the Final Work Plan for Mattawoman Creek (TtNUS, August 2001). These items are repeated in this section for completeness, and have been updated with new data, as available. Note that the CSM presented herein is for the ERA and HHRA because most of the information is applicable to both sets of receptors. The CSM specifics for the ERA and HHRA are presented at the end of this section. The conceptual model for Mattawoman Creek is presented in Figure 2-1.

2.1 SITE SETTING

The initial stages of the baseline ERA (EPA, June 1997) require a description of the habitats present, receptors present, and ecosystems at risk, which are described in the following sections. A thorough understanding of the habitats and receptors that are present allows for selection of appropriate risk questions, assessment endpoints, and measurement endpoints.

2.1.1 Physical Attributes

Mattawoman Creek drains a 79-square-mile area in northern Charles County and southern Prince George's County, Maryland. The creek originates southwest of Brandywine and flows for 30 miles where it empties into the Potomac River at river mile 71. The average annual discharge rate of Mattawoman Creek to the Potomac River is 54.2 cubic feet per second, which is a small proportion (less than 0.4 percent) of the total Potomac River freshwater flow (Lippson et al., 1979). The first 25 miles of the creek are free flowing, and the last 5 miles are a tidal embayment. Tidal amplitude in the lower reaches of Mattawoman Creek averages about 0.5 meter but fluctuates considerably depending on weather, season, and moon phase (Lippson et al., 1979). The lower portion of the creek is classified as a tidal freshwater stream throughout most of the year. During low freshwater flow periods, (usually late summer

and early fall), salinity near the mouth of the creek can reach 3 to 4 parts per thousand. When salinity is present, stratification can occur, mainly near the mouth of the creek.

The Main Area of IHDIV-NSWC is located along the northern shoreline of Mattawoman Creek from its confluence with the Potomac River upgradient for approximately 3 miles. Stump Neck Annex of IHDIV-NSWC is located along the southern shoreline from the Potomac River confluence approximately 1 mile upgradient. The basin is mostly rural but includes a rapidly developing suburban area in northern Charles County, the town of Indian Head, and IHDIV-NSWC. Concerns about increased development in the upper Mattawoman Creek basin have led to ongoing studies by the Smithsonian Environmental Research Center and Charles County/Corps of Engineers that are focusing on the development of a watershed management plan (Jordon, et al., 2000). The Indian Head Waste Water Treatment Plant (WWTP) discharges to a small creek known as Harrison Cut, which empties into Mattawoman Creek approximately 1,000 feet upgradient of the main area boundary.

The width of Mattawoman Creek becomes broader as it approaches IHDIV-NSWC (Figure 2-2). A defined creek channel is present in the stretch of the creek near the eastern main area boundary. Depths ranging from approximately 9 to 17 feet were measured in this area by project biologists during an August 2000, site visit. This clearly defined channel continues past the Scrap Yard area (Site 41), then becomes more diffuse. The entire creek becomes shallower near Thoroughfare Island and Marsh Island. Depths in these areas ranged from 2 to 6 feet in August 2000. A large flat is present in the area south of Thoroughfare Island. From Bullit's Neck to the mouth of the Potomac, Mattawoman Creek becomes broad and open, with depths ranging from 3 to 8 feet. Highly variable depths down to 14 feet were present in this broad area in August 2000. A diffuse channel is present in the middle of this final stretch of lower Mattawoman Creek.

2.1.2 Aquatic and Semi-Aquatic Biota

At least 33 species of fish inhabit Mattawoman Creek or adjacent areas, including several anadromous and semi-anadromous species such as the blueback herring (*Alosa aestivalis*), alewife (*A. pseudoharengus*), white perch (*Morone americana*), gizzard shad (*Dorsoma cepedianum*), and striped bass (*Morone saxatilis*). Marine species that use Mattawoman Creek as a nursery include the Atlantic menhaden (*Brevoortia tyrannus*), spot (*Leiosomus xanthrus*), and winter flounder (*Pseudopleuronectes americanus*). The catadromous American eel (*Anguilla rostrata*) spawns at sea and the young migrate to Mattawoman Creek to mature. Several freshwater species of gamefish are common in Mattawoman Creek, including the largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), and bluegill (*Lepomis macrochirus*), as well as several species of catfish (*Ictalurus* spp.). Benthic macroinvertebrates are also present in Mattawoman Creek.

The bald eagle (*Haliaetus leucocephalus*) and osprey (*Pandion haliaetus*) are present along Mattawoman Creek. Five bald eagle nests have been identified in the general Mattawoman Creek area. Other piscivorous birds present at the creek include the great blue heron (*Ardea herodias*), green heron (*Butorides virescens*), Forster's tern (*Sterna forsteri*), and belted kingfisher (*Ceryle alcyon*). Waterfowl such as the mallard (*Anas platyrhynchos*), American black duck (*Anas rubripes*), and wood duck (*Aix sponsa*) are abundant along Mattawoman Creek. The IHDIV-NSWC natural resources department is currently conducting a survey of wintering waterfowl present in Mattawoman Creek. Numerous turtles and aquatic snakes are regularly observed, including during an August 2000 site visit by project biologists. Reptile and amphibian species present in Mattawoman Creek have been documented during a study completed by the IHDIV-NSWC (CH2M Hill, 2001).

2.1.3 Aquatic Vegetation

Extensive aquatic vegetation is found throughout Mattawoman Creek. In the middle and upper reaches of the creek, some wooded swamps are present. In middle and lower Mattawoman Creek, extensive beds of the macrophyte spatterdock (*Nuphar luteum*) are present. The emergent pickerel weed (*Pontederia cordata*) is common, especially throughout Marsh Island. Wild rice (*Zizania aquatica*) is also present and is generally located along the periphery of the spatterdock and pickerel weed beds. Emergent vegetation is less abundant from Bullit's Neck to the mouth of Mattawoman Creek. The creek also contains abundant submerged aquatic vegetation (SAV). The Virginia Institute of Marine Science (VIMS) has conducted mapping of the SAV in the Chesapeake Bay watershed (TtNUS, August 2001). SAV in Mattawoman Creek is dominated by hydrilla (*Hydrilla verticillata*), najas (*Najas minor*), and wild celery (*Vallisneria americana*). Coontail (*Ceratophyllum demersum*) is present in the upper reaches of Mattawoman Creek near IHDIV-NSWC. Riparian vegetation is also present along the margins of the creek, including many of the species described above, as well as cattail (*Typha* spp.), common reed (*Phragmites australis*), maples (*Acer* spp.), tulip poplar (*Liriodendron tulipera*), and oaks (*Quercus* spp.). The riparian vegetation appears to be consistent along most of the banks of Mattawoman Creek associated with the installation, with the dominant vegetation types remaining generally consistent.

2.1.4 Listed Species

Several rare, threatened, and endangered species of flora and fauna have been reported in Mattawoman Creek. Protected species are listed in Table 2-1.

2.2 POTENTIAL SOURCES OF CONTAMINATION TO MATTAWOMAN CREEK

As presented in Section 2.1 of this report, Mattawoman Creek drains a large area, including the area adjacent to IHDIV-NSWC. Because of this, there are several potential sources of contamination to

Mattawoman Creek including site-related and non-site related sources. The non-site related sources are responsible for the "background" or "reference" levels of contamination in the creek, which are accounted for in the upgradient samples that were collected. Therefore, the sources of contamination in this section will focus on the sources related to IHDIV-NSWC, which include the following sources:

- Site operations with direct discharges, such as process effluents to the creek
- Stormwater erosion/runoff
- Groundwater discharge
- Accidental spills
- Deposition from air

IHDIV-NSWC has been in continuous operation since 1890. Since that time, a wide variety of operations have occurred at a variety of locations throughout the facility, primarily on the Main Area. Over time, the locations for specific operations have changed; operations have been discontinued; and new operations initiated. Initially, the facility manufactured gunpowder and propellants in addition to performing weapons testing. At various times, manufactured products included gunpowder, energetics, propellants, and explosives. Associated activities involved firing, exploding, and burning the manufactured products as part of development, testing, and waste disposal programs. Laboratory activities, along with the associated chemicals, were also part of the development and testing functions at the facility. Other routine activities and general maintenance efforts were also potential sources of contamination, such as the use of pesticides and herbicides, as well as fuel leakage and spills.

As discussed above, many activities were conducted at IHDIV-NSWC, some of which may have contributed to the migration of chemicals into Mattawoman Creek. Sites contributing contaminants through indirect transport may include landfills and disposal areas, open burn/open destruction facilities, spill sites, and roadways adjacent to or proximate to Mattawoman Creek. In many instances, it is difficult for several reasons, if not impossible, to relate contamination within Mattawoman Creek to a particular site. Many of the processes at the facility have changed over time; and therefore, what is a current permitted discharge to a particular area in Mattawoman Creek may not have been a source of contamination in the past. Also, the creek channel may have transported some chemicals upstream or downstream depending upon the tidal flow. There are some sites along Mattawoman Creek, however, where contamination may be directly linked to an on-shore source. These areas are discussed in the following sections.

2.2.1 Site 11 - Caffee Road Landfill

Site 11 extends approximately 200 feet on either side of Caffee Road to the edge of an unnamed creek on the west and to Mattawoman Creek on the south. Review of historical aerial photographs indicates

that filling activities have extended the shoreline into Mattawoman Creek as much as 150 feet from its earlier position. The majority of the Mattawoman Creek shoreline next to Site 11 consists of concrete, debris, and other fill material. One-quarter of the site, the area adjacent to the unnamed creek, is classified as a wetland. There is no information when the landfill was first used; however, it was used until the early 1960s for the disposal of bulk metal items and trash, rocket motor casings, exploded building debris, rifles, demilitarized ordnance, propellant grains residue, and open burning residue. Debris was observed in a wooded swale northwest of the site. The debris consisted of bricks, metal parts, a washing machine, and the end of a fiberglass tank, and appeared to be deposited on the surface only (i.e., not buried). It is unclear whether this debris is associated with disposal activities at Site 11. In 1980, IHDIV-NSWC removed 5,000 to 6,000 cubic yards of flashed metal parts from the wetland. Flashed metal refers to metal debris that was burned to remove trace amounts of energetics residue.

The surface above the landfill is now used as the Decontamination Burn Point, and a large collection of flashed metal parts formerly located on top of the unit has since been removed. A contractor periodically removes the metals parts for sale off site. The eastern portion of the site is now used for drum storage and waste segregation. Building 1550 (Cooling Tower), Building 1551 (Tank Farm Area), and Building 1549 (Chemical Incinerator) are located east of Site 11.

Surface soil, subsurface soil, groundwater, surface water, and sediment samples were collected as part of the remedial investigation at Site 11 (CH2M Hill, 2001). Surface soil contained low concentrations of a few Volatile Organic Compounds (VOCs) and several SVOCs widely distributed on and near the site (including around Building 24, an incinerator). Metals were detected at their highest levels and greatest frequency in the western and central portions of the site and around Building 24. Numerous surface soil samples contained arsenic, iron, and lead at concentrations above facility background levels. Total petroleum hydrocarbons – diesel range organics (TPH-DRO) were widely distributed. Several energetics were detected in surface soil, particularly in the western portion of the site, including a high concentration of perchlorate. Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration and to surface water and sediment via surface water runoff.

Subsurface soil contained few VOCs and SVOCs, and all were at lower concentrations than in surface soil. The greatest number and highest concentrations of metals in subsurface soil were in a single boring near the center of the site. Arsenic and iron were below background levels, but lead exceeded the basewide background concentration. The same soil boring contained elevated levels of TPH-DRO. Few energetics were detected in subsurface soil, although one high value of perchlorate was detected. The samples of buried waste contained several VOCs, SVOCs, metals, and energetics and some TPH-DRO, all at concentrations that suggest the waste is the source of subsurface soil contamination. Subsurface soil contaminants could migrate to groundwater by infiltration.

Only very low concentrations of VOCs and SVOCs were detected in groundwater. Few energetics (and only at low concentrations) and little TPH-DRO were detected in groundwater. Arsenic, iron, and lead were detected in groundwater at concentrations above background levels. Groundwater discharge to surface water could cause contaminants to migrate to surface water and sediment.

Sediment samples were collected from seven locations at Site 11 as part of the Remedial Investigation (CH2M Hill, 2001). Three samples (IS11SD05 through IS11SD007) were collected from an unnamed creek associated with Site 11. Four samples (IS11SD01 through IS11SD04) were collected from the bank of Mattawoman Creek. In those four samples from the bank of Mattawoman Creek, only low concentrations of VOCs, SVOCs, energetics, and TPH-DRO were detected. However, several metals, including arsenic, iron, and lead, were detected above background. Concentrations of almost all analytes in surface water were too low to warrant extensive discussion. Therefore, it appears that the metals, arsenic, iron, and lead have migrated to Mattawoman Creek.

2.2.2 Site 17 – Discarded Metal Parts Area

Site 17 is located adjacent to Site 11 to the east-northeast along Mattawoman Creek. Buildings 1569 and 1570 are situated on a ridge 20 feet above the site. Site 17 was originally defined as a 1,000-foot section of shoreline along Mattawoman Creek where metal parts were discarded. Metal parts were discarded along the shoreline from the 1960s until the early 1980s. The discarded materials included rocket motor casings, shipping containers, empty drums, and various metal parts. Large metal items along the shoreline were reportedly removed in 1989. The site area was expanded in 1997 to include the forested area 100 feet from the shoreline where dozens of rusted drums were identified. The drum contents were determined to be wax that is safe to handle (i.e., not energetic) though they may contain residual levels of energetics.

Surface soil, subsurface soil, groundwater, surface water, and sediment samples were collected as part of the remedial investigation at Site 17 (CH2M Hill, 2001). Surface soil contained a few VOCs and SVOCs, particularly in the western portion of the site, but only at low levels. The highest concentrations and most frequent detections of metals were in the eastern and western portions of the site. Arsenic, iron, and manganese concentrations were higher than background concentrations. Only low concentrations of energetics were detected. Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration and to surface water and sediment by surface water runoff.

Subsurface soil contained a few VOCs (at low levels) but contained a few elevated concentrations of SVOCs, particularly in the eastern portion of the site. The highest concentrations and greatest frequency of metals detections in subsurface soil were in both the eastern and western portions of the site.

However, the concentrations were lower than those in surface soil. Few energetics were detected. Subsurface soil contaminants could migrate to groundwater by infiltration.

High concentrations of VOCs (particularly vinyl chloride and 1,2-dichloroethene) were detected in groundwater. Filtered groundwater samples contained the highest concentrations of metals (especially iron and manganese) in one on-site well. In general, metal concentrations were lower in filtered samples than in unfiltered samples, suggesting that many of the metals remain adsorbed to solid materials in the subsurface. Few energetics were detected in groundwater and only at low concentrations. Groundwater discharge to surface water could cause contaminants to migrate to surface water and sediment.

Six sediment samples were collected at Site 17 as part of the Remedial Investigation (CH2M Hill, 2001). All samples were collected along the shoreline of Mattawoman Creek. IS17SD01 and IS17SD02 are locations upstream of the site. All Site 17 sediment samples were analyzed for explosives and TAL inorganics only. Several metals, including arsenic, iron, lead, and manganese, were detected above background in sediment. Therefore, it appears that these metals have migrated to Mattawoman Creek. However, the highest concentrations were in the samples nearest Site 11, and it is likely that Site 11 is the source rather than Site 17. Concentrations of almost all analytes in surface water were too low to warrant extensive discussion. Surface water and sediment samples collected during the remedial investigation were not analyzed for VOCs and SVOCs. During a subsequent pre-feasibility study field investigation, the highest contaminant concentrations detected in surface water were 4.1 µg/l methyl tert-butyl ether (MTBE), 0.22 µg/l methylene chloride, and 0.18 µg/l toluene.

2.2.3 Site 28 – Original Burning Ground

Site 28, Original Burning Ground, also referred to as the Slavins Dock Area and Wildlife Area, encompasses the site of a zinc recovery furnace, Artesian Well #14, and the Shoreline Burning Cage. During World War I, the Navy initiated a metal recycling program. In 1928, the Zinc Recovery Furnace, designated as Building 415, was erected. Building 415 was a one-story building with dimensions of 24 feet by 14 feet by 7 feet. The building was demolished in the early 1950s. Artesian Well #14 was installed to a depth of 430 feet in 1918. It was used as a potable well but was converted to an observation well in 1988 (CH2M Hill, August 2002). The 1.8-acre site was used as a burning ground from the 1890s to 1942. There were no records on the types of materials that were burned. However, it was concluded that smokeless powder was burned at the site based on the materials manufactured when the site was in operation. Additionally, various contaminated wastes were also burned openly. Surface debris was removed from the site in 1990.

Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration and to surface water and sediment by surface water runoff. Subsurface soil contaminants could migrate to groundwater

by infiltration. Groundwater discharge to surface water could cause contaminant migration to surface water and sediment.

At this writing, a remedial investigation for Site 28 is planned. The TIE study and previous soil samples collected by base personnel were analyzed for metals. Metals that were detected included cadmium, copper, lead, selenium, and zinc. No other sampling was conducted prior to the RI.

2.2.4 Site 39 – Organics Plant and Site 41 – Scrap Yard

Sites 39 and 41 are discussed together because they were investigated at the same time and because of their proximity to each other and Mattawoman Creek.

Site 39 is the location of an outfall where a pipe carrying wastewater from Building 497 discharges into Mattawoman Creek. Operations conducted at Building 497 from 1961 to 1965 included formulating the propellant binder, bis-2,2-dinitropropanol acetal/formal. Silver nitrate was used as a catalyst in producing the acetal/formal, and one stage of the process utilized silver in its elemental form. Reportedly, several accidental releases of acetal/formal, silver, dinitropropanol, ethylene dichloride, methylene chloride, and formaldehyde into Mattawoman Creek occurred as a result of an improperly closed valve. Also, site personnel reported that acetal/formal and silver were visible on the surface of Mattawoman Creek near this outfall. Media associated with Site 39 are Mattawoman Creek surface water and sediment.

Site 41 is a fenced scrap yard located adjacent to Mattawoman Creek. The site is approximately 750 feet long and 75 to 100 feet wide. The area is flat and surface runoff tends to pond and infiltrate, although in some areas runoff is toward Mattawoman Creek. A concrete slab is present within most of the fenced area. The slab is covered with soil in some places. The scrap yard is active and is used to store metal materials and scraps, including storage drums and office furniture. The materials are eventually sold to be recycled or reused. During a 1981 inspection, 17 transformers were identified as either containing or contaminated with PCBs. Material from these transformers is suspected to have leaked into soil in the western part of the site. Lead-acid batteries were also stored in the scrap yard. The batteries may have released lead to the surface soil. No transformers or batteries are currently stored on the site. Media associated with Site 41 are surface soil, subsurface soil, shallow groundwater, and Mattawoman Creek surface water and sediment.

Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration and to surface water and sediment by surface water runoff. Subsurface soil contaminants could migrate to groundwater by infiltration. Groundwater discharge to surface water could cause contaminants to migrate to surface water and sediment. Contaminants present in the discharge from the Site 39 outfall pipe could be deposited in surface water and sediment. Sediment samples were collected from 24 sampling locations

within Mattawoman Creek or along the Mattawoman Creek shoreline. These samples include historical data as well as data collected as part of the Remedial Investigation (TtNUS, 1999).

Analytical data for Site 39/41 shallow groundwater and surface water samples suggest that historic activities at Site 39/41 have had a minimal impact on shallow groundwater and surface water quality in the vicinity of the sites.

VOCs were detected infrequently in all media and, in general, at low concentrations in all Site 39/41 samples. Several SVOCs, primarily PAHs, were detected in Site 41 surface soil samples. All but three of the PAHs were detected in more than half of the surface soil samples. 1,2,4-Trichlorobenzene was also detected in more than one half of the surface soil samples. SVOCs were detected in only two of the Site 41 subsurface soil samples.

1,1-Dimethylhydrazine was detected in three of six sediment samples collected from locations near the Site 39 outfall. N-Nitrosodiphenylamine was detected in approximately one-third of the sediment samples associated with Site 39/41, all of which were collected within Mattawoman Creek. Several PAHs were also detected in Site 39/41 sediment samples. However, PAHs were generally less frequently detected and at lesser concentrations in Site 39/41 sediment samples than in Site 41 surface soil samples. Therefore, it appears that 1,1-dimethylhydrazine and n-nitrosodiphenyl amine may have migrated to Mattawoman Creek through the Site 39 outfall. PAHs may have migrated to Mattawoman Creek from Site 41.

Pesticides were sporadically detected in Site 41 surface and subsurface soil samples. Several pesticides were detected in Site 39/41 sediment samples. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in at least one-third of the Site 39/41 sediment samples, primarily Site 41 sediment samples collected in Mattawoman Creek. It is unclear if the Site 41 surface soil is the source of pesticides detected in Mattawoman Creek.

Widespread PCB contamination was evident in the surface soil at Site 41. However, PCBs were not detected in subsurface soil samples from Site 41 or in the Site 39/41 sediment samples. Therefore, it appears that PCBs have not migrated from Site 41 to Mattawoman Creek.

Nitrocellulose was detected in two of the Site 41 surface soil samples. However, nitrocellulose was detected in 12 of 14 Site 39/41 sediment samples. Nitroguanidine was detected in over one-half of the Site 41 surface soil samples but was detected in only two of 14 sediment samples, both of which were collected in Mattawoman Creek. It is unclear if the Site 41 surface soil is the source of these energetic compounds detected in Mattawoman Creek.

Several metals (e.g., arsenic, cadmium, lead, mercury, and silver) were detected at concentrations exceeding basewide background concentrations. Arsenic, cadmium, and lead were the most frequently detected metals in surface soil samples. The maximum concentrations of most metals in Site 41 subsurface soil samples were less than the maximum concentrations of the respective metals in surface soil samples.

Maximum concentrations of most metals detected in Site 39/41 sediment samples were less than the maximum concentrations of metals detected in Site 41 surface soil samples. The maximum concentrations of mercury and silver were detected in sediment samples collected downstream of the Site 39 outfall. Therefore, it appears that these metals may have migrated to Mattawoman Creek through the Site 39 outfall.

2.2.5 Site 57 – Former Drum Loading Area

Site 57, Former Drum Loading Area, encompasses the area located south of Building 292. Although Site 57 is located approximately 1,300 feet north of Mattawoman Creek, a storm sewer that serves the area discharges to the creek. Surface drainage from the site flows through a lined channel and natural stream before flowing into Mattawoman Creek. Previous operations from the mid-1960s until 1989 involved the use of Trichloroethylene (TCE) for vapor degreasing and general cleaning. During the 1970s and 1980s, spent TCE was transferred from a tank inside Building 292 into drums via a pipe that passed through the wall near the southern corner of the building. The drums were stored on a grass-covered area near Building 292. These operations have resulted in the contamination of soil and groundwater. Site 57 also includes Buildings 165 and 496, located approximately 150 feet southwest of Building 292, which are ether storage vaults.

Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration, to local surface water and sediment by surface water runoff, and to the storm sewer by surface water runoff. Subsurface soil contaminants could migrate to groundwater by infiltration. Groundwater could discharge to local surface water and could infiltrate the storm sewer. Local surface water and the storm sewer discharge to Mattawoman Creek. The samples discussed in the following paragraphs were collected as part of the Remedial Investigation Report for IR Site 57 (TtNUS, 2000). Only one sediment/surface water location (S57SD006/SW010) was collected in Mattawoman Creek. All other sediment and surface water samples are associated with a drainage channel (along the southwestern side of the site) that flows to an intermittent stream, eventually discharging to Mattawoman Creek.

TCE and several chlorinated hydrocarbons were detected in soil and groundwater samples. TCE and one of its degradation products, 1,2-dichloroethene, were typically detected with the greatest frequency

and at the highest concentrations. Most of the positive results for TCE in subsurface soil were associated with samples collected near the former drum loading area. TCE and cis-1,2-dichloroethene were the only chlorinated hydrocarbons detected in the surface soil samples. Maximum concentrations of TCE and several other chlorinated hydrocarbons in groundwater were associated with a monitoring well located at the southeastern corner of Building 292. Definitive patterns (i.e., from upgradient to downgradient or from upper surficial to lower surficial) of chlorinated hydrocarbon contamination in groundwater could not be identified. Investigations have indicated that contaminated groundwater has not yet migrated to Mattawoman Creek.

Although not detected in surface soil, subsurface soil, open channel surface water, or open channel sediment, diethyl ether was frequently detected in upper and lower surficial groundwater, storm sewer surface water, and storm sewer sediment. The highest concentrations of diethyl ether in the groundwater samples were found in the area near the ether storage vaults. In general, diethyl ether concentrations decreased with downgradient distance from the vaults. Diethyl ether was also detected in surface water and sediment from the storm sewer outfall to Mattawoman Creek.

Very few SVOCs were detected in Site 57 groundwater or surface water samples. Several SVOCs, primarily PAHs, were sporadically detected in surface and subsurface soil samples. Several PAHs were also detected in open channel sediment and the storm sewer outfall to Mattawoman Creek. Samples of Mattawoman Creek surface water and sediment (S57SD006/SW010) were not analyzed for SVOCs.

Although not detected in open channel or storm sewer sediment samples, nitrocellulose was detected in a majority of the surface soil, subsurface soil, groundwater, and surface water samples analyzed for this chemical. A definitive pattern of nitrocellulose contamination in relation to soil depth could not be determined. Nitrocellulose concentrations in storm sewer surface water samples increased slightly with downgradient distance. Samples of Mattawoman Creek surface water and sediment collected as part of the Site 57 remedial investigation were not analyzed for nitrocellulose.

In general, the detected concentrations of inorganics in all media do not vary greatly between upgradient and downgradient, surface and subsurface, or upper surficial and lower surficial samples. Most of the detected concentrations of metals in all media were less than facility background concentrations. Notable detections of metals include arsenic in surface and subsurface soil near Building 292 and lead in surface soil approximately 400 feet south of Building 292.

Cis-1,2-dichloroethene, diethyl ether, TCE, and vinyl chloride were detected in Mattawoman Creek surface water (S57SW010) downgradient of the Site 57 storm sewer outfall. Cis-1,2-dichloroethene and diethyl ether were also detected in sediment at this location (S57SD006). The results indicate that

chemicals from Site 57 may be migrating to Mattawoman Creek through the storm sewer outfall or from the stream that passes through the site that flows into the creek.

2.2.6 Lab Area – Sites 14, 15, 16, 49, 50, 53, 54, and 55

The Lab Area is located in the northeastern area of IHDIV-NSWC (see Figure 2-2). Sites 14, 15, 16, 49, 50, 53, 54, and 55 are collectively referred to as the Lab Area as a result of similar historic usage, the sharing of sewer utilities, and overlapping field investigations.

Site 14, the Waste Acid Disposal Pit, was described in the Initial Assessment Study (NEESA, 1983) as a former chemical disposal pit within fenced-in area located 50 feet northeast of Building 881 and 75 feet northwest of Building 444. According to that description, undetermined quantities and types of waste acids and chemicals were collected and discarded in the 15- to 20-foot deep pit. In 1975, the pit was excavated and filled with concrete up to a depth of approximately 5 feet below ground surface (CH2M Hill, 2003). It has been reported that the Chemical Disposal Pit (Site 49) was subsequently constructed on top of the Site 14 location (CH2M Hill, 2003).

Site 15, Mercury Deposits in Manhole, Fluorine Lab, is the location of the Fluorine Laboratory (Building 502) and the Surveillance/Sample Control Building (Building 103) facilities, constructed in 1942 and 1902, respectively. Building 502 housed a laboratory to develop, provide, and analyze bench scale quantities of experimental chemicals and fuels. Building 103 contained facilities to analyze raw materials and manufacturing propellants for surveillance tests. The wastewater from Buildings 502 and 103 was discharged through underground pipes and combined in a storm drain manhole approximately 100 feet from Building 502. The manhole received wastewater discharge four days per week between 1942 and the late 1980s. The average flow rate was estimated at 1,150 gallons per day. From that manhole, the wastewater flowed generally toward the west, to a manhole located approximately 60 feet east of Building 268. Then the wastewater flowed generally south for approximately 3,800 feet via several segments of 24-inch diameter pipe, first of cast iron, then of vitrified clay, passing through IW06 (later redesignated as IW80) approximately 800 feet prior to discharging into Mattawoman Creek. Contaminants known to be in the wastewater included mercury, lead, total suspended solids, and oil and grease. In 1985, a drain line from two sinks that discharged to soil beneath Building 103 was discovered. The surface soil under Building 103 was designated as Site 50 and is discussed below.

Site 16, Laboratory Chemical Disposal, Building 600, consists of the sewers draining the Research and Development Building (Building 600). Built in 1944, Building 600 contained chemical research laboratories and division offices. Waste chemicals were reportedly disposed of into the plumbing system where they combined with sanitary sewage and flowed to the sewage treatment plant. Chemicals used in quantities which exceeded 10 gallons per year included acids, amines, cyanide compounds, and

chlorinated and non-chlorinated solvents. Other materials used in smaller quantities included alkalis, alcohols, aldehydes, metals and metal compounds (including cadmium, iron, lead, mercury, and zinc), and asbestos. Each individual laboratory within Building 600 generally maintained an area for disposal of waste materials. Each laboratory generated very small quantities of wastes that were typically collected and disposed of through on-site units, such as the burn point, or containerized and transported to the permitted RCRA hazardous waste storage facility in Building 455. The wastes managed at Building 600 were laboratory wastes including acetaldehyde, acid (hydrochloric and sulfuric), acrylonitrile, butyl acetate, carbon tetrachloride, chlorine, chloroform, cyclohexane, dimethyl formamide, dimethylamine, dioxane, methyl chloride, pyridine, and toluene. Analysis of wastewater from Building 600 detected amines, cyanides, metals (cadmium, copper, lead, mercury, silver, and zinc), methylene chloride, nitrate esters, and trichloroethene.

Site 49, Chemical Disposal Pit, which is located northwest of Building 444, consists of a circular concrete pit, approximately 2.5 feet in diameter and 3 feet deep. The pit was designed to dispose laboratory containers without exposing personnel to the contents. The containers were placed on a steel grate in the pit. A metal plate was dropped on the containers. The fragments of shattered glass were caught in a wire basket below the steel grate, and the contents of the containers collected in the bottom of the pit and drained from the pit to the sanitary sewer system. The pit reportedly received limited use until the early 1970s when the container crushing hardware was removed. The Chemical Disposal Pit was removed in 2001.

Site 50, Building 103 Crawl Space, is a small, one-story building with a concrete block foundation, built in approximately 1902. Laboratory equipment containing mercury has been reportedly used in Building 103 at different times. In 1985, while replacing two sinks in Building 103, workers discovered that the sinks connected to a single drain line that discharged directly to the soil beneath the building rather than to the storm or sanitary sewer system. The sinks now discharge to a manhole. The quantity of solvents and mercury discharged to the soil from 1902 to 1985 is unknown. The crawl space below Building 103 is unpaved. A small ditch along the west wall of the crawl space drains to a shallow depression in the southwest corner, forming a collection point for runoff.

Site 53, Mercury Contamination in the Sewage System, consists of the sewage system from the Lab Area. The sewage system consists of storm sewer and sanitary sewer lines from several buildings in the area. According to IHDIV-NSWC Public Works personnel, all sewage generated by the Lab Area was piped directly to Mattawoman Creek starting in the early 1900s. This practice was altered in the early 1960s when the sanitary and storm sewer systems were separated. The Sewage Treatment Plant No. 2 (STP 2) was brought on-line in the early 1970s allowing lab area sanitary sewage to be treated prior to discharge. In the 1980s, Sewage Treatment Plant No 1 (STP 1) was upgraded and pump stations

constructed to supplement the aging STP 2. When the STP 2 was taken off-line in 1985, the sanitary sewage treated there was redirected to STP 1. In the early 1990s, Industrial Wastewater Treatment Phase I System (IPWS) was constructed to receive operations wastewater from Buildings 103 and 502 for analysis before discharge to STP 1. Storm water from the Lab Area flows to a manhole and then flows to an outfall on Mattawoman Creek. Laboratory workers from Building 102 reported that approximately 1 liter of mercury was lost per month down the sinks. Over the 77-year period that the Building 102 laboratory operated without mercury traps on sinks (1909 to 1986), mercury could have been discharged to the drain lines. Additional quantities of mercury may have been disposed down the drain lines from similar mercury handling and disposal practices at the other laboratory buildings within the Lab Area. Mercury was recovered in 1969 from a storm sewer manhole located south of Building 103, and in 1989 from a sanitary sewer manhole located west of Building 102. Both manholes have drain line connections to Building 102. No visible mercury was discovered in other manholes near and down-line of the laboratory buildings, and these manholes have been regularly inspected for signs of visible mercury. In addition, the sewer lines in the area of Building 102 were blocked with sandbags, and mercury traps were installed on the lines. In 1988, a video survey found the sewer lines near the laboratory buildings to be in poor condition and in need of repair or replacement. Several of the most damaged runs of the sanitary sewer were lined between 1988 and 1998. Free phase mercury was reportedly encountered by a contractor making repairs to the sewer system in 1998. A site inspection report completed in 1994 included the collection of sediment from lab area manholes and subsurface soil samples, and concluded that contamination (especially mercury) entering the soil system via the sewer lines would be limited in extent to the soil in contact with the joints and/or fractures in the pipes due to the natural soil properties. A field investigation completed in May of 2001 included the collection of samples from surface soil, subsurface pipe bedding soil, sewer sediment, and wetlands surface water and sediment. The subsequent report concluded that precipitation causing leaching of contaminants from the surface soil to the subsurface soil, overland flow transport of constituents, and volatilization of constituents (i.e., mercury) are the primary mechanisms of contaminant transport at the site (CH2MHill, 2001).

Site 54, Building 101 Mercury Contamination, is located in the Lab Area. In the mid-1980s, mercury droplets and an organic solvent odor were detected in the basement office when solvents were discharged through the pipe system, suggesting a potential leaky drainage pipe. In 1990, several droplets of mercury were discovered on steam pipe insulation in the basement. Mercury was detected in wipe samples and samples of bulk building material.

Site 55, Building 102, is located in the center of the Lab Area. Building 102, constructed in 1909, was used as a laboratory for testing nitrocellulose. Mercury-containing equipment was used to determine the densities and sensitivity of propellants throughout the 80 years of laboratory operations in Building 102. Floor drains in the basement were plugged in the early 1980s to prevent the release of mercury in case of

a spill. In 1986, mercury was detected in sink drains when mercury traps were installed. In 1987, metallic mercury was dripping from the basement ceiling. The source was believed to be equipment located on the first floor. Building 102 was abandoned in 1989, and the water supply to the building was terminated to help alleviate high mercury levels in the sanitary sewage sludge. Mercury was detected in wipe samples and samples of bulk building material.

Most of the structures in the Lab Area have been used as laboratories or chemical storage at one time or another during their history. Accounts of various personnel, currently or formerly employed in the labs, have indicated that historical practices, such as disposing unusable chemicals directly on the ground surface outside laboratory doors, may have led to surface soil contamination in the Lab Area. Therefore, the investigative scope was expanded to include other buildings in the Lab Area. This includes buildings 108, 108A, 303, 304, 444, 555, 556, 596, and 1348. There is limited historical information for these buildings. Samples have been collected at the Lab Area as a result of numerous previous investigations. The following paragraphs summarize results reported in the Lab Area RI Report (CH2MHill, 2002).

Surface soil contained one VOC (trichloroethene) at low concentrations and several SVOCs widely distributed through the Lab Area. The following SVOCs were detected at high concentrations: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, butyl benzyl phthalate, chrysene, di-n-butyl phthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. Four energetics (2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, HMX, and nitrocellulose) were detected in surface soil. The metals of most concern in surface soil are arsenic, lead, and mercury. The highest concentrations of metals and the largest number of detections were generally in samples collected around Buildings 102 and 103 and around other buildings in the eastern part of the Lab Area. Surface soil contaminants could migrate to subsurface soil and groundwater by infiltration, to local surface water and sediment by surface water runoff, and to the storm sewer by surface water runoff.

Subsurface soil samples were collected from the approximate depth of the sewer bedding, and sediment samples were collected from sewers. None of the sediment samples associated with the Lab Area were collected in Mattawoman Creek. Subsurface soil and sewer sediment samples contained few VOCs. Low concentrations of cumene, tetrachloroethene, and trichloroethene were observed in two subsurface soil samples, and low concentrations of tetrachloroethene were found in two sewer sediment samples. Five SVOCs [bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, diethylphthalate, and pyrene] were detected in subsurface soil samples. Fourteen SVOCs [3-methylphenol, 4-methylphenol, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, chrysene, di-n-butyl phthalate, diethyl phthalate, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene] were detected in sewer sediment. The energetics nitrocellulose and 4-nitrotoluene were detected; however, the data did not suggest that there is significant

energetics contamination as a result of leaky sewers or manholes. Arsenic, copper, iron, lead, mercury, vanadium, and zinc were detected in subsurface soil at concentrations above facility background levels. The metals of most concern in subsurface soil and sewer sediment are arsenic, lead, and mercury. Mercury concentrations were elevated in every sewer sediment sample, with some correlation to subsurface soil samples associated with the manholes, suggesting that mercury contamination in the subsurface soil occurred as a result of leaks from the sewers.

One surface water sample was collected from the emergent wetland within the limits of the Lab Area. No SVOCs or energetics were detected. Metals of concern include arsenic, lead, and mercury. The arsenic concentration in the surface water correlates with the elevated arsenic concentrations in the surface soil.

Two sediment samples were also collected from the emergent wetland. The only SVOC detected was di-n-butyl phthalate. No energetics were detected. Metals of concern include arsenic, lead, and mercury. Lead in the emergent wetland sediment likely resulted from storm water runoff from surface soil. Mercury deposited in the emergent wetland resulted mainly from surface water runoff and soil erosion.

The Lab Area is located more than 2,000 feet from Mattawoman Creek. No samples of Mattawoman Creek surface water or sediment were collected specifically for the investigation of the Lab Area. However, contaminants might have discharged to Mattawoman Creek via the sewer until the sewer was re-routed to a Wastewater Treatment Plant.

2.3 NATURE AND EXTENT OF CONTAMINATION IN MATTAWOMAN CREEK

Several investigations have been conducted within Mattawoman Creek, within tributaries discharging to Mattawoman Creek, and within on-shore sites that may have contaminated Mattawoman Creek through surface runoff, groundwater discharge, or other potential transport pathways. Section 2.2 discussed the compounds detected at IHDIV-NSWC sites that may be sources of contamination in Mattawoman Creek. In addition to those studies, the U.S. Fish and Wildlife Service (USFWS) conducted a series of investigations in Mattawoman Creek. The results of these studies are summarized below.

The USFWS collected sediment and fish samples as part of several studies in Mattawoman Creek from 1987 through 1991, although not all media were collected during each study. In 1986, IHDIV-NSWC asked the USFWS to perform a 5-year study of mercury accumulation in Mattawoman Creek fish. In response to this request, the USFWS collected bluegill, largemouth bass, and channel catfish at two sampling stations in Mattawoman Creek annually for 5 years, beginning in 1986. One sampling site was located at Marsh Island and one was located at an upgradient location just downstream of the Highway 225 Bridge over Mattawoman Creek. The conclusions from the sampling and analysis are summarized in the following paragraph.

In 1987, 1988, and 1999, total mercury concentrations in Mattawoman Creek fish in the vicinity of the IHDIV-NSWC were not significantly different than those at the upgradient reference station. In 1990, total mercury concentrations in Mattawoman Creek largemouth bass and bluegill in the vicinity of IHDIV-NSWC were not significantly different than those at the upgradient reference station, but channel catfish concentrations were significantly higher than at the upgradient station. In 1991, an additional reference site in Nanjemoy Creek was added to the sampling scheme. Total mercury concentrations in Mattawoman Creek channel catfish and bluegill in the vicinity of IHDIV-NSWC were not significantly different than those at the upgradient reference station, but largemouth bass concentrations were significantly higher than at the upgradient station. Mercury concentrations in bluegill from the upgradient site were higher than in bluegill collected at the Marsh Island site and the Nanjemoy Creek reference site. All Marsh Island fish had mercury concentrations below 1 mg/kg during all rounds, with the exception of one largemouth bass sample.

USFWS also conducted a study in 1989 to gauge the effectiveness of the IHDIV-NSWC National Pollution Discharge Elimination System (NPDES) permit. Analyses included measurement of metal residues in sediment and in several species of fish, clams, and aquatic vegetation. Bioassay tests using Mattawoman Creek surface water were conducted with larval fathead minnows, *Ceriodaphnia dubia*, and Microtox bacteria. Histopathological analyses of fish tissue were also conducted. Based on several factors, including bioaccumulation potential and suspected Mattawoman Creek contaminants, biota were analyzed for cadmium, copper, mercury, selenium, and zinc, and sediment was analyzed for chromium, silver, and arsenic. Analyses were conducted on samples collected near Marsh Island and upgradient of IHDIV-NSWC, near the Highway 225 Bridge. The study concluded the following:

- Marsh Island sediment samples contained higher concentrations of arsenic, chromium, lead, selenium, silver, and zinc than upgradient samples.

- Metal concentrations in fish, clams, and aquatic plants were not significantly different among sites, with the exception of elevated copper in aquatic plants near the IHDIV-NSWC.

- Bioassay tests showed no significant toxic effects of short-term exposure to ambient water near the IHDIV-NSWC.

- Fish histopathological results indicated that fish health might be negatively impacted near the IHDIV-NSWC.

2.4 CONTAMINANT/SEDIMENT TRANSPORT WITHIN MATTAWOMAN CREEK

Figure 2-2 is an aerial photograph of the Study area in Mattawoman Creek. As can be observed from the figure, the creek appears to flow along a distinct channel in Areas 3, 4, 5, and 6. However, the channel is not visually defined in Areas 1 and 2. The creek channels would tend to limit the amount of sediment that would be transported from the northern side of the creek (IHDIV-NSWC shoreline) to the southern side of the creek, and would cause the sediment to be transported in a more upstream and downstream direction.

In 1985, a Water Quality Assessment of Mattawoman Creek and the Adjacent Potomac River was conducted (MOEP, September 1986). Based on water quality measurements, the study reported that salt is being transported in Mattawoman Creek to about river mile (rm) 8.0, which is located approximately 1 mile upstream of Area 6. Therefore, it is possible for chemicals from the lower portions of Mattawoman Creek to be transported upstream by tidal action. The report also indicated that the configuration of the creek and the numerous marshes between rm 4.0 and 7.0 may be responsible for retarding the tidal influence of the Potomac (MOEP, September 1986).

As noted in the trip report for the August 2002 pilot study sampling event, many locations along Mattawoman Creek were rocky and sandy, and the fine-grained sediments were absent. Therefore, sediment transport from these areas would be limited. Table 3-7 in Section 3 presents the particle size distribution results for samples collected during the September 2002 main sampling event in Mattawoman Creek. Based on the results, it can be seen that although many of the sediment samples consisted of silts and clays, several of the samples consisted of gravel and sand, which typically would not be transported in the water column.

As presented in Section 2.2, the primary sources of the contamination to Mattawoman Creek from IHDIV-NSWC, are surface water runoff, stormwater discharges, and groundwater discharges. These sources would tend to deposit the chemicals along the northern shoreline of Mattawoman Creek. Therefore, although it appears that there is some potential for sediment (and thus chemicals bound to the sediment particles) to be transported throughout the creek, the greatest chemical concentrations of the chemicals would be expected to occur along the northern shoreline.

2.5 CHEMICALS OF POTENTIAL CONCERN (COPC)

Appendix A of the Work Plan (TtNUS, August 2001) presents the list of preliminary COPCs based on previous investigations and potential sources of contamination. The previous investigations/potential sources did not necessarily identify specific chemicals of potential concern, rather they helped to identify classes of chemicals that may be of concern and should be included in the list of analytes for the

Mattawoman Creek investigation. For example, energetics were not previously analyzed for in Mattawoman Creek to any large extent. However, based on site operations, it was determined that energetics should be included in the list of analytes because their presence in Mattawoman Creek was possible. This preliminary list of COPCs was used to determine the chemicals to be analyzed for in each media (i.e., surface water, sediment, tissue). In summary, analyses were conducted for:

- PAHs
- Pesticides
- PCBs
- Energetics
- Metals

2.6 POTENTIAL EXPOSURE PATHWAYS/RECEPTORS

The conceptual site model is designed to diagrammatically identify potentially exposed human and ecological receptor populations and applicable exposure pathways, based on the physical nature of the site, utilization of affected areas, and the potential chemical source areas. A complete exposure pathway has three components: a source of chemicals that can be released to the environment; a route of chemical transport through an environmental medium; and an exposure route or contact point for a human or ecological receptor. Incomplete exposure routes were eliminated from consideration.

2.6.1 Ecological Exposure Pathways/Receptors

Section 2.1 of this report described the ecological receptors that are present or may feed in Mattawoman Creek, while Section 2.2 described the chemicals that may be present in the creek. Based on the assembled information, exposure pathways and receptors for the Mattawoman Creek aquatic habitat were identified and are depicted in the conceptual site model (see Figure 2-1). Chemicals were detected (or potentially are present) in the creek that may cause direct toxicity to aquatic organisms (i.e., metals, PAHs), or may cause indirect toxicity to organisms through the food chain (i.e., pesticides, PCBs). Chemicals in the surface water or sediment may be directly toxic to organisms that are exposed to them, such as fish or benthic invertebrates. Other organisms may be exposed to chemicals by ingesting fish and benthic invertebrates that have accumulated chemicals from the surface water, sediment, or from ingestion. Therefore, the specific ecological receptor groups identified and evaluated as part of this ERA include omnivorous mammals, herbivorous and piscivorous birds, fish, aquatic vegetation, aquatic invertebrates, and benthic invertebrates.

2.6.2 Human Health Exposure Pathways/Receptors

Several potential receptors have been identified under both current and future land use conditions. These receptors were identified by analyzing the interaction of current and anticipated future land use practices and the identified sources of contamination. These receptors are as follows:

- **Construction Worker** – Potential receptor under current and future land use. This receptor class includes adult, civilian personnel involved in a short-term, one-time construction project at the site. Receptors could potentially be exposed to surface water and sediment. Exposure to surface water was limited to dermal contact. Incidental ingestion of surface water during routine work activities is expected to be negligible since surface water is not suitable for use as a drinking water source and any water that comes into contact with the hands would not adhere to the skin for potential transfer from hands to mouth. Construction workers were assumed to be exposed to sediment via incidental ingestion and dermal contact. It should be noted that construction workers are assumed not to use any kind of protective clothing (e.g., waterproof boots and gloves) under this scenario.

- **Adolescent and Adult Recreational Users** - Potential receptor under current and future land use. This receptor group includes off-site individuals who use the site for recreational activities. Recreational users may be exposed to COPCs in surface water through incidental ingestion and dermal contact while swimming. Exposure to sediment was evaluated for incidental ingestion and dermal contact. Recreational users may also be exposed to potentially contaminated fish. Although Mattawoman Creek is used for recreational activities, there are no developed regions such as beach areas in the study area. Consequently, the study area is not suitable for recreational use by young children (ages 0 to 6 years). It is extremely unlikely that two or three year olds will be playing in Mattawoman Creek on the shore of IHDIV-NSWC: therefore, recreational exposures to child recreational users (ages 0 to 6 years old) were not evaluated in the HHRA.

- **Off-Site residents**. Current and future off-site residents who reside on land adjacent to the study area may be exposed to COPCs in surface water and sediment, if they use the site for recreational activities. Off-site residents are considered to be part of the recreational user receptor group, therefore, off-site residents were not evaluated as a separate receptor group.

Future workers could also be exposed to sediment and surface water if dredging occurs in Mattawoman Creek. If dredging did occur, it would most likely involve the use of barges and heavy machinery. Dredge workers would be expected to have very little direct contact to surface water and sediment. Consequently, potential exposures to future dredge workers are expected to be less than those to a construction worker.

A summary of the anticipated receptors and exposure routes is provided in Table 2-2. Two variations of each receptor are considered in this baseline risk assessment: the reasonable maximum exposure (RME) receptor and the central tendency exposure (CTE) receptor.

Traditionally, exposures evaluated in the human health risk assessment were based on the concept of a RME only, which is defined as "the highest exposure that is reasonably expected to occur at a site" (EPA, December 1989). However, more recent risk assessment guidance (EPA, February 1992) indicates the need to address an average case or CTE. In order to provide a full characterization of potential exposure, both RME and CTE are evaluated in the risk assessment for the IHDIV-NSWC. It should be noted that the available guidance (EPA, May 1993) concerning the evaluation of CTE is limited and at times vague. Therefore, professional judgment is exercised when defining CTE conditions for a particular receptor at a site.

TABLE 2-1

PROTECTED SPECIES PRESENT IN MATTAWOMAN CREEK
NSWC INDIAN HEAD, MARYLAND

Common Name	Scientific Name	Federal Status	State Status*
Flora			
Twining bartonia	*Bartonia paniculata*	No Status	No State Status
Tickseed sunflower	*Bidens coronata*	No Status	No State Status
Swamp beggar-ticks	*Bidens discoidea*	No Status	No State Status
Pumpkin ash	*Fraxinus profunda*	No Status	No State Status
Coolwort	*Pilea fontana*	No Status	No State Status
Wafer-ash	*Ptelea trifoliata*	No Status	No State Status
Pussy willow	*Salix discolor*	No Status	No State Status
Fauna			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Least bittern	*Ixobrychus exilis*	No Status	In Need of Conservation

* "No State Status" indicates rarity in the state or within its ranges in the state.

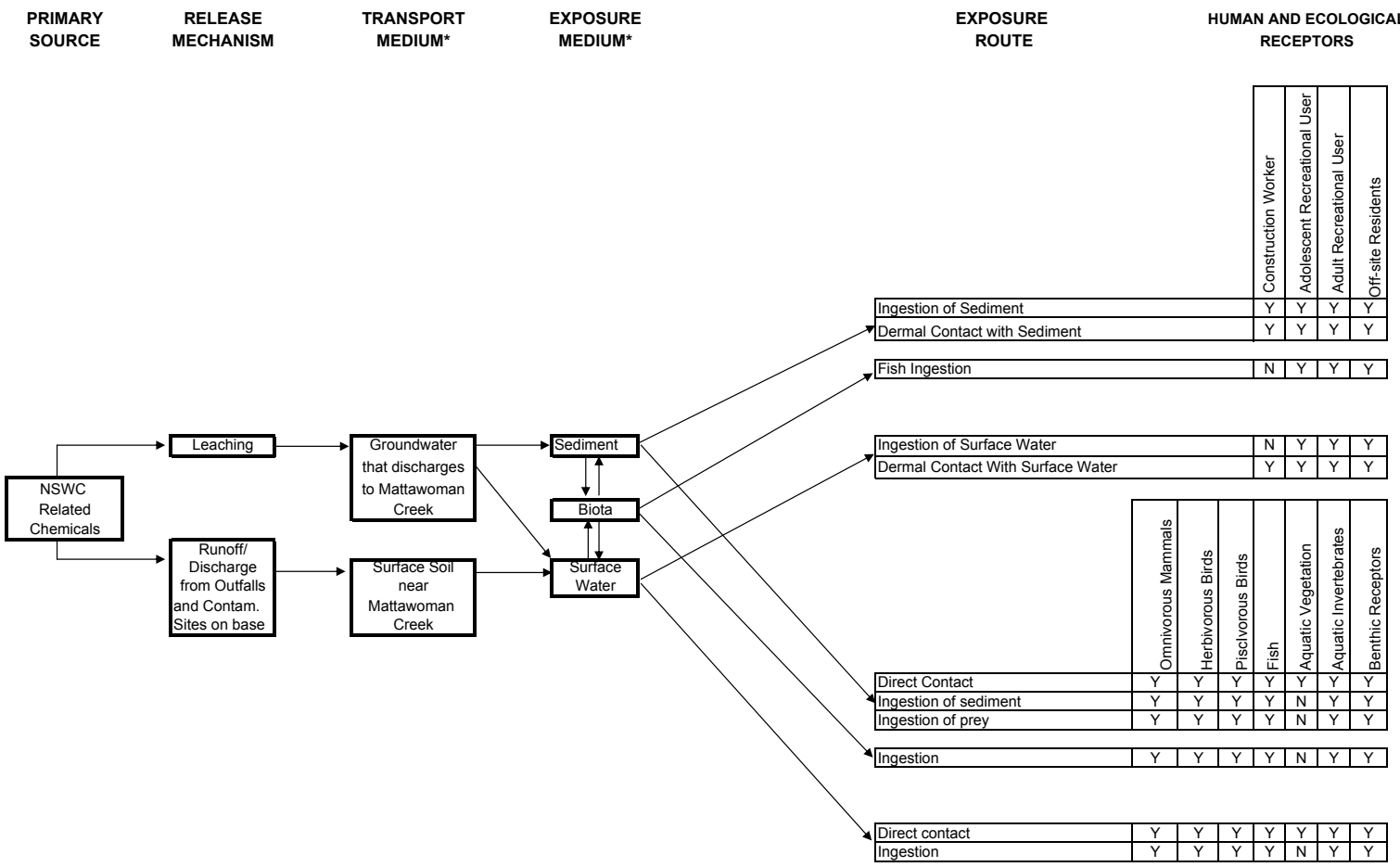
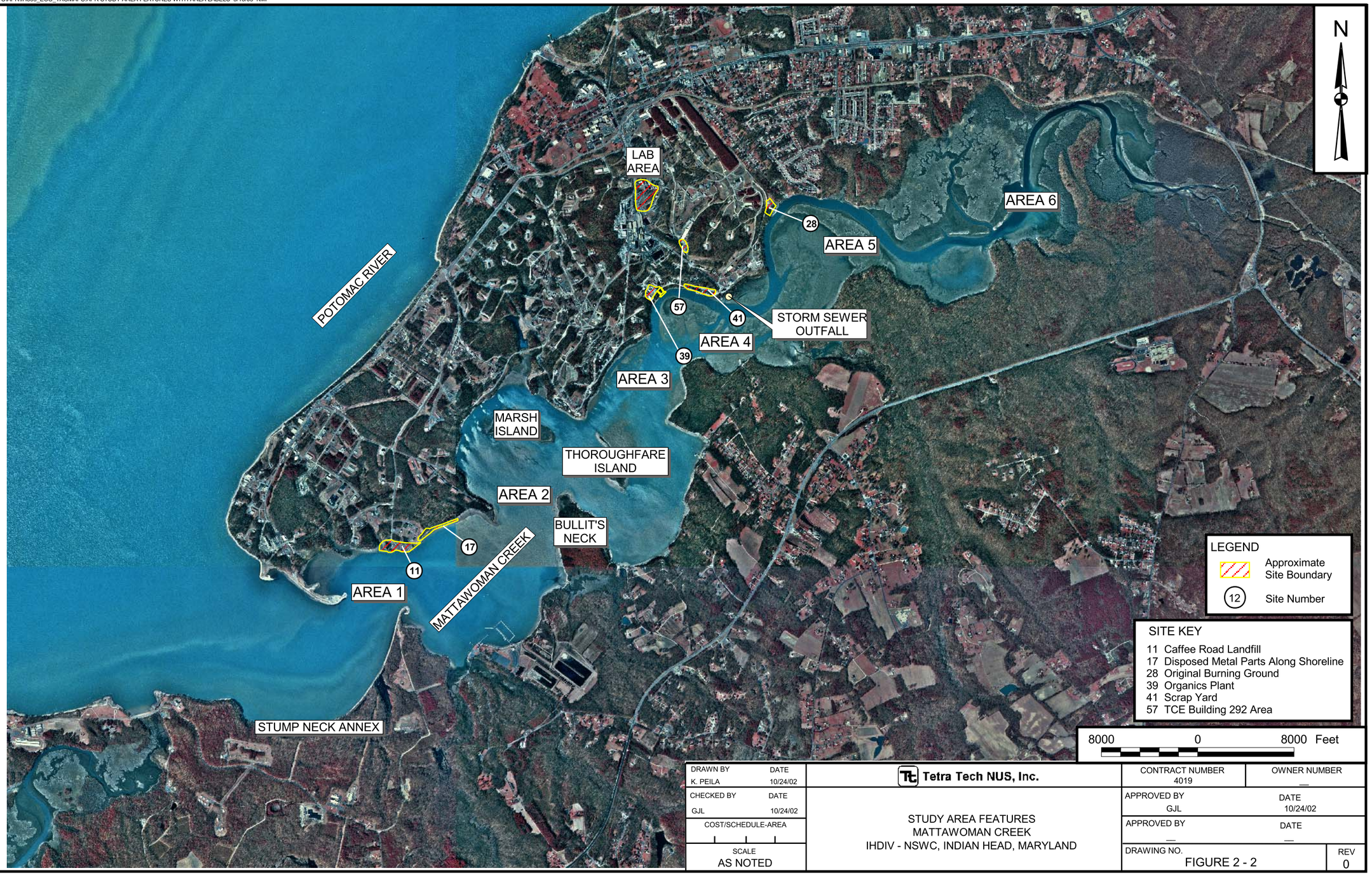


FIGURE 2-1
ECOLOGICAL AND HUMAN HEALTH CONCEPTUAL SITE MODEL
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

P:\GIS\INDIANHEAD_NSWC\APR\IH803_ECO_TAGMAPS.APR STUDY AREA FEATURES WITH AREA LABELS 5/16/03 KMP



DRAWN BY K. PEILA	DATE 10/24/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 10/24/02	STUDY AREA FEATURES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 10/24/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 2 - 2 / REV 0

3.0 FIELD INVESTIGATION PROCEDURES/OBSERVATIONS

This section describes the field investigations conducted for the Mattawoman Creek Study. Sampling and analytical protocols are summarized. The sediment toxicity testing and benthic invertebrate survey protocols are also discussed. Observations recorded by the field sampling teams are presented.

As discussed in the Work Plan for Mattawoman Creek (TtNUS, August 2001), the study area was divided into five general areas (Areas 1 through 5), based on information gathered during past environmental investigations, the locations of IRP sites, habitat information and/or discussions/site visits with the IHIRT and the BTAG. These general areas and two background or reference areas (Areas 6 and 7) are displayed in Figures 3-1 and 3-2. Background Area 6 is located along the Mattawoman upstream of general areas 1 through 5. Reference Area 7 (also evaluated as background) is located along Nanjemoy Creek.

Prior to the main field sampling event conducted by TtNUS, the Navy's Space and Naval Warfare Systems Center (SPAWAR) conducted a screening investigation of the sediment that was termed a Rapid Sediment Screening Pilot Study. The objective of the rapid screening sampling, conducted August 15-18, 2001, was to have data available to aid in the selection of samples for the main field sampling event that was conducted September 5-10, 2001. Unless otherwise noted, the rapid screening assessment was conducted in accordance with the SPAWAR Mattawoman Creek sampling and analytical protocol (Neptune, 2001), and the main field sampling event was conducted in accordance with the Work Plan for Mattawoman Creek (TtNUS, August 2001). The following subsections provide procedures and observations for these two field investigations.

3.1 RAPID SEDIMENT SCREENING ASSESSMENT

The SPAWAR field event was comprised of sediment sample collection for chemical analysis of selected metals, total PAHs, and total PCBs. The sampling was conducted to obtain a better understanding of the extent of sediment contamination in Mattawoman Creek with emphasis on the portion of Mattawoman Creek near the IHDIV-NSWC. The resulting data provided a guide for identifying locations for biological and toxicological samples that were collected as part of the main field investigation. Surface water samples were not collected as part of rapid field screening.

3.1.1 Field Sampling Methods (SPAWAR)

Samples were collected from a boat using a petite ponar. The ponar was lowered to the sediment surface, and a grab sample was collected from the upper sediment stratum. Thick vegetation and/or

rocky substrate influenced some of the sample locations. All sampling locations are displayed on Figure 3-3. Sample location coordinates were determined using Global Positioning System® (GPS).

A total of 44 samples were collected mostly from areas judged to have the greatest potential for facility related contamination. Samples were collected primarily, though not exclusively, along the length of the Mattawoman Creek shoreline near the IHDIV-NSWC main area.

Four samples were collected upstream of the study area (for background purposes) and in Nanjemoy Creek (the reference area for this study). The upgradient sample locations identified in Mattawoman Creek appeared to be similar ecologically and hydrologically to the downgradient areas near the base. The upgradient area constituted a distinct upper arm of Mattawoman Creek. This area was approximately halfway between Slavin's Dock and the Rt. 225 Bridge. Hydrilla was present, indicating that this proposed target species for sampling of aquatic vegetation could be collected there (for background purposes) during the main field event.

3.1.2 General Sampling and Observations

This section discusses the environmental sampling conducted during the screening sampling event and includes field observations reported by the field sampling team. The samples collected during the screening sampling event are listed, area by area, in Table 3-1 and displayed in Figure 3-3. In overview, the field team reported qualitative evidence of a healthy ecology in the Mattawoman Creek Study Area. Extensive emergent and submerged vegetation was observed. Raptors (e.g., eagles, ospreys), wading birds, fish and herptiles were also frequently noted during the field sampling event. Frequent human use of Mattawoman Creek was also noted. (Pleasure boats were moored near Sweden Point; fisherman and skiers were observed recreating on the Creek.)

Field sampling included water depth measurements and surface water physical parameters, including salinity, dissolved oxygen (DO), pH, specific conductance, salinity, and temperature at all sediment sampling locations.

3.1.2.1 Areas 1 and 2 Along Cornwallis Neck – Sampling and Observations

Sediment samples were collected from five locations within Area 1 (MTCSD17, 19, 20, 23, and 26). With the exception of the substrate conditions at the bend at the end of the Cornwallis Neck, the substrate in this general area is the hardest, rockiest encountered on the main area portion of Mattawoman Creek.

Sediment samples were collected from eight locations within Area 2 (locations MTCSD30, 32, 38, 39, 40, 42, 45, and 47).

Hydrilla beds were extensive in Areas 1 and 2, especially south of Marsh Island and in the bend at the tip of the Cornwallis Neck. Sampling in these areas was conducted at high tide to facilitate access by boat. The shore at some locations within Areas 1 and 2 was rocky and sandy, indicating the possible absence of fine-grained sediments, especially along Area 1. Surface water depths near shore and near the emergent vegetation varied from 2 to 4 feet. Intensive hydrilla beds were observed near shore in Area 1 and away from shore in Area 2. Shoreline sampling in Areas 1 and 2 was extremely difficult because of rocks and gravel; some samples were collected by hand. Very little organic or fine-grained sediment was noted in Areas 1 and 2.

3.1.2.2 Stump Neck Annex Area 1 – Sampling and Observations

Sediment samples were collected from four locations along Stump Neck Annex shoreline in Area 1 (locations MTCSD07, 11, 13, and 15). Two samples were collected at and near the discharge of the large creek west of the marina (MTCSD13 and 15). Samples were collected from the confluence of the large creek west of the marina and Mattawoman Creek, and in the wetlands adjoining Mattawoman Creek (near sample MTCSD011). These locations were determined in the field to be the most critical sampling areas.

Area 1 also includes a shoreline area along the Stump Neck Annex Peninsula. The shoreline and substrate in this area is rocky and sandy, and the field sampling team noted some scouring of the creek bed. The shoreline area near Sweden Point was heavily scoured and hard-packed, almost “beach-like.” These conditions made sampling nearly impossible with the ponar device. Consequently some sediment samples were collected from the shoreline. Hydrilla was less prevalent in this portion of Area 1 than in other Mattawoman Creek study areas. No IRP sites are present in this portion of Area 1.

3.1.2.3 Area 3 Sampling and Observations

Sediment samples were collected from five locations within Area 3 (MTCSD55, 56, 57, 58, 59, 63). A sheen was observed in sample MTCSDFS063.

Dense Hydrilla growth was observed in Area 3, especially near shore, such that the sampling of near shore locations by boat was difficult. Samples in these areas were collected at high tide to facilitate access by boat. The Area 3 shoreline was rocky and sandy, indicating the possible absence of fine-grained sediments. Depths near shore and near the emergent vegetation varied from 2 to 4 feet. Sampling conditions similar to those observed for Areas 1 and 2 were reported for Area 3.

3.1.2.4 Areas 4 and 5 Sampling and Observations

Samples were collected from six locations in Area 4 (MTCSD60, 62, 64, 65, 67, and 68). One proposed sediment sample was not collected because a petroleum spill had recently occurred on the facility near the creek outfall in the vicinity of the proposed location. Therefore, access to the proposed location was prevented by booms deployed by the Navy to contain the spill. A sheen was not evident on the surface water of the creek; however, a slight sheen was observed on the sample from location MTCSD68. Shoreline sampling in Area 4 was extremely difficult due to the rocks and gravel. Very little organic or fine-grained sediment was found; some samples were collected by hand. The field sampling team had difficulties locating the Site 39 outfall.

Samples were collected from seven locations in Area 5 (MTCSD70, 71, 72, 73, 75, 76, and 77). The collection of near-shore samples was difficult because of the rocky, gravelly substrate; some near-shore samples were collected by hand. The substrate near the emergent vegetation beds was fine-grained; however, sediment sampling with the ponar sampler was difficult because of the thick beds of Hydrilla.

Harrison Cut empties into Mattawoman Creek slightly upstream of Area 5. WWTP effluents discharge to this stream. The near-shore sediment substrate is sandy. However, multiple ponar samples were necessary because of the pebbles and sticks present in the sediment substrate. Two sediment samples were collected near Harrison Cut (MTCSD82 and 83). Surface water depths were approximately 2 to 4 feet near shore.

The Hydrilla growth was extremely dense in Areas 4 and 5, both near shore and away from shore. The Hydrilla beds extended out from the shoreline and out from the areas of emergent vegetation in the creek. Water depths near shore and near the emergent vegetation varied from 2 to 4 feet. The shoreline was rocky and sandy, indicating the possible absence of fine-grained sediments.

3.1.2.5 Area 6 (Upgradient Area in Mattawoman Creek) Sampling and Observations

Area 6 is an upstream area along Mattawoman Creek. The area is approximately halfway between Slavin's Dock and the Rt. 225 bridge and appears to be similar ecologically and hydrologically to the downstream areas (Areas 1 through 5).

Four sediment samples were collected from Area 6 (MTCSD78 through 81). Three of the sediment samples were collected in the upstream portions of the arm of the creek and were relatively fine-grained. The fourth sample was collected in the vicinity of the main channel and was coarser-grained.

3.1.2.6 Area 7 (Reference Area in Nanjemoy Creek) Sampling and Observations

An arm of Nanjemoy Creek was selected as a reference area for the Mattawoman Creek Study. Four sediment samples were collected from Area 7 (NJCSD01 through 04). Three of the four samples collected in Nanjemoy Creek were within the arm of the creek and were relatively fine-grained, while the fourth was collected closer to the main channel and one was coarser-grained (this was also similar to the four upgradient samples in Mattawoman Creek).

The field sampling team reported that Hydrilla was generally less prevalent along Nanjemoy Creek than along Mattawoman Creek, especially in the most downstream areas. Surface water depths were similar to those observed in Mattawoman Creek. Most of the emergent vegetation was *Spartina*; limited *Spartina* was observed in Mattawoman Creek. The salinity reading reported for Nanjemoy Creek was approximately 0.4 percent. Reference GPS points were taken at the end of the Friendship Landing dock at the pylon located at the mouth of the arm of Nanjemoy Creek that was sampled.

3.1.3 Analytical Methods

This section discusses the laboratory methods used to analyze the environmental samples collected during the initial field investigation. All rapid screening samples were analyzed according to the SPAWAR methods specified in the field screening assessment Work Plan for Mattawoman Creek (Neptune, August 2001). All samples collected during the initial field investigation were shipped to SPAWAR's laboratory in San Diego, CA, on August 18, 2001. A limited number of confirmation samples were sent to a fixed-base laboratory as a quality assurance measure.

Metals concentrations (iron, copper, zinc, lead, nickel, chromium) in the rapid screening sediment samples were determined using x-ray fluorescence (XRF) analysis. Total PAH values were determined using ultraviolet fluorescence (UVF) analysis. Total PCB values were determined using various SPAWAR immunoassay methods. A complete description of these methods and their detection limits were included in the field screening assessment Work Plan for Mattawoman Creek (Neptune, 2001).

Split samples were collected for approximately 10 percent of the rapid screening samples. Fifteen samples and 2 field duplicate samples from Mattawoman Creek, and two samples from Nanjemoy Creek, were sent to Battelle Laboratories for confirmation analysis.

3.1.4 Use of Rapid Screening Data

The rapid screening samples were collected from Mattawoman Creek and subjected to less rigorous analytical protocols than is customarily the case with samples analyzed in a fixed-base laboratory.

Although the quality of the screening data analyses was reinforced by the use of confirmation analyses conducted in a fixed-base laboratory, the confirmation analytical results were not subjected to a third-party validation process and therefore were not available for use in the ecological and human health risk assessments.

This section describes how the rapid screening data were used to help select sample locations for the main sampling event and how the data were used in this document. The rapid screening investigation was conducted several weeks prior to the main field sampling event. Results of the rapid sediment study were used in both quantitative and qualitative manners in designing the work plan. For example, during sample collection, the field crew used information derived during the rapid sediment study regarding the sediment type. As indicated by the notes in the Field Screening Trip Report, many of the proposed sediment locations were very rocky and/or had significant amounts of gravel. Therefore, this information was used to indicate where samples should not be placed.

The analytical data also were used to select locations for samples during the main sampling event. The only rapid screening sample with relatively high metal concentrations was MTC77. This sample corresponds with MTCSD026 which was collected during the main sampling event. Also, the two rapid screening samples with the greatest PCB levels (MTC23 and MTC68) correspond with samples MTCSD004 and MTCSD020 which were collected during the main sampling event. Finally, the three rapid screening samples with the greatest PAH levels (MTC23, MTC40, and MTC68) correspond with samples MTCSD004, MTCSD010 and MTCSD020 which were collected during the main sampling event. All four of those samples (MTCSD004, 010, 020, and 026) also were included among the samples subjected to toxicity testing and benthic invertebrate sampling.

The confirmation data from the rapid screening study were not added to the electronic database because the confirmation data were not validated. Table 3-2 lists the SPAWAR samples (i.e., rapid screening samples) where confirmation analyses were conducted, along with the co-located sample from the main sampling event. As indicated in the table, confirmation analyses were conducted on approximately 35 percent of the screening samples. Samples were collected from the main sampling event at all but four of the locations where the SPAWAR confirmation analyses were conducted and two of those locations were at the upgradient location (Area 6). Note that several samples were collected during the main sampling event where confirmation samples were not collected. Therefore, adding the four additional confirmation samples to the database would not significantly add to the spatial distribution. Finally, the analytical methods used for confirmation samples and main sampling event samples were different, so the results of the analysis may not be directly comparable, and not all of the analytes are the same between the confirmation samples and main sampling event samples. However, the rapid

screening data were used to supplement the extent of contamination as indicated on Figures 4-12 through 4-21 in Section 4 of this report.

3.2 MAIN SAMPLING EVENT

The main field investigation for the Mattawoman Creek Study was conducted September 5-10, 2001. In overview, the following sampling activities were completed:

- Surface water samples (32) and sediment samples (32) were collected for chemical analysis by a fixed-base laboratory.

- Fish filet and whole-body fish samples (33) were collected for chemical analysis by a fixed-base laboratory.

- Sediment samples were collected for toxicity tests (28) and for a benthic invertebrate survey (23).

All sampling locations are displayed on Figures 3-3 and 3-4. The samples collected within each study area are listed in Table 3-3. Spatial coverage within the study area was considered as a criterion for sample locations. Additionally, samples were collected in the vicinity/downstream of the major areas of identified potential impacts and in areas of substantial aquatic habitat that were determined in the field. Sampling locations for the study area were selected based, in part, on the analytical results of the SPAWAR sampling event. Upgradient samples were also collected upstream of the base near the Highway 225 bridge and reference samples were collected in Nanjemoy Creek. Nanjemoy Creek is located along the Potomac downgradient of Mattawoman Creek.

The analytical program for the samples collected during the main field investigation is detailed in Tables 3-4 through 3-6.

3.2.1 Surface Water Sampling

Surface water samples were co-located with the sediment samples which are discussed in Section 3.2.2. All surface water sampling requirements from the project Quality Assurance Project Plan (QAPP) and IHDIV-NSWC Standard Operating Procedure (SOP) SA-02 were met, unless otherwise noted.

3.2.1.1 Surface Water

A sample log sheet (Appendix A) was completed for each sampling point at the time of sample collection. Field measurements (including DO, pH, specific conductance, temperature, and salinity) were recorded at the time of sample collection.

At each sampling location, surface water samples were collected just below the water surface and prior to the collection of sediment samples. Sample containers without preservatives were filled directly from the surface water body. For sample containers with preservative, a clean, unpreserved sample container was used to transfer water from the creek into the preserved sample container. Filtered and unfiltered surface water samples were collected for metals analysis. Immediately after collection, samples were sealed and placed in a cooler at 4°C. Field measurement results are presented in Table 3-7.

A total of 32 surface water samples were collected, plus Quality Assurance/Quality Control (QA/QC) samples. Surface water sampling locations for Mattawoman Creek and Nanjemoy Creek are listed in Table 3-3 and displayed in Figures 3-3 and 3-4, respectively.

Surface water samples were analyzed for SVOCs, VOCs, pesticides, PCBs, total and dissolved metals, cyanide, energetics, chloride, fluoride, hardness, nitrate, nitrite, perchlorate, pH, sulfate, total dissolved solids (TDS), Total Organic Carbon (TOC) and total suspended solids (TSS). Selected analytes for surface water sampling are presented on Table 3-4. The analytes reflect the list of COPCs that was generated during the problem formulation in the Work Plan (TtNUS, August 2001). The analytical results for surface water sampling are discussed in Section 4.1.

3.2.2 Sediment

Sediment samples were co-located with the surface water samples discussed in Section 3.2.1. Locations considered likely to have sediment accumulation (e.g. the inside of bends, behind islands or boulders, quiet shallow areas, or very deep, low-velocity areas) were targeted for sampling. All sediment sampling met requirements of the project QAPP and IHDIV-NSWC SOP SA-02, unless otherwise noted. In all cases, sediment samples for toxicity testing and the benthic macro-invertebrate survey were collected with the samples collected for chemical analysis.

3.2.2.1 Samples for Chemical Analysis

A total of 32 sediment samples were collected and submitted to a fixed-base laboratory for analysis. Sediment sampling locations for Mattawoman Creek and Nanjemoy Creek are listed in Tables 3-3 and displayed in Figures 3-3 and 3-4, respectively.

Sediment samples were collected at a maximum depth of 6 inches using a petite ponar grab. The 0- to 6-inch interval was considered the aerobic zone. Deeper sediments in the anaerobic zone (greater than 6 inches) were not collected.

The sample was placed into a stainless steel mixing bowl for homogenization. Prior to sample mixing, approximately 5 grams of sediment was weighed out for the VOC analysis, and the sediment was transferred into the sample bottle containing methanol. The remaining sample in the mixing bowl was than homogenized by hand. The sample was then divided, and part of the sample was placed in the sample jars for chemical analysis, and for those samples subjected to toxicity tests, another part was placed in a ziploc plastic bag. Immediately after collection, all samples were placed in a cooler at 4°C.

The target chemicals for the sediment samples are identified in Table 3-5. The analytical list reflects the preliminary list of COPCs generated during the problem formulation. The analytical results for sediment chemistry sampling are discussed in Section 4.2. Particle size distribution data for the sediment samples are presented in Table 3-8.

3.2.2.2 Samples for Toxicity Tests

A total of 24 sediment samples (plus four duplicates) were collected and submitted to a laboratory for toxicity testing. As presented in Section 3.2.2.1, the sediment for toxicity testing was a split of the sample for chemical analysis. Sediment sampling locations for Mattawoman Creek and Nanjemoy Creek are listed in Table 3-3 and displayed in Figures 3-3 and 3-4, respectively.

The sediment samples for the toxicity test were collected as presented in Section 3.2.2.1. The Mattawoman and Nanjemoy creek locations selected for sediment toxicity testing are listed in Table 3-9 and displayed in Figures 3-3 and 3-4.

The sediment samples collected for toxicity testing were submitted to Tetra Tech Inc.'s Biological Research Facility in Owings Mills, Maryland, for 10-Day Survival and Growth toxicity testing, using the amphipod *Hyalella azteca .* EPA Test Method 100.1 (EPA, March 2000) (*Hyalella azteca* 10-d Survival and Growth Test for Sediments) was used for the testing. Supplemental guidance for the testing included American Society for Testing and Materials (ASTM) standards (ASTM, 2000), and Tetra Tech Inc. Standard Operating Procedures (TtNUS, January 1997). Survival and growth (as indicated by weight) were the endpoints measured for each sample. The sediment toxicity results are discussed in Section 5.0.

3.2.2.3 Samples for Benthic Community Analysis

A total of 24 sediment samples (plus four duplicates) were collected and submitted to a laboratory for benthic community analysis. The sediment samples for benthic community analysis were co-located with the samples for chemical analysis. Sediment sampling locations for Mattawoman Creek and Nanjemoy Creek are listed in Table 3-3 and displayed in Figures 3-3 and 3-4, respectively.

The sediment samples for the benthic community analyses were collected using a ponar grab. All of the sediment from the grab was sieved through a 500-micron sieve. The sediment remaining on the sieve was transferred to a ziploc bag, which was then filled with denatured alcohol. The sediment macroinvertebrate sampling was conducted in accordance with IHDIV-NSWC SOP SA-09, unless otherwise noted.

All samples were submitted to Pennington and Associates, Incorporated for identification and calculation of various metrics (i.e., total number of organisms, total number of taxa, biotic index and Shannon diversity index). The results of the benthic invertebrate survey are discussed in Section 5.0.

3.2.3 Fish Sampling

Field activities for the collection of fish tissue samples were performed from September 5-9, 2001. TtNUS collected samples in conjunction with personnel from Normandeau Associates who provided the boats and supplemental sampling equipment. As outlined in the Work Plan (TtNUS, August 2001), the objective of this investigation was to collect specific species of fish for the human health and ecological risk assessments that were representative of both human and ecological receptor consumption patterns. The proposed target species were channel catfish (*Ictalurus punctatus*), for both the human health and ecological risk assessments, and mummichog (*Fundulus heteroclitus*) for the ecological risk assessment. These species were selected because they are edible (the catfish) and abundant in Mattawoman Creek, and because they are relatively non-migratory. However, as noted below, these fish were not available in all areas so other fish were collected during the investigation.

Fish samples were collected using a variety of methods including electrofishing, gill nets, fish traps, and minnow traps. Electrofishing was not effective in all areas because of conductivity variations related to the salinity of the water. Only live or recently dead fish (i.e., no bloating, gills still red) were collected and retained for chemical analysis. Upon collection, fish were separated by species and immediately placed on wet ice for processing to include size measurement and weight. Live, non-target fish were not collected during this investigation and were returned to the water. Disabled or expired fish were disposed of in accordance with provisions in the scientific collecting permit issued for this work. As noted above, channel catfish were initially selected as the species for the filet samples analyses because they are likely

to be consumed by humans in the area. However, channel catfish were only found in Areas 1, 3, and 5. Therefore, the following species served as surrogates: white catfish, brown bullhead catfish, large-mouth bass (the most popular species for sport-fishing in the area), and white perch. Mummichogs were initially chosen as the species for whole-body analyses to serve as ecological indicators. However, during sampling, mummichogs were only found in Nanjemoy Creek (Area 7). Therefore, the following species served as surrogates for the mummichogs: pumpkinseed, spottailed shiner, and golden shiner. The shiners and pumpkinseed were selected as appropriate replacements for the mummichogs because they were the only available species in Nanjemoy Creek and they are often used as forage fish for food chain models. The following data were recorded for each fish collected: species, date/time collected, length, weight, and external gross morphological abnormalities (i.e., tumors, skeletal abnormalities).

Fish tissue samples were collected in each of the five identified investigation areas specified in the Work Plan (TtNUS, August 2001). An upgradient location near the Highway 225 bridge was also sampled, as was the reference sampling location in Nanjemoy Creek. Figures 3-3 and 3-4 present the fish sampling locations in Mattawoman Creek and Nanjemoy Creek, respectively. A total of 33 total fish tissue samples were collected for chemical analyses (Table 3-6). Tables 3-10, 3-11, and 3-12 summarize the fish that were collected during the investigation, and list the length and weight of the fish. One catfish from Area 5 had visible sores and a deformity.

As summarized in Table 3-6, fish tissue samples were analyzed for SVOCs, pesticides, PCBs, metals, cyanide, energetics, and perchlorate. The results are discussed in Section 4.3.

3.2.4 Aquatic Vegetation Sampling

Hydrilla was selected as an indicator of the potential for chemical accumulation and potential risks to aquatic vegetation. This species is common throughout Mattawoman Creek, and it is eaten by many types of herbivorous species, including waterfowl.

Samples of leafy tissue were collected using a decontaminated cutting instrument. The samples were composites of samples collected within each investigation area. The samples were placed in new plastic bags, labeled, and stored/transported on wet ice.

The Hydrilla samples were collected in the same general areas as the fish tissue samples. One composite sample was collected from each of the five investigation areas. One upgradient location near the Highway 225 bridge was also sampled, as well as one reference sampling location in Nanjemoy Creek. Vegetation sampling locations in Mattawoman Creek and in Nanjemoy Creek are presented on Figures 3 3 and 3-4, respectively.

Observations of Hydrilla growth in Mattawoman Creek during field activities indicated healthy, extremely dense coverage in the majority of the creek. Hydrilla was prevalent in Mattawoman Creek, but less prevalent at the reference location in Nanjemoy Creek. However, a number of submersed aquatic plants were present in Nanjemoy Creek.

Table 3-6 lists the target analytes and analytical methods for vegetation tissue samples. The analytes were selected based on the preliminary COPC list from the problem formulation. Analytical results are discussed in Section 4.4.

3.3 FIELD PARAMETERS

Field parameters were collected for surface water and consisted of water temperature, salinity, DO, pH, and conductivity measurements. These field parameters are presented in Table 3-7.

A Horiba U-22 water-quality meter/probe was used to collect field parameters. Calibration was documented on an equipment calibration log. During calibration, an appropriate maintenance check was performed on each piece of equipment.

The pH values in Table 3-7 appear to be increasing throughout the day (i.e., pH values collected at the end of the day are significantly greater than the pH values collected earlier in the day). Field notes indicate that the monitoring instrument was calibrated at the beginning of each work day and all other field parameter readings were consistent throughout the day. Therefore, although high pH levels can occur when algae and aquatic vegetation use CO_2 for photosynthesis, it is unlikely that the pH levels that were measured in the stream (10 to 11 standard units) were accurate. It is more likely that the pH sensor was not holding the calibration throughout the work day.

3.4 QUALITY CONTROL PARAMETERS

Sample handling includes the field-related considerations concerning field sample documentation, nomenclature, packaging, shipping, and custody. The aforementioned items were documented and performed in accordance with the Work Plan for Mattawoman Creek (TtNUS, August 2001). Field documentation forms can be found in Appendix A.

In addition to regular calibration of field equipment and appropriate documentation, quality control (QC) samples were generated during environmental sampling activities. The QC samples were collected at a rate described in the Work Plan for Mattawoman Creek (TtNUS, August 2001).

TABLE 3-1

SCREENING SAMPLING AREAS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sampling Area	Location	Sample ID
Area 1	Mattawoman Creek	MTCSDFS07
		MTCSDFS011
		MTCSDFS013
		MTCSDFS015
		MTCSDFS017
		MTCSDFS019
		MTCSDFS020
		MTCSDFS023
		MTCSDFS026
		MTCSDFS028
Area 2	Mattawoman Creek	MTCSDFS030
		MTCSDFS032
		MTCSDFS038
		MTCSDFS039
		MTCSDFS040
		MTCSDFS042
		MTCSDFS045
		MTCSDFS047
Area 3	Mattawoman Creek	MTCSDFS055
		MTCSDFS056
		MTCSDFS057
		MTCSDFS058
		MTCSDFS059
		MTCSDFS060
Area 4	Mattawoman Creek	MTCSDFS062
		MTCSDFS063
		MTCSDFS064
		MTCSDFS065
		MTCSDFS066
		MTCSDFS067
		MTCSDFS068
Area 5	Mattawoman Creek	MTCSDFS070
		MTCSDFS071
		MTCSDFS072
		MTCSDFS073
		MTCSDFS075
		MTCSDFS076
		MTCSDFS077
		MTCSDFS082
		MTCSDFS083
Area 6	Mattawoman Creek	MTCSDFS078
		MTCSDFS079
		MTCSDFS080
		MTCSDFS081
Area 7	Nanjemoy Creek	NJCSDFS01
		NJCSDFS02
		NJCSDFS03
		NJCSDFS04

TABLE 3-2

SPAWAR PILOT STUDY SAMPLES AND CO-LOCATED MAIN FIELD EVENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

AREA	SPAWAR Location	Confirmatory Data Y/N?	Co-located Sample[1]
Area 1	MTCSDFS07	Y	
	MTCSDFS011		
	MTCSDFS013	Y	
	MTCSDFS015		
	MTCSDFS017	Y	MTCSD001
	MTCSDFS019		MTCSD002
	MTCSDFS020		MTCSD003
	MTCSDFS023	Y	MTCSD004
	MTCSDFS026		
	MTCSDFS028		MTCSD005
Area 2	MTCSDFS030		MTCSD006
	MTCSDFS032		MTCSD007
	MTCSDFS038	Y	MTCSD009
	MTCSDFS039		
	MTCSDFS040	Y	MTCSD010
	MTCSDFS042		
	MTCSDFS045		MTCSD011
	MTCSDFS047	Y	MTCSD012
Area 3	MTCSDFS055		MTCSD013
	MTCSDFS056		
	MTCSDFS057	Y	MTCSD014
	MTCSDFS058		MTCSD015
	MTCSDFS059		MTCSD016
	MTCSDFS060		
Area 4	MTCSDFS062		
	MTCSDFS063	Y	MTCSD017
	MTCSDFS064		MTCSD018
	MTCSDFS065		MTCSD019
	MTCSDFS066		
	MTCSDFS067		
	MTCSDFS068	Y	MTCSD020
Area 5	MTCSDFS070		MTCSD022
	MTCSDFS071	Y	MTCSD023
	MTCSDFS072		
	MTCSDFS073		
	MTCSDFS075		MTCSD024
	MTCSDFS076		MTCSD025
	MTCSDFS077	Y	MTCSD026
	MTCSDFS082	Y	MTCSD027
	MTCSDFS083		MTCSD028
Area 6	MTCSDFS078	Y	
	MTCSDFS079		
	MTCSDFS080		
	MTCSDFS081	Y	
			MTCSD029[2]
			MTCSD030[2]
Area 7	NJCSDFS01	Y	
	NJCSDFS02		NJCSD001
	NJCSDFS03		
	NJCSDFS04	Y	NJCSD002

Footnotes:
1 Sample is the main field event co-located sample of the initial screening SPAWAR location.
2 Samples MTCSD029 and MTCSD030 were collected in locations other than SPAWAR locations.

TABLE 3-3

SAMPLING AREAS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Area	Location	Sample Locations	Samples Collected	Type of Sample	Fish Species	Whole Body or Filet
Area 1	Mattawoman Creek	MTC001	MTCSD00101	SD		
			MTCSW00101	SW		
			MTCSW00101-F	SW-F		
		MTC002	MTCSD00201	SD		
			MTCSW00201	SW		
			MTCSW00201-F	SW-F		
		MTC002	MTCSDFD004	SD		
			MTCSWFD004	SW		
			MTCSWFD004-F	SW-F		
		MTC003	MTCSD00301	SD		
			MTCSW00301	SW		
			MTCSW00301-F	SW-F		
		MTC004	MTCSD00401	SD		
			MTCSW00401	SW		
			MTCSW00401-F	SW-F		
		MTC005	MTCSD00501	SD		
			MTCSW00501	SW		
			MTCSW00501-F	SW-F		
			MTCVG001	VG		
			MTCCT00101	F	catfish	filet
			MTCCT00102	F	catfish	filet
			MTCFS001	F	pumpkinseed	whole-body
			MTCLB001	F	largemouth bass	filet
			MTCSS001	F	spottail shiner	whole-body
		MTC029	MTCSD02901	SD		
			MTCSW02901	SW		
			MTCSW02901-F	SW-F		
		MTC030	MTCSD03001	SD		
			MTCSW03001	SW		
			MTCSW03001-F	SW-F		
Area 2	Mattawoman Creek	MTC006	MTCSD00601	SD		
			MTCSW00601	SW		
			MTCSW00601-F	SW-F		
		MTC007	MTCSD00701	SD		
			MTCSW00701	SW		
			MTCSW00701-F	SW-F		
		MTC008	MTCSD00801	SD		
			MTCSW00801	SW		
			MTCSW00801-F	SW-F		
		MTC009	MTCSD00901	SD		
			MTCSW00901	SW		
			MTCSW00901-F	SW-F		
		MTC010	MTCSD01001	SD		
			MTCSW01001	SW		
			MTCSW01001-F	SW-F		
		MTC011	MTCSD01101	SD		
			MTCSW01101	SW		
			MTCSW01101-F	SW-F		
		MTC012	MTCSD01201	SD		
			MTCSW01201	SW		
			MTCSW01201-F	SW-F		
		MTC012	MTCSDFD003	SD		
			MTCSWFD003	SW		
			MTCSWFD003-F	SW-F		
			MTCVG002	VG		
			MTCFS002	F	pumpkinseed	whole-body
			MTCGS002	F	golden shiner	whole-body
			MTCLB00201	F	largemouth bass	filet
			MTCLB00202	F	largemouth bass	filet
			MTCLB00203	F	largemouth bass	filet

TABLE 3-3

SAMPLING AREAS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Area	Location	Sample Locations	Samples Collected	Type of Sample	Fish Species	Whole Body or Filet
Area 3	Mattawoman Creek	MTC013	MTCSD01301	SD		
			MTCSW01301	SW		
			MTCSW01301-F	SW-F		
		MTC014	MTCSD01401	SD		
			MTCSW01401	SW		
			MTCSW01401-F	SW-F		
		MTC015	MTCSD01501	SD		
			MTCSW01501	SW		
			MTCSW01501-F	SW-F		
		MTC016	MTCSD01601	SD		
			MTCSW01601	SW		
			MTCSW01601-F	SW-F		
			MTCVG003	VG		
			MTCCT00301	F	catfish	filet
			MTCCT00302	F	catfish	filet
			MTCFS003	F	pumpkinseed	whole-body
			MTCGS003	F	golden shiner	whole-body
			MTCLB003	F	largemouth bass	filet
Area 4	Mattawoman Creek	MTC017	MTCSD01701	SD		
			MTCSW01701	SW		
			MTCSW01701-F	SW-F		
		MTC018	MTCSD01801	SD		
			MTCSW01801	SW		
			MTCSW01801-F	SW-F		
		MTC019	MTCSD01901	SD		
			MTCSW01901	SW		
			MTCSW01901-F	SW-F		
		MTC020	MTCSD02001	SD		
			MTCSW02001	SW		
			MTCSW02001-F	SW-F		
		MTC021	MTCSD02101	SD		
			MTCSW02101	SW		
			MTCSW02101-F	SW-F		
			MTCVG004	VG		
			MTCCT00401	F	catfish	filet
			MTCCT00402	F	catfish	filet
			MTCCT00403	F	catfish	filet
			MTCFS004	F	pumpkinseed	whole-body
			MTCLB00401	F	largemouth bass	filet
			MTCLB00402	F	largemouth bass	filet
			MTCSS004	F	spottail shiner	whole-body
Area 5	Mattawoman Creek	MTC022	MTCSD02201	SD		
			MTCSW02201	SW		
			MTCSW02201-F	SW-F		
		MTC023	MTCSD02301	SD		
			MTCSW02301	SW		
			MTCSW02301-F	SW-F		
		MTC023	MTCSDFD002	SD		
			MTCSWFD002	SW		
			MTCSWFD002-F	SW-F		
		MTC024	MTCSD02401	SD		
			MTCSW02401	SW		
			MTCSW02401-F	SW-F		
		MTC025	MTCSD02501	SD		
			MTCSW02501	SW		
			MTCSW02501-F	SW-F		
		MTC026	MTCSD02601	SD		
			MTCSW02601	SW		
			MTCSW02601-F	SW-F		
		MTC026	MTCSDFD001	SD		
			MTCSWFD001	SW		
			MTCSWFD001-F	SW-F		
			MTCVG005	VG		
			MTCCT005	F	catfish	filet
			MTCFS005	F	pumpkinseed	whole-body
			MTCLB005	F	largemouth bass	filet
			MTCSS005	F	spottail shiner	whole-body

TABLE 3-3

SAMPLING AREAS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Area	Location	Sample Locations	Samples Collected	Type of Sample	Fish Species	Whole Body or Filet
Area 6	Mattawoman Creek	MTC027	MTCSD02701	SD		
			MTCSW02701	SW		
			MTCSW02701-F	SW-F		
		MTC028	MTCSD02801	SD		
			MTCSW02801	SW		
			MTCSW02801-F	SW-F		
			MTCVG006	VG		
			MTCCT006	F	catfish	filet
			MTCFS006	F	pumpkinseed	whole-body
			MTCLB006	F	largemouth bass	filet
			MTCSS006	F	spottail shiner	whole-body
Area 7	Nanjemoy Creek	NJC01	NJCSD00101	SD		
			NJCSW00101	SW		
			NJCSW00101-F	SW-F		
		NJC02	NJCSD00201	SD		
			NJCSW00201	SW		
			NJCSW00201-F	SW-F		
			NJCVG007	VG		
			NJCFS007	F	pumpkinseed	whole-body
			NJCMC007	F	mummichog	whole-body
			NJCWP007	F	white perch	filet

SD Sediment
SW Surface Water
SW-F Filtered Surface Water
VG Vegetation
F Fish

TABLE 3-4

SUMMARY OF ANALYTICAL PARAMETERS-SURFACE WATER SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TCL VOCs(1)	TCL SVOCs	TAL METALS & CYANIDE	TCL PESTICIDES / PCBs	MISC.(2)	TAL METALS-FILTERED	FIELD(3)	EXPLOSIVES(4)
IS11SW01	X	X	X		X	X		X
IS11SW02	X	X	X		X	X		X
IS11SW03	X	X	X		X	X		X
IS11SW04	X	X	X		X	X		X
IS17SW01			X		X	X		X
IS17SW01P			X		X	X		X
IS17SW02			X		X	X		X
IS17SW03			X		X	X		X
IS17SW04			X		X	X		X
IS17SW05			X		X	X		X
IS17SW06			X		X	X		X
MTCSW00101	X	X	X	X	X		X	X
MTCSW00101-F						X		
MTCSW00201	X	X	X	X	X		X	X
MTCSW00201-D		X	X	X	X			X
MTCSW00201-F						X		
MTCSW00201-F-D						X		
MTCSW00301	X	X	X	X	X		X	X
MTCSW00301-F						X		
MTCSW00401	X	X	X	X	X		X	X
MTCSW00401-F						X		
MTCSW00501	X	X	X	X	X		X	X
MTCSW00501-F						X		
MTCSW00601	X	X	X	X	X		X	X
MTCSW00601-F						X		
MTCSW00701	X	X	X	X	X		X	X
MTCSW00701-F						X		
MTCSW00801	X	X	X	X	X		X	X
MTCSW00801-F						X		
MTCSW00901	X	X	X	X	X		X	X
MTCSW00901-F						X		
MTCSW01001	X	X	X	X	X		X	X
MTCSW01001-F						X		
MTCSW01101	X	X	X	X	X		X	X
MTCSW01101-F						X		
MTCSW01201	X	X	X	X	X		X	X
MTCSW01201-D	X	X	X	X	X			X
MTCSW01201-F						X		
MTCSW01201-F-D						X		
MTCSW01301	X	X	X	X	X		X	X
MTCSW01301-F						X		
MTCSW01401	X	X	X	X	X		X	X
MTCSW01401-F						X		
MTCSW01501	X	X	X	X	X		X	X
MTCSW01501-F						X		
MTCSW01601	X	X	X	X	X		X	X
MTCSW01601-F						X		
MTCSW01701	X	X	X	X	X		X	X
MTCSW01701-F						X		
MTCSW01801	X	X	X	X	X		X	X
MTCSW01801-F						X		
MTCSW01901	X	X	X	X	X		X	X

TABLE 3-4

SUMMARY OF ANALYTICAL PARAMETERS-SURFACE WATER SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TCL VOCs(1)	TCL SVOCs	TAL METALS & CYANIDE	TCL PESTICIDES / PCBs	MISC.(2)	TAL METALS-FILTERED	FIELD(3)	EXPLOSIVES(4)
MTCSW01901-F						X		
MTCSW02001	X	X	X	X	X		X	X
MTCSW02001-F						X		
MTCSW02101	X	X	X	X	X		X	X
MTCSW02101-F						X		
MTCSW02201	X	X	X	X	X		X	X
MTCSW02201-F						X		
MTCSW02301	X	X	X	X	X		X	X
MTCSW02301-D	X	X	X	X	X			X
MTCSW02301-F						X		
MTCSW02301-F-D						X		
MTCSW02401	X	X	X	X	X		X	X
MTCSW02401-F						X		
MTCSW02501	X	X	X	X	X		X	X
MTCSW02501-F						X		
MTCSW02601	X	X	X	X	X		X	X
MTCSW02601-D	X	X	X	X	X			X
MTCSW02601-F						X		
MTCSW02601-F-D						X		
MTCSW02701	X	X	X	X	X		X	X
MTCSW02701-F						X		
MTCSW02801	X	X	X	X	X		X	X
MTCSW02801-F						X		
MTCSW02901	X	X	X	X	X		X	X
MTCSW02901-F						X		
MTCSW03001	X	X	X	X	X		X	X
MTCSW03001-F						X		
NJCSW00101	X	X	X	X	X		X	X
NJCSW00101-F						X		
NJCSW00201	X	X	X	X	X		X	X
NJCSW00201-F						X		
S39SW0010001	X	X	X					
S39SW0020001	X	X	X					
S39SW0020001-D	X	X	X					
S39SW0030001	X	X	X					
S39SW0040001	X	X	X					
S39SW0050001	X	X	X					
S39SW0060001	X	X	X					

TCL = Target Compound List
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compounds
TAL = Target Analyte List
PCB = Polychlorinated Biphenyl

1 VOCs consist of the TCL list of analytes plus diethyl ether in the 'MTC' and 'NJC' samples and bromochloromethane in the 'MTC', 'NJC' and '39DP' samples.
2 Miscellaneous parameters consist of diesel range organics (DRO) and gasoline range organics (GRO)for the 'IS11' samples, hardness for the 'IS17' samples, and chloride, fluoride, hardness, nitrate, nitrite, perchlorate, sulfate, pH, total dissolved solids (TDS), total suspended solids (TSS) and total organic carbon (TOC) for the 'MTC' and 'NJC' samples.
3 Field parameters consist of dissolved oxygen, pH, salinity, specific conductance and temperature.
4 Explosives consist of the list of analytes associated with SW-846 method 8330 plus nitroglycerine, nitrocellulose and nitroguanidine.

TABLE 3-5

SUMMARY OF ANALYTICAL PARAMETERS-SEDIMENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TCL VOCs(1)	TCL SVOCs(2)	TAL METALS & CYANIDE	TCL PESTICIDES / PCBs	MISC.(3)	AVS/SEM	GRAIN SIZE	EXPLOSIVES(4)	TPH
39DP01	X	X	X					X	
39DP01-D	X	X	X					X	
39DP02	X	X	X					X	
39DP03	X	X	X					X	
39DP04	X	X	X					X	
39DP05	X	X	X					X	
39DP06	X	X	X					X	
41DP01	X	X	X	X					X
41DP01-D	X	X	X	X					X
41DP02	X	X	X	X					X
41DP03	X	X	X	X					X
41DP04	X	X	X	X					X
41DP05	X	X	X	X					X
41DP06	X	X	X	X					X
41DP07	X	X	X	X					X
41DP08	X	X	X	X					X
41DP09	X	X	X	X					X
41DP10	X	X	X	X					X
IS11SD010001	X	X	X		X			X	
IS11SD020001	X	X	X		X			X	
IS11SD030001	X	X	X		X			X	
IS11SD040001	X	X	X		X			X	
IS17SD010001			X		X			X	
IS17SD020001			X		X			X	
IS17SD030001			X		X			X	
IS17SD040001			X		X			X	
IS17SD050001			X		X			X	
IS17SD060001			X		X			X	
MTCSD00101	X	X	X	X	X	X	X	X	
MTCSD00201	X	X	X	X	X	X	X	X	
MTCSD00201-D	X	X	X	X	X	X	X	X	
MTCSD00301	X	X	X	X	X	X	X	X	
MTCSD00401	X	X	X	X	X	X	X	X	
MTCSD00501	X	X	X	X	X	X		X	
MTCSD00601	X	X	X	X	X	X		X	
MTCSD00701	X	X	X	X	X	X		X	
MTCSD00801	X	X	X	X	X	X		X	
MTCSD00901	X	X	X	X	X	X	X	X	
MTCSD01001	X	X	X	X	X	X	X	X	
MTCSD01101	X	X	X	X	X	X	X	X	
MTCSD01201	X	X	X	X	X	X	X	X	
MTCSD01201-D	X	X	X	X	X	X	X	X	
MTCSD01301	X	X	X	X	X	X	X	X	
MTCSD01401	X	X	X	X	X	X	X	X	

TABLE 3-5

SUMMARY OF ANALYTICAL PARAMETERS-SEDIMENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TCL VOCs(1)	TCL SVOCs(2)	TAL METALS & CYANIDE	TCL PESTICIDES / PCBs	MISC.(3)	AVS/SEM	GRAIN SIZE	EXPLOSIVES(4)	TPH
MTCSD01501	X	X	X	X	X	X	X	X	
MTCSD01601	X	X	X	X	X	X	X	X	
MTCSD01701	X	X	X	X	X	X	X	X	
MTCSD01801	X	X	X	X	X	X	X	X	
MTCSD01901	X	X	X	X	X	X	X	X	
MTCSD02001	X	X	X	X	X	X	X	X	
MTCSD02101	X	X	X	X	X	X	X	X	
MTCSD02201	X	X	X	X	X	X		X	
MTCSD02301	X	X	X	X	X	X	X	X	
MTCSD02301-D	X	X	X	X	X	X	X	X	
MTCSD02401	X	X	X	X	X	X	X	X	
MTCSD02501	X	X	X	X	X	X	X	X	
MTCSD02601	X	X	X	X		X	X	X	
MTCSD02601-A					X				
MTCSD02601-A-D					X				
MTCSD02601-D	X	X	X	X		X	X	X	
MTCSD02701	X	X	X	X		X	X	X	
MTCSD02701-A					X				
MTCSD02801	X	X	X	X		X	X	X	
MTCSD02801-A					X				
MTCSD02901	X	X	X	X	X	X		X	
MTCSD03001	X	X	X	X	X	X		X	
NJCSD00101	X	X	X	X		X	X	X	
NJCSD00101-A					X				
NJCSD00201	X	X	X	X	X	X	X	X	
S39SD0010001	X	X	X	X	X	X		X	
S39SD0020001	X	X	X	X	X	X		X	
S39SD0030001	X	X	X	X	X	X		X	
S39SD0040001	X	X	X	X	X	X		X	
S39SD0050001	X	X	X	X	X	X		X	
S39SD0060001	X	X	X	X	X	X		X	
S39SD0070001	X	X	X	X	X	X		X	
S39SD0080001	X	X	X	X	X	X		X	

TCL = Target Compound List
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compounds
TAL = Target Analyte List
PCB = Polychlorinated Biphenyl
AVS = Acid Volatile Sulfide
SEM = Simultaneously Extracted Metals
TPH = Total Petroleum Hydrocarbons

TABLE 3-5

SUMMARY OF ANALYTICAL PARAMETERS-SEDIMENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TCL VOCs(1)	TCL SVOCs(2)	TAL METALS & CYANIDE	TCL PESTICIDES / PCBs	MISC.(3)	AVS/SEM	GRAIN SIZE	EXPLOSIVES(4)	TPH

1 TCL VOCs plus diethyl ether in the 'MTC' and 'NJC' samples and 1,1-diethoxyethane and dimethoxymethane in the '39DP' samples.
2 TCL SVOCs plus 1,1-dimethylhydrazine in the '39DP' samples.
3 Miscellaneous parameters consist of diesel range organics (DRO) and gasoline range organics (GRO) for the 'IS11' samples, pH and total organic carbon (TOC) for the 'IS17' samples and TOC for the 'MTC' and 'NJC' samples.
4 Explosives consist of the list of analytes associated with SW-846 method 8330 plus nitroglycerine, nitrocellulose and nitroguanidine.

TABLE 3-6

SUMMARY OF ANALYTICAL PARAMETERS-TISSUE SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SAMPLE ID	TYPE OF SAMPLE	SPECIES	WHOLE-BODY OR FILET SAMPLE	TCL SVOCs	TAL METALS & CYANIDE[1]	TCL PESTICIDES / PCBs	PERCHLORATE	EXPLOSIVES[2]	PERCENT LIPIDS
MTCCT00101	Fish	Channel catfish	Filet	X	X	X	X	X	X
MTCCT00102	Fish	Channel catfish	Filet	X	X	X	X	X	X
MTCCT00301	Fish	Channel catfish	Filet	X	X	X	X	X	X
MTCCT00302	Fish	Channel catfish	Filet	X	X	X	X	X	X
MTCCT00401	Fish	White catfish	Filet	X	X	X	X	X	X
MTCCT00402	Fish	White catfish	Filet	X	X	X	X	X	X
MTCCT00403	Fish	White catfish	Filet	X	X	X	X	X	X
MTCCT005	Fish	Channel catfish	Filet	X	X	X	X	X	X
MTCCT006	Fish	Brown bullhead catfish	Filet	X	X	X	X	X	X
MTCFS001	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCFS002	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCFS003	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCFS004	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCFS005	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCFS006	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
MTCGS002	Fish	Golden shiner	Whole-body	X	X	X	X	X	X
MTCGS003	Fish	Golden shiner	Whole-body	X	X	X	X	X	X
MTCLB001	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB00201	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB00202	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB00203	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB003	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB00401	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB00402	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB005	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCLB006	Fish	Largemouth bass	Filet	X	X	X	X	X	X
MTCSS001	Fish	Spottailed shiner	Whole-body	X	X	X	X	X	X
MTCSS004	Fish	Spottailed shiner	Whole-body	X	X	X	X	X	X
MTCSS005	Fish	Spottailed shiner	Whole-body	X	X	X	X	X	X
MTCSS006	Fish	Spottailed shiner	Whole-body	X	X	X	X	X	X
MTCVG001	Vegetation	Hydrilla	NA		X	X			
MTCVG002	Vegetation	Hydrilla	NA		X	X			
MTCVG003	Vegetation	Hydrilla	NA		X	X			
MTCVG004	Vegetation	Hydrilla	NA		X	X			
MTCVG005	Vegetation	Hydrilla	NA		X	X			
MTCVG006	Vegetation	Hydrilla	NA		X	X			
NJCFS007	Fish	Pumpkinseed	Whole-body	X	X	X	X	X	X
NJCMC007	Fish	Mummichog	Whole-body	X	X	X	X	X	X
NJCVG007	Vegetation	Hydrilla	NA		X	X			
NJCWP007	Fish	White perch	Filet	X	X	X	X	X	X

1 Vegetation samples were not analyzed for cyanide.

2 Explosives consist of the list of analytes associated with SW-846 method 8330 plus nitroglycerine, nitrocellulose and nitroguanidine.

TCL = Target Compound List
SVOC = Semivolatile Organic Compound
TAL = Target Analyte List
PCB = Polychlorinated Biphenyl
NA = Not Applicable

TABLE 3-7

WATER QUALITY FIELD MEASUREMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Date	Time	Field Measurements				
			pH	Conductivity (ms/cm)	Dissolved Oxygen (mg/L)	Temperature (^{0}C)	Salinity (%)
MTCSW00101	9/9/01	13:20	9.31	0.259	13.87	26.81	0
MTCSW00201	9/9/01	12:25	9.44	0.257	13.76	27.2	0
MTCSW00301	9/9/01	11:50	9.16	0.256	10.94	28.19	0
MTCSW00401	9/9/01	11:20	7.32	0.259	9.9	26.06	0
MTCSW00501	9/8/01	15:40	9.97	0.252	12.11	28.4	0
MTCSW00601	9/8/01	14:35	11.17	0.269	14.72	28.3	0
MTCSW00701	9/8/01	15:05	11.47	0.305	14.15	31.04	0
MTCSW00801	9/8/01	12:55	10.92	0.274	11.63	27	0
MTCSW00901	9/8/01	12:25	11.04	0.275	13.01	27.12	0
MTCSW01001	9/8/01	11:50	10.74	0.261	12.83	26.86	0
MTCSW01101	9/8/01	11:00	9.57	0.254	10.68	26.35	0
MTCSW01201	9/8/01	9:00	7	0.254	10.3	24.77	0
MTCSW01301	9/7/01	14:50	10.39	0.262	8.52	27.03	0
MTCSW01401	9/7/01	14:25	10.45	0.269	12.53	30	0
MTCSW01501	9/7/01	13:55	9.84	0.257	11.36	27.95	0
MTCSW01601	9/7/01	13:20	9.02	0.253	10.62	26.97	0
MTCSW01701	9/7/01	12:25	8.33	0.252	14.14	26.87	0
MTCSW01801	9/7/01	NI	8.91	0.25	11.91	26.28	0
MTCSW01901	9/7/01	10:05	7.53	0.251	8.88	25.83	0
MTCSW02001	9/7/01	9:30	7.67	0.251	9.75	25.8	0
MTCSW02101	9/7/01	8:45	5.43	0.284	8.07	25.67	0
MTCSW02201	9/6/01	16:00	8.54	0.232	17.2	27.43	0
MTCSW02301	9/6/01	15:15	9.03	0.232	13.92	27.14	0
MTCSW02401	9/6/01	14:45	7.95	0.232	14.11	26.9	0
MTCSW02501	9/6/01	14:25	6.78	0.227	11.95	27.27	0
MTCSW02601	9/6/01	11:45	7.06	0.236	11.4	26.41	0
MTCSW02701	9/6/01	9:45	6.3	0.232	9.02	25.67	0
MTCSW02801	9/6/01	10:25	6.61	0.233	11.18	25.95	0
MTCSW02901	9/9/01	14:00	10.14	0.254	11.92	26.61	0
MTCSW03001	9/9/01	14:40	10.93	0.228	16.71	28.2	0
NJCSW00101	9/5/01	16:15	7.23	7.54	8.33	28.04	0.4
NJCSW00201	9/5/01	17:15	7.88	8.91	9.79	27.79	0.5

NI = Not indicated on field sample log sheet

TABLE 3-8

GRAIN SIZE DISTRIBUTION RESULTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample	% Gravel	% Sand	% Silt	% Clay
NJCSD00101	0	61.6	22.2	16.2
NJCSD00201	0.6	29.7	65.2	4.5
MTCSDFD001	37.7	59.1	1.2	2
MTCSDFD002	0	29.2	58	12.8
MTCSDFD003	2.2	85.8	5.9	6.1
MTCSDFD004	0	50	30.2	19.8
MTCSD00101	0	50.9	32.6	16.5
MTCSD00201	0	34.2	54.5	11.3
MTCSD00301	12	67.1	15.3	5.6
MTCSD00401	2.4	79.4	14.2	4
MTCSD00901	0	7.2	78	14.8
MTCSD01001	0	21.4	72.4	6.2
MTCSD01101	0	4	69.3	26.7
MTCSD01201	3.5	88.4	6.5	1.6
MTCSD01301	4.8	34.9	30	30.3
MTCSD01401	0	18	46.4	35.6
MTCSD01501	3	81.9	9.1	6
MTCSD01601	0	25	60.4	14.6
MTCSD01701	44.3	52.3	3.2	0.2
MTCSD01801	0	55.1	27.1	17.8
MTCSD01901	0	8.4	71.8	19.8
MTCSD02001	3.4	92.6	2.8	1.2
MTCSD02101	1	82.7	9.6	6.7
MTCSD02301	0	31.7	54.9	13.4
MTCSD02401	1.7	47.2	31	20.1
MTCSD02501	11.6	81.4	1.9	5.1
MTCSD02601	43.6	54.6	1.4	0.4
MTCSD02701	0	79.4	18.6	2
MTCSD02801	0	15.3	57.6	27.1

Notes:
MTCSDFD001 is a duplicate of MTCSD02601
MTCSDFD002 is a duplicate of MTCSD02301
MTCSDFD003 is a duplicate of MTCSD01201
MTCSDFD004 is a duplicate of MTCSD02001

TABLE 3-9

LOCATION OF SEDIMENT TOXICITY/MACROINVERTEBRATE DATA
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Area	Location	Sample Number	Sediment Toxicity Test	Benthic Macroinvertebrate Community Test
Area 1	Mattawoman Creek	MTCSD00101	X	X
		MTCSD00201	X	X
		MTCSD00201D	X	X
		MTCSD00301	X	X
		MTCSD00401	X	X
Area 2	Mattawoman Creek	MTCSD00901	X	X
		MTCSD01001	X	X
		MTCSD01101	X	X
		MTCSD01201	X	X
		MTCSD01201D	X	X
Area 3	Mattawoman Creek	MTCSD01301	X	X
		MTCSD01401	X	X
		MTCSD01501	X	X
		MTCSD01601	X	X
Area 4	Mattawoman Creek	MTCSD01701	X	X
		MTCSD01801	X	X
		MTCSD01901	X	X
		MTCSD02001	X	X
Area 5	Mattawoman Creek	MTCSD02301	X	X
		MTCSD02301D	X	X
		MTCSD02401	X	X
		MTCSD02501	X	X
		MTCSD02601	X	X
		MTCSD02601D	X	X
Area 6	Mattawoman Creek	MTCSD02701	X	X
		MTCSD02801	X	X
Area 7	Nanjemoy Creek	NJCSD00101	X	X
		NJCSD00201	X	X

TABLE 3-10

COLLECTED FISH SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

	Fillet Samples for Human Health Risk Assessment					Whole-Body Samples for Ecological Risk Assessment			
Station	**Channel Catfish (CT)**	**White Catfish (CT)**	**Brown Bullhead (CT)**	**Large-Mouth Bass (LB)**	**White Perch (WP)**	**Pumpkin-Seed (FS)**	**Spottailed Shiner[2] (SS)**	**Golden Shiner[2] (GS)**	**Mummi-chog[2] (MC)**
007					NJCWP007	NJCFS007			NJCMC007
001	MTCCT00101 MTCCT00102			MTCLB001		MTCFS001	MTCSS001[a]		
002				MTCLB00201 MTCLB00202 MTCLB00203		MTCFS002		MTCGS002	
003	MTCCT00301 MTCCT00302			MTCLB003		MTCFS003		MTCGS003	
004		MTCCT00401 MTCCT00402 MTCCT00403		MTCLB00401 MTCLB00402		MTCFS004	MTCSS004[3]		
005	MTCCT005			MTCLB005		MTCFS005	MTCSS005		
006			MTCCT00601 MTCCT00602	MTCLB006		MTCFS006	MTCSS006		

1 - Entries are sample (shorter) or subsample (longer) numbers
2 - Minnow-size fish
3 - 40 to 50% golden shiner

TABLE 3-11

FISH SAMPLES COLLECTED FOR HUMAN HEALTH RISK ASSESSMENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

	Fish Species						
Sample Number	**Channel Catfish**	**White Catfish**	**Brown Bullhead**	**Largemouth Bass**	**White Perch**	**Length (cm)**	**Weight (grams)**
MTCCT00101	X					44.6	920
MTCCT00102	X					40.7	681
MTCLB001				X		29.5	368
MTCLB00201				X		37.6	920
MTCLB00202				X		34.7	727
MTCLB00203				X		35.6	730
MTCLB003				X		43.7	1390
MTCCT00301	X					46.5	1057
MTCCT00302	X					31.4	219
MTCCT00401		X				33.6	471
MTCCT00402		X				29	293
MTCCT00403		X				30.5	332
MTCLB00401				X		31.5	489
MTCLB00402				X		34.7	597
MTCCT00501	X					46.3	545
MTCLB00501				X		29.9	372
MTCCT00601			X			26.9	20
MTCCT00602			X			23.4	158
MTCLB00601				X		37.6	786
NJMWP007					X	29.2	389
NJMWP007					X	21.7	187

TABLE 3-12
FISH SAMPLES COLLECTED FOR ECOLOGICAL RISK ASSESSMENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Fish Species				Average Length (cm)	Average Weight (grams)
	Pumpkinseed	Spottailed Shiner	Golden Shiner	Mummichog		
MTCFS001	X				11.63	32
MTCSS001		X	X		8.03	5.44
MTCFS002	X				11.9	36
MTCGS002			X		7.06	3.5
MTCFS003	X				11.6	30.4
MTCGS003			X		14.8	62.6
MTCFS004	X				11.9	36.25
MTCSS004		X	X		8.06	5.05
MTCFS005	X				10.69	26.29
MTCSS005		X			9.85	7.89
MTCFS006	X				10.81	27
MTCSS006		X			10.35	7.79
NJMFS007	X				13.48	61.2
NJMMC007				X	6.49	4.85

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DRAWN BY K. PEILA	DATE 7/16/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL	DATE 7/19/02	MATTAWOMAN CREEK STUDY AREAS MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 3 - 1	REV 0

DRAWN BY K. PEILA DATE 7/19/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NO. —
CHECKED BY GJL DATE 7/19/02	NANJEMOY CREEK STUDY AREA NANJEMOY CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL DATE 7/19/02	
COST/SCHEDULE-AREA		APPROVED BY — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 3 - 2	REV 0

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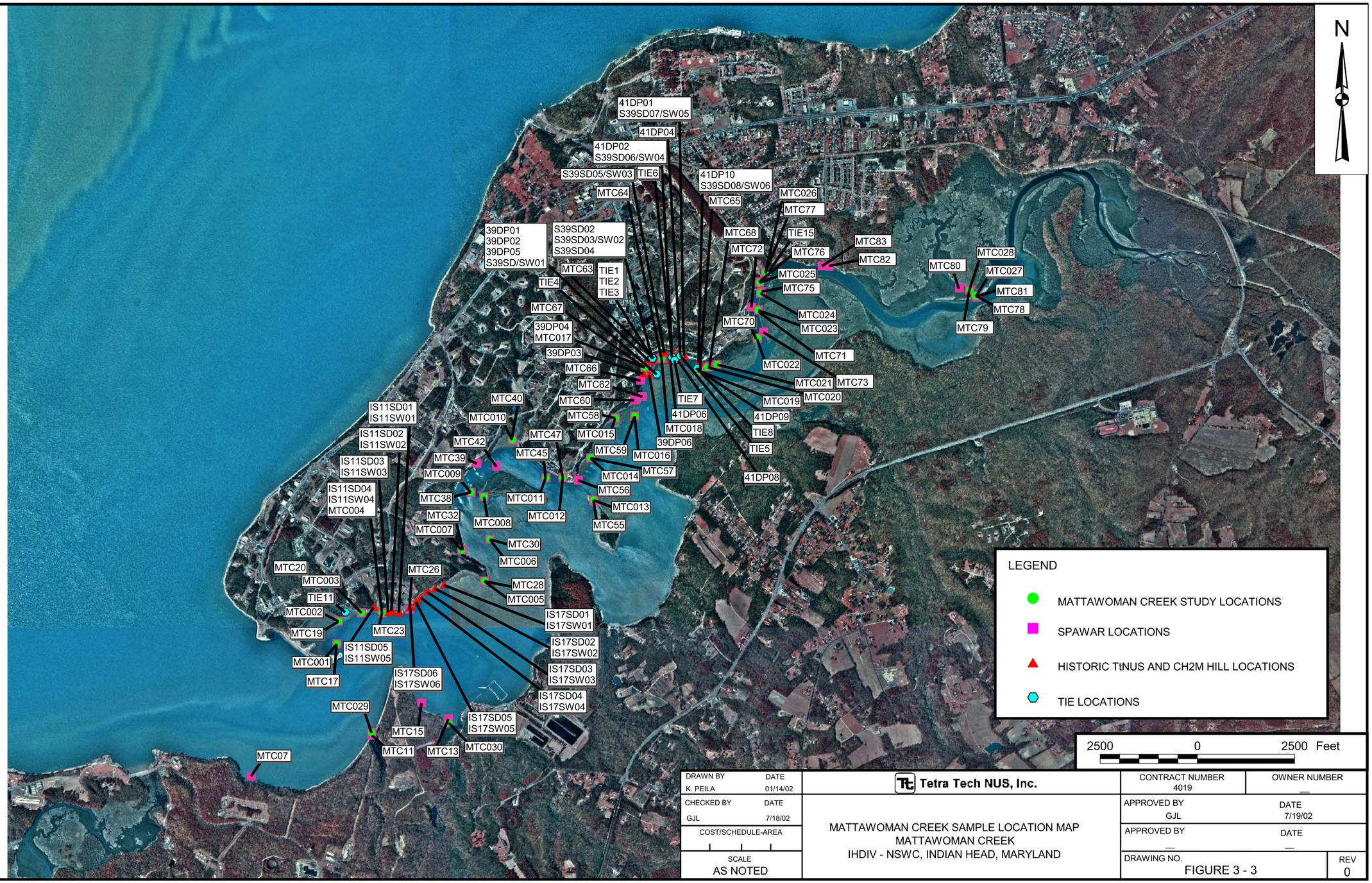
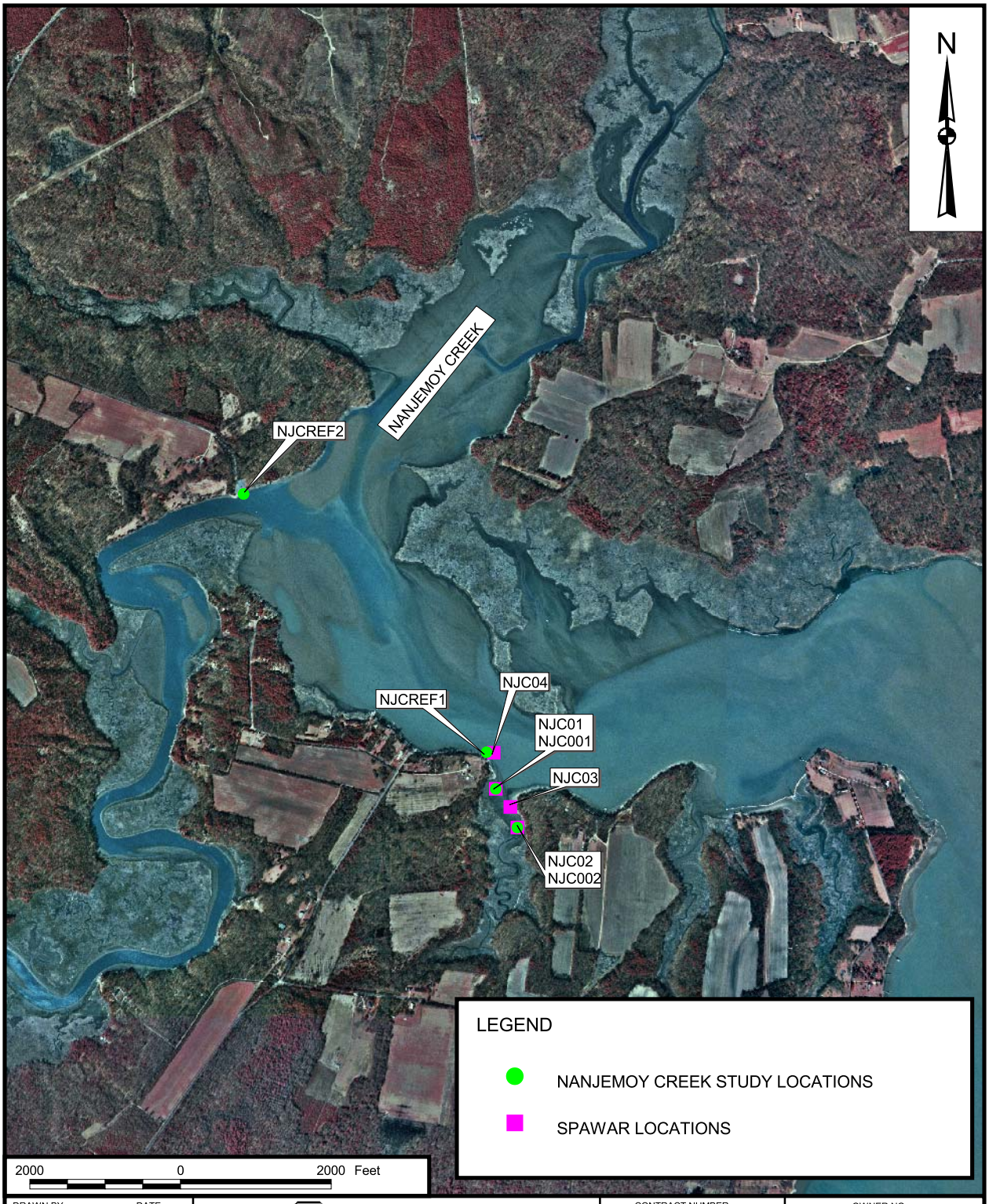


DRAWN BY K. PEILA	DATE 01/14/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	MATTAWOMAN CREEK SAMPLE LOCATION MAP MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 3 - 3 / REV 0



DRAWN BY K. PEILA	DATE 7/18/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NO. —
CHECKED BY GJL	DATE 7/18/02	NANJEMOY CREEK SAMPLE LOCATION MAP NANJEMOY CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 3 - 4 / REV 0

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4.0 FIELD INVESTIGATION RESULTS/NATURE AND EXTENT OF CONTAMINATION

This section summarizes and evaluates the results of the chemical analysis of environmental samples collected during the Mattawoman Creek Study sampling as described in Sections 2.0 and 3.0. Specifically, this section summarizes the nature and extent of contamination in surface water, sediment, fish tissue and vegetation samples collected at the locations displayed on Figures 3-3 and 3-4. The results of the sediment toxicity study and the benthic macroinvertebrate study described in Section 3 are presented in Section 5.

Environmental samples for the Mattawoman Creek Study were collected in September 2001 by TtNUS (the main field investigation referenced to in Section 3) and during several previous investigations by TtNUS and others that included samples collected from Mattawoman Creek. The previous investigations included the following:

- **Field screening sampling event for the Mattawoman Creek Study.** The field screening sampling event was conducted in August 2001 using SPAWAR methods (referenced in Section 3). Sediment samples were collected in both Mattawoman and Nanjemoy creeks and were analyzed for metals by XRF, pesticides and PCBs by immunoassay methods and PAHs by UVF. The samples were analyzed on site using the previously mentioned SPAWAR methods. In addition, a percentage of the samples were also sent to a fixed-base laboratory for confirmation.

- **Remedial investigations conducted for IR Sites 11 and 17** by CH2M Hill (CH2M Hill, July 2001). Sediment and surface water samples collected along the Mattawoman Creek shoreline at these Sites between July and October 2000 were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, energetic compounds, Target Analyte List (TAL) metals and other miscellaneous parameters.

- **Toxicity Identification Evaluation (TIE) study conducted by SAIC** (SAIC, October 2001). The SAIC TIE study consisted of a series of toxicity tests as well as the chemical analysis of bulk and pore water sediment samples collected during October 2000. Many of the TIE sediment samples were collected along the Mattawoman Creek shoreline and were analyzed for metals, PAHs, pesticides, PCBs, energetic compounds, Acid Volatile Sulfides/Simultaneously Extracted Metals (AVS/SEM) and other miscellaneous parameters.

- **Remedial investigations conducted for IR Sites 39 and 41** by TtNUS (August and September 1992 and October 1997). Sediment samples were collected along the Creek in the vicinity of Sites 39

and 41 in the fall of 1992 and were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, select energetic compounds, and a few other miscellaneous parameters. Surface water (VOCs, SVOCs and metals) and sediment samples (VOCs, SVOCs, pesticides/PCBs, energetic compounds, metals, AVS/SEM and other miscellaneous parameters) were collected in the same area in the fall of 1997.

Sampling stations are referred to in this section as locations, and references are made to the study area in which the samples from each station were collected. For example, "TtNUS location 26" describes the sampling station where surface water samples MTCSW026 and 026D were collected, along with the corresponding sediment samples. The list of targeted analytes for all TtNUS samples and the CH2M Hill samples were presented in Tables 3-3 through 3-5. A fixed-base analytical laboratory analyzed all of these samples. Additionally, 100 percent of the data associated with these samples, with the exception of those collected in 1992, were validated according to the U.S. EPA Region 3 Standard Operating Procedures for Validation of Contract Laboratory Program (CLP) Inorganic and Organic Data (U.S. EPA, April 1993; September 1994) and the National Functional Guidelines for Inorganic and Organic Data Review (U.S.EPA, February 1994; October 1999). Thus, the data evaluation presented in this section is based primarily on analytical results for these samples. All analytical results for these samples and the TtNUS samples collected in 1992 are presented in Appendix B. Note that the 1992 data were not discussed in this section of the report or included in the human health or ecological risk assessments because samples were collected so long ago.

Chemical concentrations detected in environmental samples collected from background/reference Areas 6 and 7 (September 2001) are presented in Tables 4-1 through 4-7. The number of background samples collected for each media ranged from two to five samples. Consequently, the maximum concentration detected in each media/dataset is used as a point of comparison in the narrative presented in Sections 4.1 through 4.4. Although the background data set is small, which does not allow for a strong statistical comparison to the site data, the results are sufficient for a qualitative evaluation of the site data to determine if the chemical concentrations in the site samples are similar to background levels.

The analytical results for all TtNUS samples (except those collected in 1992) and the CH2M Hill samples were compared to background concentrations and to various human health and ecological criteria listed in Tables 4-8 through 4-10 and defined below:

<u>Surface Waters:</u>

- EPA Region 3 Risk-Based Concentrations (RBCs) for Tap Water
- Federal Ambient Water Quality Criteria (AWQC) for Freshwater - Chronic Effects
- Federal AWQC for Saltwater - Chronic Effects

- EPA Region 3 BTAG Aquatic Freshwater (lowest of flora and fauna values)
- EPA Region 3 BTAG Aquatic Marine (lowest of flora and fauna values)

Sediments:

- EPA Region 3 RBCs for Residential Exposure to Soil
- EPA Region 3 BTAG Sediment (lowest of flora and fauna values)

Fish Tissue:

- EPA Region 3 RBCs for Fish - Chemical concentrations detected in the fish fillet samples are compared to these RBCs; chemical concentrations in the whole-body fish samples are not.

The EPA Region 3 RBCs are those published in the April 2, 2002, version of the EPA Region 3 RBC Table which contains reference doses (RfDs) and Cancer Slope Factors (CSFs) for 400 to 500 chemicals. The toxicity factors associated with these chemicals have been combined with "standard" exposure scenarios to calculate the RBCs. The RBCs are chemical concentrations corresponding to fixed levels of risk [i.e., a Hazard Quotient (HQ) of 1 or a lifetime cancer risk of 1E-6; the lowest (most conservative) concentration is selected] for water (specifically tap-water), air, fish tissue and soil. The tap-water and soil RBCs referenced as screening levels in this section assume a residential land use scenario. Consequently, they are conservative benchmarks because Mattawoman Creek is not used as a domestic water supply source and receptor exposure to sediments is anticipated to be significantly less intense than receptor exposure to soils (assuming a residential land use scenario).

The Federal AWQC are a compilation of the EPA's national recommended water quality criteria for 157 pollutants, developed pursuant to section 304(a) of the Clean Water Act (CWA). The criteria provide guidance in adopting water quality standards under section 304(a) of the CWA. Water quality criteria developed under section 304(a) of the CWA are based on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects.

The EPA Region 3 BTAG criteria are a set of conservative guidelines for the evaluation of sampling data at Superfund sites. The numbers in the BTAG reference tables are based upon the lowest value from a combination of sources considered to be protective of the most sensitive organism in a given medium. The media are the basic units of the habitat and are considered to be fundamental to the well-being of the endemic ecological populations.

The surface water screening levels selected for the baseline ERA are the lowest of the published Federal AWQCs (freshwater or saltwater) and the EPA Region 3 BTAG aquatic values (Freshwater or Marine).

Benchmarks for HMX and total 1,2-dichloroethene came from other references (and are listed in Table 4-8) because AWQC and BTAG values are not available for these chemicals. The ecological screening criteria for surface water referenced throughout the remainder of Section 4 are labeled "Minimum Ecological Surface Water Criteria" in the Section 4 tables.

The sediment screening levels selected for the baseline ERA are the lowest EPA Region 3 BTAG values for sediment (flora or fauna). Supplemental criteria were calculated for those analytes lacking BTAG criteria (see Appendix B). The ecological screening criteria for sediment referenced throughout the remainder of Section 4 are labeled "Minimum Ecological Sediment Criteria" in the Section 4 tables.

There are no ecological screening criteria available for the whole-body fish and vegetation samples; therefore, these results are compared to background concentrations only.

The remainder of this section discusses the nature and extent of contamination across the various media with comparisons to background values, criteria (where applicable), historical or recent related data (if available) and across sampling areas and species (for fish samples). Section 4.1 addresses surface water contamination. Section 4.2 discusses sediment chemistry. Sections 4.3 and 4.4 address the nature and extent of contamination in fish and vegetation tissue, respectively. Within each section, analytical fractions are discussed in the following order: VOCs, SVOCs, pesticides/PCBs, energetic compounds, and inorganic parameters.

Results for PAHs are presented in the data tables both as individual concentrations of each analyte and as sums of concentrations for various groups. The following summary illustrates which compounds are included within each group. Total PAHs, high molecular weight PAHs and low molecular weight PAHs are the arithmetical sums of the individual, positively detected concentrations of the compounds listed in the table below. The BAP Equivalent for the carcinogenic PAHs was calculated by multiplying the positive detections of the compounds below by a Toxicity Equivalence Factor (TEF) and summing the results.

SUMMARY OF PAHs AS BAP(1) EQUIVALENTS

Total PAHs	High Molecular Weight PAHs	Low Molecular Weight PAHs	Carcinogenic PAHs as BAP Equivalents
2-Methylnaphthalene		2-Methylnaphthalene	
Acenaphthene		Acenaphthene	
Acenaphthylene		Acenaphthylene	
Anthracene		Anthracene	
Benzo(a)anthracene	Benzo(a)anthracene		Benzo(a)anthracene (TEF(2) = 0.1)

Total PAHs	High Molecular Weight PAHs	Low Molecular Weight PAHs	Carcinogenic PAHs as BAP Equivalents
Benzo(a)pyrene	Benzo(a)pyrene		Benzo(a)pyrene (TEF = 1.0)
Benzo(b)fluoranthene	Benzo(b)fluoranthene		Benzo(b)fluoranthene (TEF = 0.1)
Benzo(g,h,i)perylene	Benzo(g,h,i)perylene		
Benzo(k)fluoranthene	Benzo(k)fluoranthene		Benzo(k)fluoranthene (TEF = 0.01)
Chrysene	Chrysene		Chrysene (TEF = 0.001)
Dibenz(a,h)anthracene	Dibenz(a,h)anthracene		Dibenz(a,h)anthracene (TEF = 1.0)
Fluoranthene	Fluoranthene		
Fluorene		Fluorene	
Ideno(1,2,3-cd)pyrene	Ideno(1,2,3-cd)pyrene		Ideno(1,2,3-cd)pyrene (TEF = 0.1)
Naphthalene		Naphthalene	
Phenanthrene		Phenanthrene	
Pyrene	Pyrene		

1 BAP = Benzo(a)pyrene
2 TEF = Toxicity Equivalence Factor

4.1 SURFACE WATER

A total of 28 surface water samples and four duplicate surface water samples were collected during the main TtNUS field investigation (September 2001):

Area	Number of Samples
1	7 plus 1 duplicate (MTC002)
2	7 plus 1 duplicate (MTC012)
3	4
4	5
5	5 plus 2 duplicates (MTC023 and MTC026)

Ten surface water samples and one duplicate were collected as part of the CH2M Hill RI for Sites 11 and 17. All of the CH2M Hill samples were collected along the shoreline in the immediate vicinity of Sites 11 and 17 within Area 1. Six surface water samples and one duplicate were collected in 1997 as part of TtNUS RI for Sites 39 and 41. The Site 39 and 41 samples were collected along the shoreline and in Mattawoman Creek within Area 4.

The analytical program for each surface water sample was presented in Table 3-3. The surface water samples from the September 2001 sampling event were analyzed for TCL VOCs plus diethyl ether, TCL SVOCs, TCL pesticides/PCBs, energetic compounds, total TAL metals, dissolved TAL metals, cyanide, chloride, fluoride, hardness, nitrate, nitrite, perchlorate, pH, sulfate, TDS, TOC, TSS and field measurements of pH, conductivity, DO, water temperature and salinity. The CH2M Hill samples from Site 11 were analyzed for TCL VOCs, TCL SVOCs, total TAL metals, dissolved TAL metals, cyanide, energetic compounds, ammonium perchlorate, diesel range organics (DRO) and gasoline range organics (GRO). The CH2M Hill samples from Site 17 were analyzed for total TAL metals, dissolved TAL metals, cyanide, energetic compounds and hardness. The TtNUS RI samples were analyzed for VOCs, SVOCs, metals and cyanide only.

Chemical concentrations detected in the surface water samples are displayed in Figures 4-1 through 4-5. Analytical results for all parameters detected at least once in surface water are presented in Tables 4-11 through 4-15. Basic descriptive statistics (frequency of detection, range of positive detections, average of positive detections, etc.) for each area, and comparisons to relevant criteria and background are presented in Tables 4-16 through 4-20. Neither pesticides nor PCBs were detected in any of the surface water samples. Analytical results for the remaining target analytes are discussed below.

4.1.1 VOCs

Four aromatic hydrocarbons (e.g., benzene), two chlorinated hydrocarbons (e.g., trichloroethene), acetone, bromoform, diethyl ether, and methyl tert-butyl ether were detected in 20 percent or less of the surface water samples collected from the study area. However, with the exception of toluene (C_{max} = 30 µg/L) and total xylenes (C_{max} = 48 µg/L), the maximum concentrations detected did not exceed 10 µg/L. With the exception of the BTEX compounds, VOCs were detected in one or two samples only. VOCs were not detected in the background surface water samples or in samples collected from Area 5. Background samples were not analyzed for methyl-tert-butyl ether; only the Site 11 surface water samples collected by CH2M Hill were analyzed for this compound.

The BTEX compounds were detected at several locations in Areas 1, 2, and 3. Because these compounds and methyl-tert-butyl ether are fuel components, facility-related, as well as non-facility-related anthropogenic activities may have contributed to the concentrations noted in the surface water samples. Solvents such as TCE (and by-products) and diethyl ether were only detected in samples from Area 4. (TCE was detected in Area 4 sediment samples only [TtNUS location 21]). Note that TtNUS sample location 21 is near an outfall from a storm sewer that passes through the TCE contaminated Site 57. Bromoform, a trihalomethane compound, is often formed during the chlorination of public water supplies and wastewater discharges. The concentration detected in the study area surface waters is less than the

current Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) for trihalomethane compounds (80 µg/L).

Several VOCs were detected at maximum concentrations less than criteria presented in Tables 4-16 through 4-20. In many cases, the analytical results for these VOCs were qualified during the validation process as "estimated", and/or they were less than or similar to the sample quantitation limits (i.e., non-detect results) reported for other samples. The following descriptive statistics are summarized from Tables 4-16 through 4-20:

VOCs DETECTED AT CONCENTRATIONS LESS THAN CRITERIA

Analyte	Frequency of Detection	Area Where Detected	Range of Detected Concentrations (µg/L)	Range of Detection Limits (Nondetects) (µg/L)	Results Estimated During Validation?
Bromoform	1/11	1	0.5	1 – 10	Yes
Methyl tert-butyl ether	1/4	1	1	10	Yes
Toluene	1/11	1	3	1 – 10	Yes
	4/7	2	1 – 23	1	No
	1/4	3	30	1	No
	1/11	4	0.6	1	Yes
Acetone	1/1	2	5	--	Yes
Cis-1,2-dichloroethene	1/11	4	4	1	No
Diethyl ether	1/5	4	6	1	Yes
Total xylenes	1/11	1	4	1 –10	No
	4/7	2	1 – 48	1	No
	1/4	3	40	1	No

Only one acetone result was reported for Area 2 because analytical results reported for the remaining samples (non-detect results with sample quantitation limits of 5 µg/L) were qualified as unusable (R) during data validation. With the exception of bromoform and total xylenes, all of these VOCs were also detected in sediment samples collected from the study area. Fish tissue samples were not analyzed for VOCs.

As summarized below, Tables 4-16 through 4-20, show that three VOCs were detected at maximum concentrations greater than the Region 3 $RBCs_{tap}$.

VOCs DETECTED AT CONCENTRATIONS EXCEEDING THE REGION 3 RBC_{tap}

Analyte	Frequency of Detections	Area Where Detected	Range of Detected Concentrations (µg/L)	Minimum Ecological Criteria (µg/L)	Region 3 RBC for Tap Water (µg/L)
Benzene	1/11	1	0.7	700	0.32
	3/7	2	1 – 8		
	1/4	3	5		
Ethylbenzene	1/11	1	0.6	430	3.3
	3/7	2	0.8 – 7		
	1/4	3	6		
Trichloroethene	2/11	4	1 – 6	2000	0.026

None of these VOCs were detected at concentrations exceeding the ecological criteria. All of the positive detections reported for benzene and trichloroethene exceeded $RBCs_{tap}$. Only two of the positive detections for ethylbenzene exceeded the $RBCs_{tap}$ (samples MTCSW00301 in Area 1 and MTCSW01001 in Area 2). Of the three VOCs listed above, trichloroethene was the only VOC also detected in sediment samples collected from the study area.

4.1.2 SVOCs

Two PAH compounds (2-methyl naphthalene, naphthalene) and a common plasticizer [bis-(2-ethyl hexyl) phthalate] were the only SVOCs detected in surface water samples from the study area.

2-Methylnaphthalene and naphthalene were detected in one sample only (MTCSW01001 from Area 2) at concentrations (qualified during data validation as “estimated”) less than screening criteria. These analytes were not detected in background samples. SVOCs were not detected in samples collected from Area 3.

SVOCs DETECTED IN SURFACE WATER VERSUS SCREENING CRITERIA

Analyte	Present in Sampling Areas	Range of Detections (µg/L)	Minimum Ecological Criteria (µg/L)	Region 3 RBC for Tap Water (µg/L)
Bis(2-ethylhexly)phthalate	1, 4 & 5	1	30	4.8
2-Methlynaphthalene	2	2	300	120
Naphthalene	2	2	100	6.5

Bis(2-ethylhexyl)phthalate was detected in two of 11 samples collected from Areas 1 and 4, and in three of five samples from Area 5. This SVOC was not detected in the background surface water samples. All

analytical results were qualified during the data validation process as “estimated” and were less than aforementioned ecological and human health criteria, and sample quantitation limits reported for other samples (i.e., non-detect results). Bis(2-ethylhexyl)phthalate is a common field and laboratory contaminant and is present in plastic products.

4.1.3 Energetics

Three energetics compounds (perchlorate, 1,3-dinitrobenzene, and 4-nitrotoluene) were detected in the Area 1 surface water samples. HMX was the only energetic compound detected in Area 2 surface water samples. No energetic compounds were detected in background surface water samples or samples collected from Areas 3, 4, or 5. (Although perchlorate is listed on Tables 4-16 through 4-20 with the miscellaneous parameters, it is an energetic and is discussed in this section with the other energetic compounds.) Maximum reported concentrations do not exceed 5 µg/L.

Ecological screening criteria are not available for either perchlorate or 4-nitrotoluene. As shown in the summary below, Tables 4-16 through 4-20 indicate that analytical results are an order of magnitude less than criteria. All of the positive results reported were less than or similar to sample quantitation limits reported for other samples (i.e., non-detect results).

ENERGETICS DETECTED IN SURFACE WATER VERSUS SCREENING CRITERIA

Analyte	Area Where Detected	Frequency of Detections	Range of Detected Concentrations (µg/L)	Minimum Ecological Criteria (µg/L)	Region 3 RBC for Tap Water (µg/L)
1,3-Dinitrobenzene	1	1/17	0.075	1200	3.7
4-Nitrotoluene	1	1/17	0.11	NA	61
HMX	2	1/17	0.15	330	1800

4.1.4 Inorganics

Barium, iron, manganese, and vanadium were detected in 80 percent (or more) of the unfiltered and/or filtered surface water samples. The maximum inorganic concentrations detected were generally reported for samples collected near RI Sites 39 and 17 and at TtNUS sample location 21. Frequency of detection statistics, summarized from Tables 4-16 through 4-20, are presented below. Vanadium was not detected in unfiltered or filtered background samples. Barium and iron were not detected in filtered background samples. Analytical results reported for barium and vanadium do not exceed the criteria. Several iron results reported for unfiltered surface water samples (five from Area 1, two from Area 4 and one from Area 5) and a few results reported for filtered surface water samples exceed background concentrations. However, only the iron results reported for the unfiltered samples exceed ecological criteria; no analytical

results reported for iron exceed $RBCs_{tap.}$ Over 50 percent of the manganese results reported for unfiltered and filtered surface water samples exceed ecological screening criteria; no manganese analytical results exceed $RBCs_{tap}$. Additionally, manganese concentrations reported for both unfiltered and filtered samples do not exceed background concentrations.

INORGANICS FREQUENCY OF DETECTION STATISTICS

Analyte	Area 1	Area 2	Area 3	Area 4	Area 5
Barium (unfiltered)	17/17	7/7	4/4	11/11	5/5
Barium (filtered)	16/17	7/7	4/4	5/5	4/5
Iron (unfiltered)	17/17	7/7	4/4	11/11	5/5
Iron (filtered)	5/17	1/7	1/4	1/5	1/5
Manganese (unfiltered)	17/17	7/7	4/4	11/11	5/5
Manganese (filtered)	3/17	1/7	2/4	5/5	3/5
Vanadium (unfiltered)	14/17	7/7	4/4	6/11	4/5
Vanadium (filtered)	7/17	7/7	4/4	5/5	3/5

Aluminum and cadmium were detected in approximately 40 percent of the unfiltered or filtered surface water samples from the study area. Aluminum was detected in unfiltered samples for Areas 1, 2, 4 and 5 but was not detected in any filtered sample. All of the detections reported for aluminum were greater than the ecological criteria; however, only two exceeded background concentrations. Cadmium was detected more frequently in the filtered samples than in unfiltered samples. The majority of the cadmium results reported for the filtered samples exceed background concentrations and ecological screening criteria. Cadmium results reported for the unfiltered samples do not. Cadmium was detected in samples from all five sub-areas; the maximum concentration was reported for a filtered sample from Area 5 (TtNUS Location 25). However, this analytical result, as well as all of the other positive results reported for cadmium, was qualified as “biased-high”. The majority of these positive results were only slightly higher than the detection limit and because these samples were filtered in the laboratory, rather than in the field at the time of collection, it is possible that some of these results could be attributable to laboratory contamination. In fact, cadmium was positively detected in at least one laboratory blank, leading to a data validation qualification of “nondetected” for one of the reported results.

Arsenic, copper, lead, nickel, and zinc were primarily detected in Areas 1 and 4. The frequency of detection was typically less than 25 percent. As summarized below from the information in Tables 4-16 through 4-20, metals concentrations are generally greater in samples from Areas 1 and 4 than in samples collected from Areas 2, 3, and 5. However, the number of samples collected in Areas 1 and 4 exceeds the number of samples collected in Areas 2, 3, and 5 by a factor of two or more. The maximum concentrations reported for most of the metals in Areas 1 and 4 are associated with samples collected from RI locations near Sites 11, 17, 39, and 41, and TtNUS Location 21. (Trichloroethene,

cis-1,2-dichloroethene, and diethyl ether were also detected at TtNUS Location 21. Note that TtNUS Sample Location 21 is near an outfall from a storm sewer that passes through the TCE-contaminated Site 57.)

INORGANICS IN SURFACE WATER DESCRIPTIVE STATISTICS BY AREA

Analyte	Area 1	Area 2	Area 3	Area 4	Area 5
Arsenic (unfiltered)	6.5 (2/17) (H)	6.9 (3/7) (H)	--	8.3 (2/11) (H)	--
Arsenic (filtered)	4.5 (1/17) (H)	5.4 (1/7) (H)	--	4.9 (1/5) (H)	--
Copper (unfiltered)	5.4 (7/17) (E)	--	--	28.1 (1/11) (E)	--
Copper (filtered)	4.8 (3/17) (E)	--	--	69.1 (1/5) (E)	--
Lead (unfiltered)	38.4 (7/17) (E,H)	--	--	5.2 (2/11) (E)	--
Lead (filtered)	1.3 (1/17)	--	--	32 (2/5) (E,H)	66.9 (1/5) (E,H)
Nickel (unfiltered)	3.5 (5/17)	--	--	4 (6/11)	--
Nickel (filtered)	17.9 (4/17) (E)	--	--	--	--
Zinc (unfiltered)	32.7 (3/17) (E)	--	--	90.4 (3/11) (E)	--
Zinc (filtered)	29.9 (1/17) (E)	--	--	--	--

Note: The maximum detected concentration and frequency of detection statistics are presented for each area. “E” and “H” subscripts indicate that a metal was detected in an area at concentrations exceeding ecological (E) or human health (H) criteria. Maximum concentrations are in µg/L.

The inorganics listed above were not detected in the background surface water samples.

Filtered surface water metals concentrations (copper, lead, and nickel) were greater than unfiltered concentrations in some samples collected from Area 1 and Area 4. This may be attributable, in part, to either or both of the following reasons:

1) During sample collection, the unfiltered and filtered samples are collected in two different bottles. The unfiltered portion was preserved immediately after collection with nitric acid. The sample aliquot to be filtered was filtered and preserved at the laboratory. The particulate content and dissolved metals content of each sample may have differed at the time of analysis.

2) Although the copper, nickel, and lead results from some samples that had higher filtered concentrations (as compared to unfiltered concentrations) were not qualified due to laboratory contamination, several other surface water samples in the datasets were qualified "B" due to blank contamination for these metals. Consequently, low-level blank contamination may have impacted the analytical results reported.

Analytical results reported for arsenic (unfiltered and filtered samples) exceed the RBC_{tap}. However, the maximum concentrations detected do not exceed either ecological criteria or the current federal SDWA MCL (10 µg/L). Lead results reported for three samples exceed the RBC_{tap} of 15 µg/L (one unfiltered sample from Area 1; one filtered sample each from Areas 4 and 5). One to three lead results in Areas 1, 4, and 5 also exceed ecological criteria. Copper results reported for six unfiltered (and one filtered) samples from Area 1 and one filtered and one unfiltered sample from Area 4 were greater than ecological criteria; the analytical results for copper do not exceed the RBC_{tap}. The nickel result reported for one filtered sample collected from Area 1 exceeds ecological criteria; none of the analytical results reported for nickel exceed the $RBC_{tap.}$ With the exception of results reported for one unfiltered sample from Area 4, all zinc detections reported exceed the ecological criteria; none of the analytical results reported for zinc exceed the $RBC_{tap.}$

Beryllium, chromium, selenium, and silver were detected in only one or two unfiltered and/or filtered samples as described below.

- Beryllium - one of seven unfiltered samples from Area 2 (C_{max} = 0.12 µg/L)

- Chromium - detected in one of 17 unfiltered samples from Area 1 (C_{max} = 3.4 µg/L); one of five unfiltered samples from Area 5 (C_{max} = 0.93 µg/L); and in one of 17 filtered samples from Area 1 (C_{max} = 9.7 µg/L)

- Selenium - detected in one of 17 unfiltered (C_{max} = 5.8 µg/L) and one of 17 filtered samples (C_{max} = 4.9 µg/L) in Area 1

- Silver - detected in one of 11 unfiltered samples from Area 4 (C_{max} = 6 µg/L)

Analytical results reported for these metals do not exceed $RBC_{tap.}$ Chromium in the Area 1 sample (unfiltered and filtered samples), exceeds both the maximum background concentration and the ecological criteria. The selenium result for Area 1 sample, IS17SW05, exceeds the ecological criteria and background. Silver results for Area 4 Sample S39SW0020001 (unfiltered) and its duplicate exceed the ecological criteria.

With the exception of magnesium results reported for two filtered samples from Area 1, the common cations, calcium, potassium, magnesium and sodium were detected in all unfiltered and filtered surface water samples collected from the study area. RBCs and ecological criteria do not exist for these analytes because they are essential nutrients and are non-toxic at typical environmental concentrations. Maximum detected concentrations for the study area samples do not exceed concentrations reported for the background samples.

Cyanide was only detected in Area 1 in five of the 17 samples collected. The concentrations detected ranged from 1.1 to 10 µg/L. All five of the detections were greater than the ecological criteria of 1 µg/L; but less than the maximum background concentration.

Nitrate was detected in five of 22 samples in Areas 1 through 4. Nitrate was not detected in Area 5. There are no ecological criteria for nitrate; results reported for nitrate do not exceed either background concentrations or the RBC_{tap}.

4.2 SEDIMENT CHEMISTRY

A total of 28 sediment samples and four duplicates were collected during the main TtNUS field investigation (September 2001):

Area	Number of Samples
1	7 plus 1 duplicate (MTC002)
2	7 plus 1 duplicate (MTC012)
3	4
4	5
5	5 plus 2 duplicates (MTC023 and MTC026)

These sediment samples were co-located with the surface water samples. The samples were analyzed in fixed-base laboratories, and the analytical results were subjected to third-party data validation. As a result, the data were suitable for use in ecological and human health risk assessments. Ten sediment samples collected as part of the CH2M Hill RI for Sites 11 and 17 (located within Area 1), are included in this nature and extent of contamination evaluation, as well as eight sediment samples collected in 1977 for the TtNUS RI for Site 39/41 (Area 4). Analytical data from the following sources are also discussed in this section, but are not included in the data summary tables or figures.

- The site investigation for IR Sites 39/41 (Area 4) - 16 sediment and two duplicates samples were collected in 1992.

- The aforementioned SAIC TIE investigation that included the collection of sediment samples from locations along Mattawoman Creek. One TIE sample was collected in Area 1. A second sample was collected in Area 5, and eight samples were collected from Area 4.

- The initial field screening investigation for the Mattawoman Creek conducted in August 2001 using SPAWAR methods.

The sediment samples collected during the September 2001 sampling event were analyzed for TCL VOCs, diethyl ether, TCL SVOCs, TCL pesticides/PCBs, energetic compounds, TAL metals, cyanide, AVS/SEM and TOC. The CH2M Hill samples from Site 11 were analyzed for TCL VOCs, TCL SVOCs, TAL metals, cyanide, energetic compounds, DRO, GRO and ammonium perchlorate. The CH2M Hill samples from Site 17 were analyzed for TAL metals, cyanide, energetic compounds, pH, TOC and ammonium perchlorate. The TtNUS RI samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, AVS/SEM, energetics, pH and TOC (see Table 3-4).

The SAIC TIE samples were analyzed for a smaller list of parameters, consisting of select metals, PAHs, pesticides, PCBs, energetics, AVS/SEM and TOC. The field screening (SPAWAR) samples were analyzed for metals, pesticides, PCBs and PAHs only.

Chemical concentrations detected in the sediment samples that are the focus of this data evaluation are displayed in Figures 4-5 through 4-11. Analytical results for all parameters detected at least once in sediment are presented in Tables 4-21 through 4-25. Basic descriptive statistics (frequency of detection, range of positive detections, average of positive detections, etc.) for each area and comparisons to relevant criteria and background are presented in Tables 4-26 through 4-30. Analytical results for sediment samples were compared to the previously defined EPA Region 3 $RBC_{res\text{-}soil}$ and ecological criteria and the maximum background concentrations reported for sediment sampling locations in Areas 6 and 7 (Table 4-2).

Figures 4-12 and 4-19 are eight color coded figures generated to present the concentrations of select chemicals (total PAHs, arsenic, cadmium, copper, lead, mercury, silver, and zinc). These figures include data from samples collected during the SPAWAR sampling event (indicated as the screening locations), along with the all of the data that was used in the risk assessment from the main sampling event (indicated as the fixed-base locations). Only the SPAWAR data from areas where fixed-based samples were not collected during the main sampling event were included in Figures 4-12 through 4-19, because the SPAWAR data were screening data (see Section 3.1.4). Therefore, the fixed-base results from the same locations are considered more reliable data. The SPAWAR data is presented in Appendix B-8.

Also, as noted in Appendix B-8, the SPAWAR values for PAHs are approximately 10 times greater than the corresponding fixed-base confirmation samples. Therefore, the SPAWAR data were divided by 10 prior to their inclusion on Figure 4-12.

Sample points on the figures are different colors based on their concentrations. A sample is white if it is below the Threshold Effects Concentration (TEC) (MacDonald et al., 2000); it is blue if it is between the TEC and the Probable Effects Concentration (PEC) (MacDonald et al., 2000); and green if it is greater than the PEC. Because there is not a TEC or PEC for silver, the Effects Range-Low (ER-L) and Effects Range-Median (ER-M) from Long et al., (1995) values were used in place of the TEC and PEC, respectively. Yellow, orange, and red colors were used in the sample figures to indicate greater concentrations of the chemicals in the sediment samples. Section 5.6.1.1 of the ecological risk assessment portion of this report describes the significance of these values in the risk assessment.

4.2.1 VOCs

One BTEX compound (toluene), two chlorinated hydrocarbons (trichloroethene, cis-1,2 dichloroethene), two chlorinated methane compounds (chloromethane, chloroform), two ethers (diethyl ether, methyl tert-butyl ether), two ketones (acetone, 2-butanone), and carbon disulfide were detected in the study area sediment samples. With the exception of acetone (C_{max} = 2,400 µg/kg; frequency of detection (FOD) > 50 percent) and carbon disulfide (C_{max} = 45 µg/kg; FOD > 50 percent), which are also common field and laboratory blank contaminants, all of these VOCs were detected in four or less samples and at maximum concentrations less than 60 µg/kg. With the exception of chloroform, chloromethane, 2-butanone, and carbon disulfide, all of these chemicals were also detected in surface water samples collected from the study area at maximum concentrations not exceeding 50 µg/L. With the exception of acetone and carbon disulfide, none of these VOCs were detected in the background sediment samples collected from Areas 6 and 7.

As summarized below from the information in Tables 4-26 through 4-30, acetone and carbon disulfide (two common lab/field blank contaminants) were detected in all five study areas:

COMMON LAB/FIELD BLANK CONTAMINANTS FREQUENCY OF DETECTION STATISTICS

Analyte	Area 1	Area 2	Area 3	Area 4	Area 5
Acetone	6/11	6/7	4/4	5/13	5/5
Carbon disulfide	4/11	7/7	4/4	7/13	4/5

1 Frequency of detection statistics are presented.

All of the positive results reported for carbon disulfide exceed the sediment ecological criteria but are less than background. However, only two of the positive results reported for acetone (Area 4) exceed the ecological criteria and the maximum background concentration (samples S39SD0070001 and S39SD0080001, collected in 1997). Acetone concentrations that were reported for more recently collected samples are an order of magnitude less than those reported for the 1997 samples.

Other VOCs were detected less frequently and were not detected in all five study areas. They are as follows:

- 2-Butanone - detected in one of 11 samples from Area 1 and two of 13 samples from Area 4
- Chloromethane - detected in one of 11 samples from Area 1
- Toluene - detected in Areas 1 through 4 (one sample only in each area)
- Chloroform - detected Areas 3 and 5 (one sample only in each area)
- Cis-1,2-dichloroethene – detected in one of five samples from Area 4
- Diethyl ether - detected two of 5 samples from Area 4
- Trichloroethene – detected in one of 13 samples from Area 4
- Methyl-tert-butyl ether - detected in one of five samples from Area 5

These VOCs were not detected at concentrations exceeding criteria presented in Tables 4-26 through 4-30. Additionally, chloromethane and chloroform results approximate the concentration range reported for nondetect results. All results reported for toluene, trichloroethene or methyl-tert-butyl ether were qualified as “estimated” results during the data validation process and are less than the sample quantitation limits reported for non-detected results. The samples collected in Area 4 with the cis-1,2-dichloroethene, diethyl ether, and trichloroethene detections were collected at locations MTCSD020 and/or MTCSD021. These samples are located near the Site 57 storm sewer outfall, which has been a source of VOCs to Mattawoman Creek in the past (see Section 2.2.5).

Only carbon disulfide and chloromethane were detected in the 1992 samples. Carbon disulfide was detected in three of 16 samples collected (concentrations of 3, 5 and 6 µg/kg), one from Site 39 and two from Site 41. Chloromethane was detected in four of 16 samples collected (concentrations of 5, 13, 16 and 17 µg/kg), two each from Sites 39 and 41.

4.2.2 SVOCs

Seventeen PAH compounds, 4-methyl phenol, two phthalate compounds, carbazole, dibenzofuran, and n-nitroso-di-phenyl amine were detected in one or more sediment samples collected from the study area. All of these chemicals tend to partition to sediments (versus surface water) when they are introduced into

the environment. Consequently, SVOCs were detected infrequently and at concentrations not exceeding 5 µg/L in the surface water samples collected from the study area. Bis(2-ethyl hexyl phthalate) and 4-methylphenol were the only SVOCs detected in both the sediment samples and the fish tissue samples (whole-body and/or fillet).

As shown in Tables 4-26 through 4-30, PAHs are the predominant SVOCs in the sediments. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene and pyrene were detected in all five areas and at maximum concentrations exceeding 1,000 µg/kg (but less than 4,000 µg/kg). The maximum concentrations were reported for location 12 (Area 2), and locations 20 and 21 (Area 4). TtNUS locations 12 and 20 are co-located with SPAWAR locations 47 and 68. The SPAWAR samples collected at locations 47 and 68 also demonstrated elevated PAH concentrations (total PAH concentrations did not exceed 70,000 µg/kg). PAHs were not detected in the Area 6 or 7 background sediment samples. Figure 4-12 is a color-coded figure that presents the total PAH concentration ranges in the sediment samples collected in Mattawoman Creek.

As indicated from the text in Section 3.1.2.4, one proposed sediment sample was not collected during the SPAWAR pilot study because there was an oil spill in the area and the proposed sample location was within the perimeter of the booms that were set up to contain the spill. Sample SPAWAR location 68 was close to where the booms were set up, and may have been impacted by the oil spill. Also, a slight sheen was observed on the sediment sample from this location. Therefore, the PAHs in sediment samples MTCSD020 and MTCSD021 may be related to the release of oil in this area. Also, as discussed in Section 2.2.5, several PAHs were detected in the open channel sediment and storm sewer outfall samples from Site 57 to Mattawoman Creek. Sediment samples MTCSD020 and MTCSD021 were located near the Site 57 open channel sediment and storm sewer outfall samples so PAHs from Site 57 also may be a source of the PAHs in MTCSD020 and MTCSD021. Sediment sample MTCSD012 is located near a small motor test facility which is located along Mattawoman Creek. PAHs are generated as part of the motor testing ad may be the source of PAHs at MTCSD012.

The greatest concentrations of PAHs were found in Areas 1, 2, and 4 (see Figure 4-15), although the elevated detections were sporadic. The maximum detection was found in MTCSD021 at 15,099 mg/kg. Concentrations decreased in downstream samples to 7,345 mg/kg in MTCSD020 to 820 mg/kg in MTCSD019 (approximately 500 feet downstream). The next nearest upstream sample (MTCSD022), approximately 1,200 feet, had a detected total PAH concentration of 960 mg/kg.

The second greatest detection of total PAHs was found in Area 2 at sample MTCSD012 with a concentration of 12,765 mg/kg. Concentrations of total PAHs decreased upstream and downstream from this location. MTC56, a SPAWAR screening location, located approximately 350 feet upstream had a

concentration of 239 mg/kg, while MTCSD010, located approximately 1,600 feet downstream had a concentration of 410 mg/kg. MTCSD011 and MTCSD013 (not shown on Figure 4-12) were collected offshore within Mattawoman Creek approximately 400 and 1,000 feet from MTCSD012. PAHs were not detected in these samples.

The maximum detections of total PAHs in Area 1 were samples MTCSD004 (2,396 mg/kg) and IS11SD02 (2,033 mg/kg). These two samples are located approximately 300 feet apart and are separated by IS11SD03, collected in the middle of the two samples. These concentrations appear to be isolated detections along the shoreline because the total PAH concentration of sample IS11SD03 was much lower at 201 mg/kg. Additionally, concentrations of total PAHs decreased in upstream and downstream locations. MTCSD002, the next nearest downstream sample collected approximately 1,200 feet from MTCSD004, had a total PAH concentration of 616 mg/kg. MTC26, a SPAWAR screening location, is the next nearest upstream sample, collected approximately 500 feet upstream of IS11SD02. The concentration of total PAHs in this location was 165 mg/kg. Several of these sediment samples were collected as part of the CH2M Hill investigations of Sites 11 and 17. The sediment samples were generally collected along the shoreline in this area so it is not known how far the elevated PAH levels extend into Mattawoman Creek.

It should be noted, however, that the concentrations in the study area samples are similar to background soil and sediment concentrations reported in the literature. PAHs are fuel components and by-products of combustion. Consequently, facility-related anthropogenic activities may have contributed to the PAH concentrations detected in the sediment samples collected from the study area.

Frequency of detection statistics from Tables 4-26 through 4-30 are summarized below for the SVOCs detected in the study area sediment samples.

SVOCs IN SEDIMENT DESCRIPTIVE STATISTICS BY AREA

Analyte	Area 1	Area 2	Area 3	Area 4	Area 5
Anthracene	76 (1/11)	540 (1/7) (E)	--	480 (2/13) (E)	--
Benzo(a)anthracene	250 (2/11)	1700 (2/7) (H,E)	100 (1/4)	1400 (4/13) (H,E)	120 (2/15)
Benzo(a)pyrene	210 (2/11) (H)	1800 (2/7) (H,E)	96 (1/4) (H)	1000 (3/13) (H,E)	110 (3/5) (H)
Benzo(b)fluoranthene	400 (6/11)	2000 (3/7) (E)	150 (2/4)	1500 (7/13) (E)	220 (3/5)
Benzo(g,h,i)perylene	120 (1/11)	1100 (1/7)	--	330 (3/13)	51 (1/5)
Benzo(k)fluoranthene	170 (2/11)	730 (1/7) (E)	--	1500 (3/13) (E)	50 (1/5)

Analyte	Area 1	Area 2	Area 3	Area 4	Area 5
Bis(2-ethylhexyl)phthalate	150 (2/11)	--	--	410 (4/13)	--
Chrysene	370 (4/11)	1700 (2/7) (E)	120 (1/4)	1400 (7/13) (E)	180 (3/5)
di-n-Butyl phthalate	630 (1/11)	--	--	640 (3/13)	--
Dibenzo(a,h)anthracene	55 (1/11)	220 (1/7) (H,E)	--	130 (2/13) (H,E)	--
Diethyl phthalate	99 (1/11)	65 (1/7)	840 (1/4) (E)	--	--
Fluoranthene	410 (6/11)	4000 (3/7) (E)	160 (2/4)	2600 (7/13) (E)	180 (3/5)
Indeno(1,2,3-cd)pyrene	130 (2/11)	1100 (1/7) (E)	--	400 (3/13)	55 (1/5)
Phenanthrene	290 (3/11) (E)	2600 (2/7) (E)	--	1500 (5/13) (E)	--
Pyrene	350 (6/11)	4000 (3/7) (E)	170 (3/4)	2300 (7/13) (E)	240 (3/5)
4-Methylphenol	--	80 (1/7)	--	--	--
Acenaphthylene	--	340 (1/7) (E)	--	83 (1/13) (E)	--
Carbazole	--	110 (1/7)	--	140 (2/13)	--
Dibenzofuran	--	80 (1/7)	--	94 (1/13)	--
Fluorene	--	180 (1/7) (E)	--	200 (2/13) (E)	--
2-Methylnaphthalene	--	--	--	85 (2/13) (E)	--
Acenaphthene	--	--	--	120 (2/13) (E)	--
n-Nitrosodiphenylamine	--	--	--	4800 (6/13) (E)	500 (4/5) (E)
Naphthalene	--	--	--	71 (2/13)	--

Note: The maximum detected concentration and frequency of detection statistics are presented for each area. "E" and "H" subscripts indicate that an SVOC was detected in an area at concentrations exceeding ecological (E) or human health (H) criteria. Maximum concentrations are in µg/kg.

Several SVOCs were detected at concentrations exceeding the ecological criteria; however, only benzo(a)anthracene, benzo(a)pyrene, and dibenzo(ah)anthracene were detected at concentrations exceeding the $RBC_{res\text{-}soil}$. Benzo(ghi)pyrene, bis(2-ethyl hexyl)phthalate, di-n-butyl phthalate, 4-methylphenol, carbazole, dibenzofuran, and naphthalene concentrations do not exceed the human health or ecological criteria presented in Tables 4-26 through 4-30. Bis(2-ethylhexyl)phthalate and di-n-butyl phthalate detections reported were generally similar to the sample quantitation limits reported for non-detect results for these analytes. 4-Methylphenol was detected in one Area 2 sediment sample

(the duplicate of sample MTCSD01201); the estimated result is less than sample quantitation limits reported for non-detect results for other sediment samples.

Several SVOCs, primarily PAHs and a few detections of 1,1-dimethylhydrazine and N-nitrosodiphenylamine were found in the 1992 sediment samples. The majority of the positive PAH detections and all three of the 1,1-dimethylhydrazine detections were found in the vicinity of Site 39. Four of the five detections for N-nitrosodiphenylamine were found in the vicinity of Site 41.

4.2.3 Pesticides/PCBs

Three pesticide compounds (4,4'-DDD, 4,4'-DDE, and alpha-BHC) and one PCB (Aroclor-1248) were detected infrequently (one or two sediment samples only) and at maximum concentrations that do not exceed aforementioned human health screening criteria. The pesticides were detected in Area 4 only; Aroclor-1248 was detected in Area 1 only. Pesticides/PCBs were not detected in the background sediment samples. However, the pesticide concentrations reported (C_{max} = 10 µg/kg) are similar to background concentrations reported in the literature for sediments. The Aroclor-1248 concentration (170 µg/kg) detected in Sample MTCSD00401 was greater than the ecological criteria of 22.7 µg/kg. The positive detections reported for 4,4'-DDE (4.1 µg/kg and 6 µg/kg) marginally exceed the ecological criteria (2.2 µg/kg). Pesticides were only detected in TtNUS samples collected in 1997.

4.2.4 Energetics

As summarized below from the information in Tables 4-26 through 4-30, three nitrobenzene compounds, four nitrotoluene compounds, and HMX were detected infrequently (one or two sediment samples only) and at maximum concentrations not exceeding 250 µg/kg:

ENERGETICS DETECTED IN SEDIMENT VERSUS SCREENING CRITERIA

Analyte	Range of Detected Concentrations (mg/kg)	Range of Nondetected Concentrations (mg/kg)	Background Concentrations (mg/kg)	Minimum Ecological Criteria (mg/kg)	Region 3 RBC for Soil (mg/ kg)
1,3,5-Trinitrobenzene	0.094	0.25	ND	0.002	2300
1,3-Dinitrobenzene	0.069	0.25	ND	0.007	7.8
2,4,6-Trinitrobenzene	0.066 – 0.1	0.25	ND	0.09	21
2,6-Dinitrotoluene	0.1	0.25	ND	0.294	78
2-Amino-4,6-dinitrotoluene	0.22	0.25	ND	NA	4.7
3-Nitrotoluene	0.18 – 0.22	0.25	ND	NA	1600
4-Nitrotoluene	0.14	0.16 – 0.25	ND	NA	780
HMX	0.1	0.25	0.17	0.005	3900

With the exception of one detection of HMX in Area 5, these energetics were detected in Area 1 sediment samples only. HMX was the only energetic compound detected in the background sediment samples. 1,3,5-Trinitrobenzene, 1,3-dinitrobenzene, 2,4,6-trinitrobenzene and HMX were detected at concentrations exceeding ecological screening criteria; energetics were not detected at concentrations exceeding the $RBC_{res\text{-}soil}$. All of the positive detections were less than sample quantitation limits reported for nondetect results and were qualified during the data validation process as "estimated" concentrations. All of the ecological criteria, with the exception of 2,6-dinitrotoluene, are also less than the associated nondetect values. The maximum concentration of four of the above analytes (1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4,6-trinitrobenzene and 3-nitrotoluene) occurred in Sample IS17SD020001, collected from Mattawoman Creek during the RI investigation of Site 17.

Nitrocellulose (C_{range} = 2 to 4780 mg/kg; FOD = 30/36) was detected in one or more sediment samples collected from each of the five study areas and in all four background sediment samples (C_{range} = 1.3 to 56 mg/kg). Fifty percent or more of the nitrocellulose concentrations reported for samples collected in Areas 3, 4, and 5 exceed the maximum nitrocellulose concentration reported in the background samples; nitrocellulose concentrations detected in Areas 1 and 2 do not. Human health and ecological screening criteria are not available for nitrocellulose. However, nitrocellulose is generally considered a non-toxic compound to both human receptors and biota (See Section 6).

Perchlorate, an extremely water soluble compound, was not detected in the sediment samples collected from the study area, although only the CH2M Hill samples from Sites 11 and 17 were analyzed for this chemical.

4.2.5 Inorganics

Summarizing from Tables 4-26 through 4-30, the following inorganics were detected in sediment samples collected from the study area.

INORGANICS IN SEDIMENT DESCRIPTIVE STATISTICS BY AREA

	Area 1	Area 2	Area 3	Area 4	Area 5
Aluminum (11,400)	13,100 (17/17) B	13,400 (7/7) B	12,400 (4/4) B	19,600 (13/13) B,E	9,860 (5/5)
Antimony (ND)	63.9 (7/17) B,H	ND	ND	0.69 (1/13) B	ND
Arsenic (4.1)	32.7 (16/17) B,E,H	14.6 (7/7) B,E,H	9.6 (1/4) B,E,H	16.6 (10/13) B,E,H	70.7 (2/5) B,E,H
Barium (112)	169 (17/17) B,E	152 (7/7) B,E	154 (4/4) B,E	163 (13/13) B,E	122 (5/5) B,E

	Area 1	Area 2	Area 3	Area 4	Area 5
Beryllium (1.3)	1.2 (11/17)	1.4 (7/7) B	1.5 (4/4) B	1.6 (13/13) B	1.2 (5/5)
Cadmium (3.5)	18.7 (15/17) B,E	4.1 (7/7) B,E	1.5 (3/4) E	1.7 (8/13) E	116 (5/5) B,E,H
Chromium (25)	69.7 (17/17) B	31.6 (7/7) B	29 (4/4) B	32.3 (13/13) B	23.1 (5/5)
Cobalt (19.8)	20 (16/17) B,E	22.6 (7/7) B,E	21.7 (4/4) B,E	34.7 (13/13) B,E	15.9 (4/5) E
Copper (22.7)	757 (15/17) B,E	36.3 (7/17) B,E	37.1 (4/4) B,E	120 (13/13) B,E	229 (4/5) B,E
Cyanide (ND)	4.7 (1/17) B	3.8 (1/17) B,E	ND	0.18 (1/13) B	ND
Iron (27,900)	13,400 (17/17) B,E,H	32,800 (7/7) B,E,H	31,500 (4/4) B,E,H	43,800 (13/13) B,E,H	25,200 (5/5) B,E,H
Lead (30.7)	76,400 (17/17) B,E,H	54.2 (7/7) B,E	45.8 (4/4) B	87.9 (13/13) B,E	3,010 (5/5) B,E,H
Manganese (876)	1,120 (17/17) B,E,	1,030 (7/7) B,E	851 (4/4) E	1,470 (13/13) B,E	691 (5/5) E
Mercury (ND)	0.53 (10/17) B,E	0.54 (4/7) B,E	0.24 (2/4) B,E	8.7 (12/13) B,E	0.34 (3/4) B,E
Nickel (22.5)	46.4 (16/17) B,E	30.6 (7/7) B,E	28.4 (4/4) B,E	39.8 (13/13) B,E	22 (4/5) E
Selenium (ND)	1.7 (1/17) B,E	ND	ND	ND	ND
Silver (0.76)	10.9 (10/17) B,E	1.4 (6/7) B,E	4.8 (3/4) B,E	308 (10/13) B,E	5.9 (4/5) B,E
Thallium (ND)	4.2 (3/17) B	2.9 (2/7) B	ND	2.7 (3/13) B	2.4 (1/5) B
Vanadium (32.9)	39 (17/17) B	43.5 (7/7) B	40.3 (4/4) B	53.4 (13/13) B	33.6 (5/5) B
Zinc (142)	1,910 (13/17) B,E	148 (6/7) B	204 (3/4) B,E	273 (13/13) B,E	71,000 (5/5) B,E,H

Note: The maximum concentrations and frequency of detection statistics are presented for each area. The “B”, “E” and “H” subscripts indicate that at least one detection was reported above background (B), ecological (E) or human health (H) criteria. Maximum background concentrations are presented in parentheses next to the chemical. All concentrations are in mg/kg.

As summarized above, the majority of these inorganics were detected in 80 percent or more of the samples analyzed. However, antimony, cyanide, selenium, and thallium were detected infrequently (i.e., in less than 20 percent of the samples analyzed).

The maximum concentration reported for several of the inorganics (e.g., antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc) exceeds the maximum background concentration by an order of

magnitude. The elevated detections of these metals are primarily associated with samples near Site 11 (Area 1), Site 39/41 (Area 4), and samples collected from TtNUS Location 26 (Area 5) during the main field investigation (September 2001). An overview of environmental contamination at Sites 11 and 39/41 was presented in Section 2; metals were among the chemicals of potential concern for these sites.

Figures 4-16 through 4-22 are color-coded figures that present concentration ranges for select metals in the sediment samples collected in Mattawoman Creek. The following paragraphs summarize the spatial areas that these metals represent.

Arsenic

The greatest arsenic concentrations were found in Areas 1, 4, and 5 (see Figure 4-13). The maximum arsenic detection (58.1 mg/kg) was found at MTCSD026 in Area 5. The concentrations decreased in the downstream samples to 13.8 mg/kg in MTCSD025 (approximately 350 feet downstream of MTCSD026) to less than 10 mg/kg in the next three downstream samples (approximately 600 to 2,000 feet downstream of MTCSD026). No sediment samples were collected immediately upstream of MTCSD026 so the spatial area of the elevated arsenic detections in that direction is not known.

Area 1 had the next greatest concentrations of arsenic. Several samples had concentrations between 15 mg/kg and 33 mg/kg (with the exception of one sample with a lower concentration) along an approximately 1,000 to 1,200 foot stretch of shoreline, and may extend a few hundred more feet downstream to MTCSD003. Several of these sediment samples were collected as part of the CH2M Hill investigations of Sites 11 and 17.

Finally, several samples had arsenic concentrations between 9.8 mg/kg and 17 mg/kg in Area 4. These samples were in an 800 to 900 foot section of the creek. No sediment samples were collected immediately upstream so the spatial area of the elevated arsenic detections in that direction is not known.

Cadmium

The greatest cadmium concentrations were found in Areas 1 and 5 (see Figure 4-14). The maximum cadmium detection (79.9 mg/kg) was found at MTCSD026 in Area 5. Downstream samples were significantly lower from 0.4 mg/kg in MTCSD025 (approximately 350 feet downstream) to 2.3 mg/kg and 1.35 mg/kg in samples MTCSD024 and MTCSD023 (approximately 600 to 2,000 feet downstream of MTCSD026). No sediment samples were collected immediately upstream of MTCSD026 so the spatial area of the elevated cadmium detections in that direction is not known.

Area 1 had the next greatest concentrations of cadmium. Five samples had concentrations between 4.2 mg/kg and 18.7 mg/kg along an approximately 1,000 to 1,200 foot stretch of shoreline. Sample MTCSD003 (approximately 500 feet downstream from this area) had a cadmium concentration of 1 mg/kg. Sediment samples in this area were collected along the shoreline to evaluate conditions at Sites 11 and 17.

Copper

Copper was detected at the greatest concentrations in Area 1 and sample MTCSD026 in Area 5 (see Figure 4-15). Concentrations of copper ranged from 335 mg/kg to the maximum detected copper concentration of 757 mg/kg along an approximately 1,000 to 1,200 foot of shoreline in Area 1. Sediment samples upstream decreased from 149 mg/kg in IS17SD05 (less than 250 feet upstream from the elevated area) to less than 32 mg/kg in the next three upstream samples. Approximately 500 feet downstream from the elevated area, detection of copper in MTCSD003 was 8.6 mg/kg.

Copper was detected at the next greatest concentration in sample MTCSD026 in Area 5. The copper concentration in this sample was 160.7 mg/kg. Concentrations decreased in the next three downstream samples with concentrations less than 25 mg/kg. No sediment samples were collected immediately upstream of MTCSD026 so the spatial area of the elevated copper detections in that direction is not known.

Lead

Similar to other metals, the greatest detections of lead occurred in Area 1 and sample MTCSD026 in Area 5 (see Figure 4-16). The maximum detected concentration occurred in sample IS11SD01 at 76,400 mg/kg. Concentrations in upstream and downstream samples decreased. The three upstream samples (approximately 1,000 feet from IS11SD01) decreased to less than 36 mg/kg while downstream sample concentrations decreased to 15.8 mg/kg in sample MTCSD003 (approximately 1,000 feet from IS11SD01). Sediment samples in this area were collected along the shoreline to evaluate conditions at Sites 11 and 17.

Sample MTCSD026 in Area 5 had the second highest concentration of lead at 2,170 mg/kg. Concentrations decreased in the downstream samples MTCSD025 and MTCSD024 (approximately 350 to 600 feet downstream of MTCSD026). No sediment samples were collected immediately upstream of MTCSD026 so the spatial area of the elevated lead detections in that direction is not known.

Mercury

The greatest mercury concentrations were found in Area 4 (see Figure 4-17). The maximum mercury detection was found in sample S39SD07. Concentrations upstream decreased to 2 mg/kg in sample S39SD08 (approximately 500 feet from S39SD07) to 0.13 mg/kg in MTCSD020 (approximately 700 feet upstream from S39SD07). The concentrations in the two downstream samples decreased to less than 0.18 mg/kg (approximately 500 feet from S39SD07). Samples MTCSD018 and MTCSD019 were collected within Mattawoman Creek (approximately 650 feet from S39SD07, see Figure 4-20). Concentrations in these samples were 0.37 mg/kg and 0.26 mg/kg, respectively.

Silver

The greatest concentrations of silver were found in Areas 1, 4, and 5 (see Figure 4-18). The maximum silver detection was found in S39SD04 at 308 mg/kg in Area 4. Concentrations were lower in samples S39SD03 and 39DP05, which were collected within the immediate vicinity of S39SD04 (see Figure 3-3), at 66 mg/kg and 43 mg/kg, respectively. These samples are immediately bounded by two downstream samples that are less than 1 mg/kg. Samples MTCSD018 and MTCSD019 were collected within Mattawoman Creek, approximately 300 and 1,200 feet offshore of S39SD04. Concentrations of silver in these samples were lower at 1.5 mg/kg and 1.6 mg/kg, respectively.

The second greatest concentrations of silver were found in Area 1, particularly in samples IS11SD03, IS11SD01, IS17SD05, IS17SD06, and IS11SD04. These samples comprise an approximately 1,000 foot stretch of shoreline; concentrations ranged from 10.9 mg/kg in IS11SD03 to 4.5 mg/kg in IS17SD06. Concentrations immediately upstream (approximately 250 feet) and downstream (approximately 500 feet) of these samples were less than 1 mg/kg. These sediment samples were collected along the shoreline to evaluate conditions at Sites 11 and 17.

MTCSD023, located within Mattawoman Creek in Area 5, appears to be an isolated detection of silver at 4.6 mg/kg. Upstream samples (approximately 500 to 1,100 feet) were less than 1 mg/kg. The nearest downstream sample, MTCSD022 (also an onshore sample), was collected approximately 700 feet from MTCSD023 and also lower at 1.4 mg/kg.

Zinc

The greatest concentrations of zinc were found in Area 1 and in sample MTCSD026 in Area 5 (see Figure 4-19). The maximum detection was found in MTCSD026 at 61,900 mg/kg. Concentrations decreased in downstream samples MTCSD025 and MTCSD024 (approximately 600 feet downstream of MTCSD026)

to less than 75 mg/kg. No sediment samples were collected immediately upstream of MTCSD026 so the spatial area of the elevated arsenic detections in that direction is not known.

The next greatest concentrations of zinc were located along approximately 1,000 to 1,200 stretch of shoreline in Area 1. Concentrations in these samples ranged from 712 mg/kg to 1,910 mg/kg. Concentrations decreased in the four upstream samples to less than 120 mg/kg (approximately 750 feet upstream from the elevated area). Zinc was not detected in MTCSD003 (approximately 500 feet downstream of the elevated area). Several of these sediment samples were collected as part of the CH2M Hill investigations of Sites 11 and 17. The sediment samples were generally collected along the shoreline in this area so it is not known how far the elevated zinc levels extend into Mattawoman Creek.

Silver, lead, zinc, and cadmium concentrations were also notable in several SPAWAR and TIE samples collected from the study area as indicated below:

- Silver concentrations between 3.7 mg/kg and 5.6 mg/kg were detected in sediment samples collected from SPAWAR Location 23 (Area 1), Location 60 (Area 3) and Locations 62 and 63 (Area 4). (The maximum background silver concentration was 0.76 mg/kg.) SPAWAR Location 23 is in the vicinity of TtNUS Location 4 (3.2 mg/kg). Locations 60, 62, and 63 are bounded by/in the vicinity of TtNUS Locations 16, 17, and 18 (2.7 mg/kg, 0.1 mg/kg, 1.5 mg/kg). The silver concentration reported for TIE Location 2 (203 mg/kg) may reflect its proximity to Sites 39/41.

- Zinc and lead concentrations as high as 11,930 mg/kg and 471 mg/kg, respectively, were detected at SPAWAR Location 77. This location is co-located with TtNUS Location 26 (zinc =61,900 mg/kg; lead=2,170 mg/kg), and TIE Location 15 (cadmium = 32.1 mg/kg; lead 1,010 mg/kg; zinc = 21,600 mg/kg). There are no TtNUS, SPAWAR, or TIE locations immediately upgradient of this location

Most of the analytical results reported for the other inorganics listed in Tables 4-26 through 4-30 are similar to concentrations reported in the background samples or are less than two times the maximum background concentration.

One or more results reported for antimony, arsenic, cadmium, iron, lead, and zinc exceeded the $RBC_{res\text{-}soil}$:

- Antimony – Analytical results reported for three samples associated with CH2M Hill Site 11 (Area 1).

- Arsenic, iron – One or more results from each area. (However, even background arsenic concentrations exceed the $RBC_{res\text{-}soil}$.)

- Cadmium – Analytical results reported for TtNUS location 26 in Area 5.

- Lead – Analytical results reported for TtNUS location 26 in Area 5 and five samples from CH2M Hill Site 11 (Area 1).

- Zinc - Analytical result reported for TtNUS Location 26 in Area 5.

As summarized above from Tables 4-26 through 4-30, analytical results exceeding the conservative ecological screening criteria were reported for several inorganics in sediment samples collected in all five study areas. However, two positive detections for cyanide (MTCSD00201, Area 1, and the duplicate of Sample MTCSD01201, Area 2) and one for aluminum (Sample S39SD0070001, Area 4) exceeded the ecological criteria. Selenium (1.7 mg/kg) was detected once (Sample IS11SD030001, Area 1); the ecological screening criteria is 1 mg/kg. Analytical results reported for chromium and vanadium do not exceed the ecological criteria presented in Table 4-9. There are no ecological criteria presented for beryllium and thallium.

4.2.6 AVS/SEM

As a precipitant of heavy metals, sulfide is important in controlling the bioavailability of metals in sediments (EPA, December 1991). The relative amounts of SEM and AVS are important for the prediction of potential metal bioavailability. In general, metals tend to bind to sulfide when they are present. When AVS concentrations exceed SEM concentrations in a sample, the assumption is that all of the SEM metals are bound to the sulfides; and therefore, they are not bioavailable or toxic. The reverse situation (i.e., SEM results exceed AVS results) is not necessarily an indicator that the samples are toxic, only that the potential is there for the heavy metals to be available to living things. Results for AVS/SEM are reported for all of the sediment samples included in this study, with the exception of the CH2M Hill samples from Sites 11 and 17.

The AVS concentration was subtracted from the sum of the SEM metal concentrations for each sediment sample. This result is included in the analytical database (Appendix B) and is an indication of the potential for metal bioavailability. The range of (SEM) – (AVS) results for each sampling Area is summarized below:

- Area 1 – 0.43 μmol/g to 9.85 μmol/g
- Area 2 – 0.36 μmol/g to 20.1 μmol/g
- Area 3 – (-2.04) μmol/g to 5.32 μmol/g
- Area 4 – (-37.5) μmol/g to 7.24 μmol/g
- Area 5 – (-0.43) μmol/g to 963 μmol/g

Negative results indicate a low potential for bioavailability because all of the SEM metals are bound to sulfides. The maximum result reported for Area 1 (Sample MTCSD00401) exceeds results reported for all other Area 1 samples by a factor of five. (Most of the results for Area 1 samples were between 1 and 2 μmol/g.) The average result for Area 1 is 2.54 μmol/g. The average result for Area 2 is 6.08 μmol/g. Only four samples were collected from Area 3; the highest result, 5.32 μmol/g (MTCSD01401), exceeds results reported for all other Area 3 samples by a factor of five. (Results calculated for two Area 3 samples are less than 1 μmol/g, and the minimum result is negative.) The average result for Area 3 is 0.86 μmol/g. Negative results were calculated for two samples, S39SD0070001 and S39SD0080001 from Area 4. Most of the other results range from less than 1 to approximately 7 μmol/g. The average for Area 4 is -2.6 μmol/g. Results reported for two Area 5 samples [MTCSD02601 and its duplicate (MTCSDFD001)] exceed other results reported for other Area 5 samples by two orders of magnitude. The results reflect the elevated zinc concentrations at TtNUS Location 26 which were discussed above. The other SEM metal concentrations in this sample also exceed those reported for other samples from Area 5. Results reported for other Area 5 samples ranged from negative to less than 4 μmol/g.

4.2.7 Total Organic Carbon and Percent Silt

Figures 4-20 and 4-21 are color-coded figures that present TOC and percent silt concentration ranges in sediment samples collected in Mattawoman Creek. Areas which may be depositional are indicated by areas with high TOC and high percent silt. Additionally, hard bottom characteristics would be evidenced by areas depicting low percent silt (i.e., fine materials).

TOC concentrations were greatest in Area 4 and Area 2 sediment samples. Many samples in Area 4 were within the range of 4 to 18 percent TOC, and samples in Area 2 were in the 2 to 7 percent TOC range. TOC concentrations in the other samples ranged from 0 to 7 percent. Fewer samples were analyzed for grain size than for TOC. Percent silt levels varied among the samples but the majority of samples in Areas 2 and 4 had silt levels that were greater than 69 percent.

The TOC and percent silt data indicate that Areas 2 and 4 may be more depositional that some of the other areas, with the exception of the locations of isolated samples. This may be because Areas 2 and 4 appear to be lower energy areas because of the curves in the creek in these areas. It is also apparent

from the figures that the isolated samples with greater TOC and percent silt levels are in areas that appear to be depositional such as the furthest downstream samples in Area 1.

4.3 FISH TISSUE

Fish tissue samples were collected from all five sub-areas within the study area and in background/reference Areas 6 and 7 during the September 2001 sampling event (Table 3-2). Nineteen fillet samples (16 study area samples and three background) and 14 whole-body samples (10 study area samples and four background) were collected and analyzed to meet project objectives for human health and ecological risk assessment, respectively. All of the fish samples were analyzed for TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, energetics and perchlorate.

Channel catfish were initially selected as the target species for the fillet samples because they are likely to be consumed by humans visiting the area. However, during the September 2001 sampling event, channel catfish were only found in Areas 1, 3 and 5. Because channel catfish were not as abundant as anticipated, other species were collected as surrogates for the channel catfish. White catfish, brown bullhead catfish, white perch and largemouth bass, the most popular species for sport fishing in the area, were used as surrogates where channel catfish could not be collected.

Mummichogs were the species initially chosen as the target species for the whole-body samples to be evaluated in the ecological risk assessment. However, mummichogs were only found in Nanjemoy Creek (Area 7). Consequently, pumpkinseeds, spot-tailed shiners and golden shiners were collected to serve as surrogate species where mummichogs could not be collected (see Section 3.2.3).

4.3.1 Fillet Samples

Chemical concentrations detected in the fillet samples are displayed in Figure 4-22. Analytical results for all parameters detected at least once are presented in Table 4-31. Basic descriptive statistics (frequency of detection, range of positive detections, average of positive detections, etc.) and comparisons to relevant criteria and background are presented in Table 4-32. Species and numbers collected include white catfish (3), largemouth bass (8) and the target species channel catfish (5). Chemical concentrations detected in the fillet samples were compared to the EPA Region 3 RBC for fish and the maximum background values obtained from fillet samples in Areas 6 and 7 as shown in Table 4-3.

4.3.1.1 SVOCs

The following four SVOCs were detected in the fillet samples:

- 4-Methylphenol – 80 to 64,000 µg/kg (11 positive detections in 16 samples)
- Benzaldehyde – 43 to 91 µg/kg (five positive detections in 16 samples)
- Bis(2-ethylhexyl)phthalate – 75 to 2,200 µg/kg (14 positive detections in 16 samples)
- Phenol - 54 to 150 µg/kg (three positive detections in 16 samples)

Benzaldehyde was detected in the largemouth bass samples only and at concentrations less than both the RBC_{fish} and the maximum background concentration. The other SVOCs were detected at concentrations exceeding background. However, the maximum 4-methylphenol concentration (Sample MTCCT00403) is only slightly greater than the maximum background value (45,000 µg/kg). All three phenol detections (occurring in catfish samples from Areas 1 and 5 and a bass sample from Area 4) exceed the maximum background value (46 µg/kg). Eight of the 14 detections reported for bis(2-ethylhexyl)phthalate exceed the maximum background concentration (800 µg/kg), although most appear to be similar to background concentrations. [Bis(2-ethylhexyl)phthalate is a common laboratory contaminant and a plasticizer.] SVOCs were not detected in the Area 5 samples at concentrations exceeding background. SVOC concentrations reported for samples from the other sub-areas and between species are similar.

4-Methylphenol and bis(2-ethylhexyl)phthalate) were detected at concentrations exceeding the EPA Region 3 RBC_{fish}. Six of the 11 positively detected results for 4-methylphenol were greater than the RBC_{fish} (6,800 µg/kg). None of the exceedances were for samples from Areas 2 or 5; four of the six exceedances were reported for catfish samples, whereas only two of the exceedances were reported for bass samples. Twelve of the 14 positively detected results for bis(2-ethylhexyl)phthalate were greater than the RBC_{fish} of 230 µg/kg. None of the exceedances were reported for samples collected from Area 5. Maximum 4-methylphenol and bis(2-ethylhexyl)phthalate background concentrations are also greater than their respective RBCs.

4.3.1.2 Pesticides/PCBs

The following six pesticides/PCBs were detected in one or more of the fillet samples at concentrations exceeding those reported for the background samples.

- 4,4'-DDE – 4.2 to 110 µg/kg ([12 positive detections in 16 samples; reported concentrations for six samples exceed RBC_{fish} (9.3 µg/kg)]

- Aroclor-1260 – 39 to 380 µg/kg [12 positive detections in 16 samples; all concentrations detected exceed RBC_{fish} (1.6 µg/kg)]

- Dieldrin – 7.3 µg/kg [one positive detection in 15 samples; the concentration detected exceeds RBC_{fish} (0.2 µg/kg)]

- Endosulfan I – 2.1 µg/kg (one positive detection in 16 samples)

- Endrin – 5 µg/kg (one positive detection in 16 samples)

- Gamma chlordane – 3.2 to 8.5 µg/kg (three positive detections in 14 samples)

4,4-DDE was detected in all of the catfish samples and four of the bass samples collected. Six of the 12 positive detections for 4,4-DDE were greater than both the background value (8.7 µg/kg) and the RBC_{fish} (9.3 µg/kg). The exceedances were reported for catfish samples collected in Areas 1, 3 and 4 (C_{range} = 30 to 110 µg/kg); exceedances did not occur for samples from Area 5. Catfish samples were not collected in Area 2. 4,4-DDE concentrations detected in four bass samples (C_{range} = 4.2 to 8.6 µg/kg) were similar to each other and to the results reported for the two catfish samples that did not exceed either the background concentration or the RBC_{fish}. Dieldrin, endosulfan I, gamma chlordane, and endrin were detected in catfish samples only; the positive detections are similar to sample quantitation limits reported for non-detect results.

Aroclor-1260 was detected consistently across the sampling areas and across the species tested. Concentrations noted in the catfish samples (C_{range} = 39 to 380 µg/kg) were generally higher than those reported for the bass samples (C_{range} = 42 to 59 µg/kg). All of the positive detections reported for aroclor-1260 exceed both the background value and the RBC_{fish}. However, the background concentration (73 µg/kg) and sample quantitation limits reported for the four non-detect results also exceed the RBC_{fish} (1.6 µg/kg).

4.3.1.3 Energetics

The following six energetics were detected infrequently in the fillet samples:

- 1,3-Dinitrobenzene – 0.057 mg/kg [one detection in 16 samples; a catfish sample (MTCCT005) from Area 5]

- 2-Amino-4,6-dinitrotoluene – 0.096 mg/kg [one detection in 16 samples; a catfish sample (MTCCT00402) from Area 4]

- HMX – 0.083 mg/kg [one detection in 16 samples; a catfish sample (MTCCT005) from Area 5]

- Nitrocellulose – 5.7 mg/kg [one detection in 16 samples; a catfish sample (MTCCT00402) from Area 4].

- Perchlorate – 10,200 µg/kg [one detection in 16 samples; a bass sample (MTCLB00201) from Area 2]

- Nitroguanidine – 0.12 to 0.19 µg/kg [two detections in 16 samples; bass samples from Areas 3 and 4 (MTCLB003 and MTCLB00401), respectively]

Energetic compounds were not detected in the background fillet samples.

Positive detections for 1,3-dinitrobenzene and HMX (Sample MTCCT005) were less than the RBC_{fish} and the nondetect results reported for these analytes for other fillet samples. The positive detection for 2-amino-4,6-dinitrotoluene (Sample MTCCT00402) was only slightly greater than the RBC_{fish} and less than the nondetect results reported for the analyte in other samples (i.e., the result was qualified as an estimated value). The positive detection reported for nitrocellulose (Sample MTCCT00402) was similar to the nitrocellulose results reported for other samples that were qualified as nondetected results due to laboratory blank contamination. RBC_{fish} concentrations are not available for perchlorate, nitrocellulose, and nitroguanidine.

4.3.1.4 Inorganics

Sixteen inorganics were detected in the fillet samples collected from the study area. However, only chromium and arsenic were reported at concentrations exceeding the RBC_{fish}. Chromium (C_{range} = 0.92 to 6.2 mg/kg) was detected in only three of 16 samples (all bass samples); all results were greater than the background value of 0.59 mg/kg. The maximum concentration, 6.2 mg/kg, was reported for Sample MTCLB00202, a bass sample from Area 2; the RBC_{fish} for chromium is 4.1 mg/kg. Arsenic (C_{range} = 0.65 mg/kg to 1.6 mg/kg) was positively detected in eight of 16 samples; the results exceeded the RBC_{fish} (0.0021 mg/kg) but were less than the maximum background concentration. Arsenic was detected in both bass and/or catfish samples collected from each area.

Aluminum, cadmium, iron and zinc were detected in eight or nine of the 16 samples analyzed. These inorganics were not detected at concentrations exceeding the $RBC_{fish.}$ The concentrations reported are less than or similar to those reported in the background fillet samples. The majority of the detections were noted in catfish samples and were evenly distributed throughout the sampling areas.

Copper, cyanide, mercury, lead and barium were detected infrequently in the fillet samples (one, two, two, four, and four times from Areas 1 through 5, respectively in 16 samples) and at concentrations that do not

exceed the RBC_{fish} where available (an RBC_{fish} is not available for lead). However, copper, cyanide, and lead were not detected in the background samples. The mercury and barium concentrations noted in the fillet samples do not exceed background concentrations. The maximum copper, barium, and mercury concentrations were reported for samples collected from Area 5. The maximum cyanide and lead concentrations were reported for samples from Area 2. Three of the four lead detections were reported for catfish samples collected from Areas 3 and 4.

The common cations, calcium, potassium, magnesium and sodium were positively detected in all samples. RBC_{fish} concentrations do not exist for these analytes because they are essential nutrients. The maximum concentration (only) of potassium exceeded background concentrations. Manganese was detected in 15 of 16 samples at concentrations that do not exceed background concentrations or the $RBC_{fish.}$

4.3.2 Whole-Body Samples

Chemical concentrations detected in the 10 whole-body fish samples (pumpkinseed and shiner) collected for the ecological risk assessment are displayed in Figure 4-23. Species and numbers collected include pumpkinseed (5), spot-tailed shiner (3) and golden shiner (2). One shiner and one pumpkinseed sample were collected in each of the Areas 1 through 5.

Analytical results for all parameters detected at least once are presented in Tables 4-33, 4-33A and 4-33B. Basic descriptive statistics (frequency of detection, range of positive detections, average of positive detections, etc.) are presented in Tables 4-34, 4-34A and 4-34B. Ecological screening criteria are not available for the whole-body samples; therefore, the analytical results are compared to the maximum background values presented in Table 4-6.

4.3.2.1 SVOCs

The following five SVOCs were detected in the whole-body fish samples:

- 4-Methylphenol – 35 to 39,000 µg/kg (nine detections in 10 samples)
- Bis(2-ethylhexyl)phthalate – 120 to 1900 µg/kg (six detections in 10 samples)
- Benzaldehyde – 34 to 53 µg/kg (three detections in 10 samples)
- Phenol - 94 to 140 µg/kg (three detections in 10 samples)
- 2-Methylphenol – 73 to 170 µg/kg (two detections in 10 samples)

4-Methylphenol and bis(2-ethylhexyl)phthalate were detected in greater than 50 percent of the samples analyzed. 4-Methylphenol was detected in all five pumpkinseed samples and four of five shiner samples.

Concentrations reported for the pumpkinseed samples ranged from 5,400 µg/kg to 39,000 µg/kg, with the exception of sample MTCFS002 (35 µg/kg), Area 2. With one exception (MTCFS002), all results reported for the pumpkinseed samples exceeded the background value of 660 µg/kg. The positive detections reported for the shiner samples ranged from 150 to 12,000 µg/kg; three of the four positive detections exceeded 660 µg/kg. Four of the six positive detections reported for bis(2-ethylhexyl)phthalate (C_{range} = 780 µg/kg to 1,900 µg/kg; Areas 1, 3, and 4) exceeded (but were similar to) the maximum background concentration of 800 µg/kg. Although 4-methyl phenol was detected in the fish fillet samples, this chemical was detected in one of 40 sediment samples, only, and was not detected in the study area surface water samples. Bis(2-ethylhexyl)phthalate was detected in six of 40 sediment samples and seven of 38 surface water samples.

Benzaldehyde, 2-methylphenol, and phenol were detected in 30 percent (or less) of the samples analyzed. Benzaldehyde was detected in pumpkinseed samples from Areas 1, 2 and 5; the positive detections were less than the background value and sample quantitation limits reported for non-detect results. 2-Methylphenol was detected in shiner samples from Areas 1 and 3; the results were qualified as estimated results and are less than sample quantitation limits reported for non-detect results. 2-Methylphenol was not detected in the background samples. The positive detections reported for phenol were from one pumpkinseed sample (Area 3) and two shiner sample (Areas 2 and 4); the concentrations detected are similar to background values.

4.3.2.2 Pesticides/PCBs

The following three pesticides/PCBs were detected in the whole-body fish samples:

- 4,4'-DDD – 3.9 µg/kg (one detection in 10 samples)
- 4,4'-DDE – 3.3 to 17 µg/kg (seven detections in 10 samples)
- Aroclor-1260 – 34 to 130 µg/kg (six detections in 10 samples)

As noted in the analytical results reported for the fillet samples, 4,4-DDE and aroclor-1260 were the most frequently detected pesticide/PCB compounds in the whole-body fish samples. 4,4-DDE was detected in four of five shiner samples and three of five pumpkinseed samples; analytical results are generally similar to the maximum detected background value (8.7 µg/kg). Aroclor-1260 was detected in 6 samples (three shiner and three pumpkinseed). With one exception, the analytical results are similar to the background value (59 µg/kg) and the sample quantitation limits reported for the non-detect results. The maximum aroclor-1260 concentration was reported for Area 4 sample MTCSS004 (130 µg/kg). The maximum 4,4-DDE concentration (17 µg/kg) was also noted at this location.

4,4-DDD was detected in one Area 4 shiner sample (MTCSS004); the result was reported as an estimated value similar to the non-detect results reported for the other samples. 4,4-DDD was not detected in the background samples.

4.3.2.3 Energetics

Two energetic compounds were detected in the whole-body fish samples:

- Nitroglycerin – 0.1 to 0.22 mg/kg (four detections in 10 samples)
- Nitroguanidine – 0.068 mg/kg (one detection in 10 samples)

Nitroguanidine was detected in one Area 5 shiner sample (MTCSS005). Nitroglycerin was noted in two pumpkinseed samples (Areas 1 and 4) and two shiner samples (Areas 2 and 5). The maximum detected concentration was reported for Area 5 sample MTCSS005. All detections reported for these compounds were less than the sample quantitation limits reported for non-detect results for these analytes. These compounds were not detected in the background samples.

4.3.2.4 Inorganics

Inorganics were detected in all of the whole-body fish samples collected from the study area. The majority of the maximum detected concentrations were reported for samples collected from Areas 2 and 3.

Arsenic, barium, iron, manganese and zinc were detected in all 10 whole-body fish samples. As summarized in Table 4-34 analytical results reported for study area samples are similar to the concentrations reported in background pumpkinseed and shiner samples.

Aluminum, cadmium, and vanadium were detected in 50 percent (or more) of the samples analyzed:

- Aluminum – eight detections in 10 samples (C_{range} = 3.6 to 20.6 mg/kg); three detections marginally exceed maximum background (15.9 mg/kg).

- Cadmium – six detections in 10 samples (C_{range} = 0.017 to 0.025 mg/kg); cadmium was not detected in background samples.

- Vanadium – five detections in 10 samples (C_{range} = 0.076 to 0.38 mg/kg); two detections marginally exceed maximum background (0.14 mg/kg).

Chromium, cyanide and lead were detected infrequently in whole-body fish tissue samples (three, two, and two detections in 10 samples, respectively). The maximum chromium concentration (6.6 mg/kg; Area 2) is an order of magnitude greater than all other results and exceeds the background concentration (1.2 mg/kg). With the exception of this datum, positive results reported for chromium, cyanide and lead were similar to the sample quantitation limits reported for the non-detect results. Cyanide and lead were not detected in the background samples

As noted in the analytical results reported for the fillet samples, the common cations, calcium, potassium, magnesium and sodium were detected in all samples. These common cations were not detected in study area samples at concentrations exceeding maximum background concentrations.

4.4 VEGETATION TISSUE

Seven vegetation samples were collected during the September 2001 sampling event. One sample was collected from each sampling area (i.e., Areas 1 to 5) and one from each reference area (Areas 6 and 7). Each sample collected was a composite of samples from several locations within the sampling area. The samples were collected in the same general areas as the fish samples. Hydrilla was the species selected as representative of the potential for chemical accumulation and ecological risk to aquatic vegetation because it is common throughout Mattawoman Creek and is consumed by many types of herbivorous species, including waterfowl.

The vegetation samples were analyzed for TAL metals and TCL pesticides/PCBs. Metals concentrations detected in the five Hydrilla samples from Areas 1 through 5 collected for the ecological risk assessment are displayed in Figure 4-24. PCBs/pesticides were not detected in the samples.

Analytical results for all metals detected at least once are presented in Table 4-35. Basic descriptive statistics (frequency of detection, range of positive detections, average of positive detections, etc.) are presented in Table 4-36. Ecological screening criteria are not available for the Hydrilla samples; therefore, the analytical results are compared to the maximum background values presented in Table 4-7.

Aluminum, barium, calcium, iron, magnesium, manganese, potassium and vanadium were detected in all samples. Beryllium, nickel and sodium were detected in two or three of the five samples. Cadmium, chromium and zinc were detected in one of five samples only. As shown in Tables 4-35 and 4-36, the metals concentrations reported for the study area samples are less than or similar to concentrations noted in the two reference area samples. As summarized below from the information in Table 4-36, only the maximum calcium, potassium, and zinc concentrations exceed (but are similar to) the maximum background concentrations.

INORGANICS IN VEGETATION TISSUE EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS

Analyte	Range of Positive Detections (mg/kg)	Maximum Background Concentration (mg/kg)
Calcium	703 – 960	616
Potassium	2690 – 3580	2560
Zinc	21.6	18.3

Of the TAL metals, eight (potassium, calcium, magnesium, iron, manganese, zinc, copper and nickel) are considered to be essential elements for plant growth. Three (sodium, cobalt and selenium) are considered to be beneficial elements which promote plant growth and two (chromium and vanadium) have been proposed as candidates for essential or beneficial elements (Essential Elements for Plant Growth, www.soils.wisc.edu/~barak/soilscience326/listofel.html).

4.5 SUMMARY AND CONCLUSIONS

The following items briefly summarize the nature and extent of contamination detected in surface waters, sediments, and fish tissue samples collected during the Mattawoman Creek Study:

- Metals are the most significant contaminants detected in the Mattawoman Creek study area. Elevated "hot spots" of metals contamination are most notable in the sediments. However, the contamination is not pervasive across the study area. One or more detections reported for several metals (e.g., antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc) exceed study area background sediment concentrations by an order of magnitude (or more), as well as human and/or ecological screening criteria. Figures 4-13 through 4-18 present color tag maps for selected metals to visually show the areas of elevated metals contamination. The elevated detections are primarily associated with sediment samples from Site 11 (Area 1), Site 39/41 (Area 4), and samples collected from TtNUS Study Area Location 26 (Area 5). Most of the analytical results reported for other inorganics were similar to concentrations reported in the study area sediment background samples or are less than two times the maximum background concentrations. Metals concentrations reported for surface water samples from Areas 1 and 4 are generally greater than those reported for Areas 2, 3, and 5. The maximum concentrations reported for most of the metals in Areas 1 and 4 are associated with surface water samples collected from study area locations in the vicinity of Sites 11, 17, 39, 41, and TtNUS Location 21. With the exception of arsenic and chromium, inorganics were not detected in fish fillet samples at concentrations exceeding the EPA Region 3 RBC for fish ingestion. With a few exceptions, most inorganic concentrations detected in fillet and whole-body fish tissue samples reflect background conditions. Metals concentrations noted in the study area Hydrilla samples are also similar to concentrations noted in the background samples.

- Several PAH compounds (C_{max} < 5000 µg/kg) and two phthalate compounds (C_{max} < 1000 µg/kg) were the predominant SVOCs detected in the study area sediment samples. Several of these compounds were detected at concentrations exceeding ecological screening criteria. Four [benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(ah)anthracene] were also detected at concentrations exceeding the EPA Region 3 RBCs for soil (residential land use scenario). Any interpretation of the PAH data must consider the fact that PAHs are common, anthropogenic contaminants frequently detected in soils and sediments as a result of the wide-spread use of petroleum products in our modern, industrialized society. For example, Mattawoman Creek receives surface water run-off from roadways and areas that have been paved with asphalt and is also impacted by fuels/fuel exhaust from motorized boats. The PAH concentrations reported for the sediment samples are within the range of concentrations reported as anthropogenic background for soils (see Appendix B-9 for anthropogenic reference data from the literature). That being said, however, as discussed in Section 4.2.2, elevated levels of PAHs were detected primarily in three sediment samples: MTCSD012, MTCSD020, and MTCSD021. The source of the PAHs in sample MTCSD012 may be the small motor testing area located adjacent to Mattawoman Creek in the area of this sample. The source of PAHs in samples MTCSD020 and MTCSD021 may be the oil spill that occurred during the pilot study or from sediment in the open channel sediment and storm sewer outfall samples from Site 57. Phthalates are often detected in environmental media as a result of the common use and disposal of plastics. With the exception of the maximum diethyl phthalate concentration, phthalates were not detected in study area sediment samples at concentrations exceeding human or ecological screening criteria defined in Section 4. One phthalate compound [bis(2-ethyl hexyl) phthalate] was detected in over 50 percent of the fish tissue samples collected at concentrations that exceeded the EPA Region 3 RBC for fish ingestion but were also similar to those reported for the background samples. [Bis(2-ethyl hexyl) phthalate is a common laboratory contaminant because it is present in plastics.]

- 4-Methylphenol (C_{max} = 80 µg/kg), carbazole (C_{max} = 140 µg/kg), dibenzofuran (C_{max} = 94 µg/kg), and N-nitrosodiphenylamine (C_{max} = 4,800 µg/kg) were SVOCs also detected in the study area sediments but the frequency of detection was generally less than that reported for many of the PAHs discussed above. With the exception of N-nitrosodiphenylamine, these SVOCs were not detected in sediment samples at concentrations exceeding human health or ecological criteria. Three phenolic compounds (4-methyl phenol, phenol, and 2 methyl phenol) and benzaldehyde were detected in the fish fillet or whole-body fish tissue samples. With the exception of 4-methyl phenol results noted for whole-body fish tissue samples (pumpkinseed), the majority of the positive detections reported were similar to those noted in the background samples. The maximum 4-methyl phenol concentration

detected in the fish fillet samples exceeded the EPA Region 3 RBC for fish ingestion but was also similar to the maximum concentration reported for the study area background samples.

- SVOCs were not significant contaminants in the surface water samples collected from the study area. Two PAH compounds (2-methyl naphthalene, naphthalene) and bis(2-ethyl hexyl)phthalate were detected infrequently. The maximum concentrations reported (1 or 2 µg/L) do not exceed the human or ecological screening criteria evaluated in the Mattawoman Creek study. SVOCs were not detected in surface water samples collected from Area 3.

- The degradation products of 4,4-DDT (i.e., 4,4-DDD and 4,4-DDE) were the predominant pesticides detected in the sediment and fish tissue samples. Pesticides (4,4-DDD, 4,4-DDE, and alpha-BHC) were detected infrequently in the sediment samples (one or two Area 4 samples only) and at concentrations (C_{max} < 10 µg/kg) not exceeding the EPA Region 3 RBC for soil ingestion (residential). With the exception of 4,4-DDE, pesticides (4,4-DDD, dieldrin, endosulfan I, endrin, gamma chlordane) were also detected infrequently (one to three samples only) in the fish tissue samples, and the majority of the results reflect background conditions. 4,4-DDE was detected in catfish and bass fillet samples in all areas except Area 2. The majority of the positive detections noted in the catfish fillet samples exceeded the EPA Region 3 RBC for fish ingestion and the study area background concentrations.

- PCBs were detected in sediment and fish tissue samples but were not detected in surface water samples. Aroclor-1248 was detected in one Area 1 sediment sample only at a concentration (170 µg/kg) exceeding the ecological screening level (22.7 µg/kg) but not exceeding the current EPA Region 3 RBCs for soil. In contrast, aroclor-1260 was detected in the majority of the fish fillet samples (both catfish and bass) at concentrations (C_{range} = 39 to 380 µg/kg) exceeding the EPA Region 3 RBC for fish ingestion (1.6 µg/kg) and in some samples at concentrations exceeding the study area background concentration (73 µg/kg). With the exception of one sample from Area 4 (130 µg/kg, a shiner sample), the PCB results for whole-body fish tissue samples are similar to study area background concentrations.

- With the exception of nitrocellulose (in sediments) and nitroglyercin (in whole-body fish tissue samples), energetic compounds were detected infrequently (one or two samples only) in the study area surface water, sediment, and fish tissue samples. 1,3-Dintrobenzene, 4-nitrotoluene, HMX, and perchlorate were reported for the surface water samples. All surface water results (less than 1 µg/L) are less than both human health and ecological screening criteria. Three nitrobenzene compounds (e.g., 1,3,5-trinitrobenzene) and four nitrotoluene compounds (e.g., 2,4,6-trinitrotoluene) (Area 1 sediments only), and HMX (Area 5 sediments only) were detected in study area sediment samples at

maximum concentrations not exceeding 250 µg/kg. The three nitrobenzene compounds and HMX were detected at concentrations exceeding ecological criteria; none of the results exceeded the RBCs for soil. Nitrocellulose, a relatively non-toxic chemical was detected in the majority of the sediment samples. A similar listing of energetic compounds was detected in the fish fillet samples. The maximum 2-amino-4,6-dinitrotoluene (0.096 mg/kg) concentration reported for the fish fillet samples exceeded available Region 3 RBC for fish ingestion (0.081 mg/kg). Nitroglycerin (C_{max} = 0.22 mg/kg; four detections) and nitroguanidine (C_{max} = 0.068 mg/kg; one detection) were the only energetics detected in the whole-body fish samples. These compounds were not detected in study area background samples.

- VOCs were not significant contaminants in the environmental media collected from the study area. BTEX compounds, two chlorinated solvents (trichloroethene, cis-1,2-dichloroethene), acetone, bromoform, diethyl ether, and methyl tert-butyl ether were detected infrequently in the surface water samples at maximum concentrations not exceeding 50 µg/L. Three of these VOCs (benzene, ethylbenzene, and trichloroethene) were detected infrequently at concentrations exceeding EPA Region 3 RBCs for tap water; no VOCs were detected in surface water samples at concentrations exceeding ecological criteria. A similar listing of VOCs was noted in the sediment samples collected from the study area. With the exception of acetone and carbon disulfide, the VOCs were reported infrequently and at maximum concentrations generally below 100 µg/kg. Acetone and carbon disulfide (two common laboratory/field blank contaminants) were detected in over 50 percent of the sediment samples. While analytical results reported for these VOCs did exceed ecological screening criteria, none of the positive detections noted exceeded the EPA Region 3 RBCs for soil. (The fish fillet and whole-body samples were not analyzed for VOCs.)

TABLE 4-1

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND SURFACE WATER SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION NORTHING EASTING SITE AREA OF CONCERN SAMPLE ID MATRIX SAMPLE DATE	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[2]	REGION 3 RBC-TAP WATER[3]	MTC027 335538.46 1271543.78 MATTAWOMAN CREEK AREA 6 MTCSW02701 / MTCSW02701-F SW 9/6/2001	QUAL	MTC028 335705.07 1271379.33 MATTAWOMAN CREEK AREA 6 MTCSW02801 / MTCSW02801-F SW 9/6/2001	QUAL	NJC001 282855.94 1272625.48 NANJEMOY CREEK AREA 7 NJCSW00101 / NJCSW00101-F SW 9/5/2001	QUAL	NJC002 282348.5 1272913.41 NANJEMOY CREEK AREA 7 NJCSW00201 / NJCSW00201-F SW 9/5/2001	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE RESULTS	AVERAGE OF ALL ANALYTICAL RESULTS[4]
INORGANICS (UG/L)																
ALUMINUM	25	37000	253		255		587		440		4/4	587		NJCSW00101	384	384
BARIUM	10000	2600	35.4		30.8		57		55.6		4/4	57		NJCSW00101	44.7	44.7
CADMIUM	0.27	18	0.1	U	0.1	U	0.17	K	0.1	U	1/4	0.17	K	NJCSW00101	0.17	0.08
CALCIUM	NA	NA	10300		10300		50300		40500		4/4	50300		NJCSW00101	27850	27850
CHROMIUM	2	110	1.1	K	0.59	K	1.8	K	1.4	K	4/4	1.8	K	NJCSW00101	1.2	1.2
CYANIDE	1	730	9.9	B	6.1	B	10.2	B	36.8		1/4	36.8		NJCSW00201	36.8	12.5
IRON	320	11000	410		404		577		512		4/4	577		NJCSW00101	476	476
MAGNESIUM	NA	NA	8190		8130		153000		132000		4/4	153000		NJCSW00101	75330	75330
MANGANESE	10	730	50		49.4		353		1190		4/4	1190		NJCSW00201	411	411
POTASSIUM	NA	NA	3530		3300		64400		52700		4/4	64400		NJCSW00101	30983	30983
SODIUM	NA	NA	25200		25000		1230000		1040000		4/4	1230000		NJCSW00101	580050	580050
FILTERED INORGANICS (UG/L)																
CALCIUM	NA	NA	10200		10400		49700		40200		4/4	49700		NJCSW00101-F	27625	27625
MAGNESIUM	NA	NA	7850		7710		149000		126000		4/4	149000		NJCSW00101-F	72640	72640
MANGANESE	NA	NA	4.9	B	2.2	B	249		153		2/4	249		NJCSW00101-F	201	101
POTASSIUM	NA	NA	3590		3110		64800		54700		4/4	64800		NJCSW00101-F	31550	31550
SODIUM	NA	NA	25800		24000		1150000		957000		4/4	1150000		NJCSW00101-F	539200	539200
MISCELLANEOUS PARAMETERS (MG/L)																
CHLORIDE	230000	NA	40.7		42		2420		2040		4/4	2420		NJCSW00101	1136	1136
FLUORIDE	2000	NA	0.19		0.19		25	U	25	U	2/4	0.19		MTCSW02701, MTCSW02801	0.19	6.3
HARDNESS	NA	NA	59		59		760		640		4/4	760		NJCSW00101	380	380
NITRATE	NA	58	0.05	UJ	0.05	UJ	0.5	J	0.5	J	2/4	0.5	J	NJCSW00101, NJCSW00201	0.5	0.26
NITRITE	NA	3.7	0.05	UJ	0.05	UJ	2.5	J	2.5	J	2/4	2.5	J	NJCSW00101, NJCSW00201	2.5	1.3
PH (S.U.)	NA	NA	7.3	J	7.2	J	7.1	J	7.2	J	8/8	7.88		NJCSW00201	7.1	7.1
SULFATE	NA	NA	26.3		27.3		299		276		4/4	299		NJCSW00101	157	157
TOTAL DISSOLVED SOLIDS	NA	NA	180		160		4000		2900		4/4	4000		NJCSW00101	1810	1810
TOTAL ORGANIC CARBON	NA	NA	6		7		7		8		4/4	8		NJCSW00201	7	7
TOTAL SUSPENDED SOLIDS	NA	NA	13		11		28		38		4/4	38		NJCSW00201	22.5	22.5
FIELD PARAMETERS																
DISSOLVED OXYGEN (MG/L)	NA	NA	25.7		26.0		8.3		9.8		4/4	26.0		MTCSW02801	17.4	17.4
PH (S.U.)	NA	NA	6.3		6.6		7.2		7.9		8/8	7.9		NJCSW00201	7.1	7.1
SALINITY (%)	NA	NA	0		0		0.4		0.5		2/4	0.5		NJCSW00201	0.23	0.23
SPECIFIC CONDUCTANCE (MS/CM	NA	NA	0.23		0.23		7.5		8.9		4/4	8.9		NJCSW00201	4.2	4.2
TEMPERATURE (C)	NA	NA	9.0		11.2		28.0		27.8		4/4	28.0		NJCSW00101	19.0	19.0

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

NA = Not Applicable.
RBC = Risk-Based Concentration

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-2

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND SEDIMENT SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION NORTHING EASTING SITE AREA OF CONCERN SAMPLE ID MATRIX SAMPLE DATE	MINIMUM SEDIMENT ECOLOGICAL CRITERIA[2]	REGION 3 RBC RESIDENTIAL-SOIL[3]	MTC027 335538.46 1271543.78 MATTAWOMAN CREEK AREA 6 MTCSD02701 / MTCSD02701-A SD 9/6/2001	QUAL	MTC028 335705.07 1271379.33 MATTAWOMAN CREEK AREA 6 MTCSD02801 / MTCSD02801-A SD 9/6/2001	QUAL	NJC001 282855.94 1272625.48 NANJEMOY CREEK AREA 7 NJCSD00101 / NJCSD00101-A SD 9/5/2001	QUAL	NJC002 282348.5 1272913.41 NANJEMOY CREEK AREA 7 NJCSD00201 SD 9/5/2001	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF POSITIVE RESULTS	AVERAGE OF ALL ANALYTICAL RESULTS[4]
VOLATILE ORGANICS (UG/KG)																
ACETONE	NA	7800000	100		120		210	J	14	U	3/4	210	J	NJCSD00101	140	110
CARBON DISULFIDE	NA	7800000	19	J	15	J	71	J	14	U	3/4	71	J	NJCSD00101	35	28
METHYL ACETATE	NA	78000000	23	U	21	U	42	J	14	U	1/4	42	J	NJCSD00101	42	18
METHYLENE CHLORIDE	NA	85000	23	U	21	U	10	J	4	J	2/4	10	J	NJCSD00101	7	9
TETRACHLOROETHENE	57	12000	23	U	21	U	39	UJ	4	J	1/4	4	J	NJCSD00201	4	11
TRICHLOROFLUOROMETHANE	NA	23000000	23	U	21	U	39	UJ	7	J	1/4	7	J	NJCSD00201	7	12
INORGANICS (MG/KG)																
ALUMINUM	NA	78000	5430		11400		9770	J	1250		4/4	11400		MTCSD02801	6960	6960
ARSENIC	8.2	0.43	2.7	J	2.5	UJ	4.1	J	1.3	J	3/4	4.1	J	NJCSD00101	2.7	2.3
BARIUM	NA	5500	68.1		112		58	J	7.6		4/4	112		MTCSD02801	61.4	61.4
BERYLLIUM	NA	160	0.72		1		1.3	J	0.19		4/4	1.3	J	NJCSD00101	0.80	0.80
CADMIUM	1.2	78	2.6	J	2.3	J	3.5	J	0.47	J	4/4	3.5	J	NJCSD00101	2.2	2.2
CALCIUM	NA	NA	1380		1490		1490	J	980		4/4	1490	--/J	MTCSD02801, NJCSD00101	1340	1340
CHROMIUM	81	230	14.1	K	21.3	K	25	J	4.5	K	4/4	25.0	J	NJCSD00101	16.2	16.2
COBALT	NA	1600	12	K	10.8	K	19.8	J	2.7	K	4/4	19.8	J	NJCSD00101	11.3	11.3
COPPER	34	3100	13.8	J	11.1	J	22.7	J	2.8	B	3/4	22.7	J	NJCSD00101	15.9	12.3
IRON	NA	47000	13600		18100		27900	J	3720		4/4	27900	J	NJCSD00101	15800	15800
LEAD	46.7	400	19.4	J	14.6	J	30.7	J	4.9	J	4/4	30.7	J	NJCSD00101	17.4	17.4
MAGNESIUM	NA	NA	1000		1850		3590	J	416		4/4	3590	J	NJCSD00101	1710	1710
MANGANESE	NA	1600	299	J	288	J	876	J	175	J	4/4	876	J	NJCSD00101	410	410
NICKEL	20.9	1600	12.9	K	15	K	22.5	J	2.7	K	4/4	22.5	J	NJCSD00101	13.3	13.3
POTASSIUM	NA	NA	512		770		1460	J	352		4/4	1460	J	NJCSD00101	774	774
SILVER	1	390	0.76	L	0.36	UL	0.44	UJ	0.14	UL	1/4	0.76	L	MTCSD02701	0.76	0.31
SODIUM	NA	NA	304	B	234	B	3760	J	382	J	2/4	3760	J	NJCSD00101	2070	1100
VANADIUM	NA	550	18.2	K	28.1	K	32.9	J	4.6	K	4/4	32.9	J	NJCSD00101	21.0	21.0
ZINC	150	23000	108	J	69.9	J	142	J	19	J	4/4	142	J	NJCSD00101	84.7	84.7
AVS/SEM PARAMETERS (UMO/G)																
ACID VOLATILE SULFIDE	NA	NA	7.87781		0.19738		0.16959	U	0.0541	U	2/4	7.9		MTCSD02701	4.0	2.0
COPPER	NA	NA	0.17613	B	0.50898	J	0.12321	B	1.99241	J	2/4	2.0	J	NJCSD00201	1.3	0.7
LEAD	NA	NA	0.14997		0.16439		0.21833		0.02679		4/4	0.2		NJCSD00101	0.1	0.1
NICKEL	NA	NA	0.12923	B	1.5042	J	0.19825	B	2.28138	J	2/4	2.3	J	NJCSD00201	1.9	1.0
TOTAL SEM - AVS	NA	NA	0.33602		9.98627		0.21833		4.30058		4/4	10.0		MTCSD02801	3.7	3.7
ZINC	NA	NA	8.06386		8.00608		1.92936	B	0.20161	B	2/4	8.1		MTCSD02701	8.0	4.3
MISCELLANEOUS PARAMETERS (MG/KG)																
TOTAL ORGANIC CARBON	NA	NA	25000	J	34500	J	69200	J	1460	J	4/4	69200	J	NJCSD00101-A	32500	32500
EXPLOSIVES (MG/KG)																
HMX	NA	3900	0.25	U	0.25	U	0.17	J	0.25	U	1/4	0.2	J	NJCSD00101	0.2	0.1
NITROCELLULOSE	NA	NA	56	J	26.4	J	8.2	J	1.3	J	4/4	56	J	MTCSD02701	23	23
FIELD PARAMETERS (%)																
PERCENT CLAY	NA	NA	2		27.1		16.2		4.5		4/4	27.1		MTCSD02801	12.5	12.5
PERCENT GRAVEL	NA	NA	0		0		0		0.6		1/4	0.60		NJCSD00201	0.15	0.15
PERCENT SAND	NA	NA	79.4		15.3		61.6		29.7		4/4	79.4		MTCSD02701	46.5	46.5
PERCENT SILT	NA	NA	18.6		57.6		22.2		65.2		4/4	65.2		NJCSD00201	40.9	40.9

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

AVS = Acid Volatile Sulfide
SEM = Simultaneously Extracted Metals
RBC = Risk-Based Concentration
NA= Not Applicable

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-3

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND FILET SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES FILET OR WHOLE BODY SAMPLE ID MATRIX SAMPLE DATE	REGION 3 RBC FOR FISH[2]	MATTAWOMAN CREEK AREA 6 CATFISH FILET MTCCT006 ET 09/06/01	QUAL	MATTAWOMAN CREEK AREA 6 LARGE MOUTH BASS FILET MTCLB006 ET 09/07/01	QUAL	NANJEMOY CREEK AREA 7 WHITE PERCH FILET NJCWP007 ET 09/06/01	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM DETECT	AVERAGE OF POSITIVE DETECTS	AVERAGE OF ALL ANALYTICAL RESULTS[3]
SEMIVOLATILE ORGANICS (UG/KG)													
4-METHYLPHENOL	6800	45000		320	U	330	U	1/3	45000		MTCCT006	45000	15000
BENZALDEHYDE	140000	330	U	500		330	U	1/3	500		MTCLB006	500	280
BIS(2-ETHYLHEXYL)PHTHALATE	230	9900	UJ	78	J	800	J	2/3	800	J	NJCWP007	440	1900
PHENOL	810000	330	U	46	J	330	U	1/3	46	J	MTCLB006	46	120
PESTICIDES/PCBS (UG/KG)													
4,4'-DDE	9.3	8.7	J	3.3	U	4.5	J	2/3	8.7	J	MTCCT006	6.6	5.0
AROCLOR-1260	1.6	73	J	33	U	33	U	1/3	73	J	MTCCT006	73	35
INORGANICS (MG/KG)													
ALUMINUM	1400	20.1		5.3		3.5		3/3	20.1		MTCCT006	9.6	9.6
ARSENIC	0.0021	0.71	U	2.2	K	2	K	2/3	2.2	K	MTCLB006	2.1	1.5
BARIUM	95	1.1		0.8	K	1.3		3/3	1.3		NJCWP007	1.1	1.1
CADMIUM	1.4	0.017	U	0.02	U	0.024	K	1/3	0.02	K	NJCWP007	0.02	0.01
CALCIUM	NA	619		21900		15500		3/3	21900		MTCLB006	12700	12700
CHROMIUM	4.1	0.19	B	0.59	K	0.3	B	1/3	0.59	K	MTCLB006	0.59	0.28
IRON	810	47.3		6.5	B	3.2	B	1/3	47.3		MTCCT006	47.3	17.4
MAGNESIUM	NA	104		674		406		3/3	674		MTCLB006	395	395
MANGANESE	27	3.1	K	1.6	K	7.8		3/3	7.8		NJCWP007	4.2	4.2
MERCURY	0.14	0.043	U	0.17		0.059		2/3	0.17		MTCLB006	0.11	0.08
POTASSIUM	NA	1330		3250		2030		3/3	3250		MTCLB006	2200	2200
SODIUM	NA	267		969		519		3/3	969		MTCLB006	585	585
VANADIUM	9.5	0.072		0.08	UL	0.11		2/3	0.11		NJCWP007	0.09	0.07
ZINC	410	5	B	13.4		17.3		2/3	17.3		NJCWP007	15.4	11.1
MISCELLANEOUS PARAMETERS													
LIPIDS (%)	NA	0.59		0.19		0.74		3/3	0.74		NJCWP007	0.51	0.51
EXPLOSIVES (MG/KG)													
RDX	0.029	0.12	J	0.25	U	0.25	U	1/3	0.1	J	MTCCT006	0.1	0.1

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
3 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

RBC = Risk-Based Concentration
PCB = Polychlorinated Biphenyl

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-4

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND PUMPKINSEED SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES FILET OR WHOLE BODY SAMPLE ID MATRIX SAMPLE DATE	MATTAWOMAN CREEK AREA 6 PUMPKINSEED WHOLE BODY MTCFS006 ET 09/06/01	QUAL	NANJEMOY CREEK AREA 7 PUMPKINSEED WHOLE BODY NJCFS007 ET 09/06/01	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM DETECT	AVERAGE OF ALL POSITIVE DETECTS	AVERAGE OF ALL ANALYTICAL RESULTS[2]
SEMIVOLATILE ORGANICS (UG/KG)										
4-METHYLPHENOL	310	J	61	J	2/2	310	J	MTCFS006	190	190
BENZALDEHYDE	330	U	120	J	1/2	120	J	NJCFS007	120	140
BIS(2-ETHYLHEXYL)PHTHALATE	260	J	330	U	1/2	260	J	MTCFS006	260	210
PHENOL	65	J	330	U	1/2	65	J	MTCFS006	65	120
PESTICIDE/PCBS (UG/KG)										
4,4'-DDE	4.7		3.3	U	1/2	4.7		MTCFS006	4.7	3.2
AROCLOR-1260	33	U	36	J	1/2	36	J	NJCFS007	36	26
INORGANICS (MG/KG)										
ALUMINUM	7.2		6.4		2/2	7.2		MTCFS006	6.8	6.8
ARSENIC	1.4	K	1.7	K	2/2	1.7	K	NJCFS007	1.6	1.6
BARIUM	1.6		1.1		2/2	1.6		MTCFS006	1.4	1.4
CALCIUM	8210		13300		2/2	13300		NJCFS007	10800	10800
IRON	19.1		40.5		2/2	40.5		NJCFS007	29.8	29.8
MAGNESIUM	247		358		2/2	358		NJCFS007	303	303
MANGANESE	5.8	K	11.7		2/2	11.7		NJCFS007	8.8	8.8
POTASSIUM	1310		1600		2/2	1600		NJCFS007	1450	1450
SODIUM	443		667		2/2	667		NJCFS007	560	560
VANADIUM	0.087		0.14		2/2	0.14		NJCFS007	0.11	0.11
ZINC	15.1		17.4		2/2	17.4		NJCFS007	16.3	16.3
MISCELLANEOUS PARAMETERS										
LIPIDS (%)	1.4		1		2/2	1.4		MTCFS006	1.2	1.2

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.

PCB = Polychlorinated Biphenyl

TABLE 4-5

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND SHINER AND MUMMICHOG SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES FILET OR WHOLE BODY SAMPLE ID MATRIX SAMPLE DATE	MATTAWOMAN CREEK AREA 6 SPOTTAIL SHINER WHOLE BODY MTCSS006 ET 09/07/01	QUAL	NANJEMOY CREEK AREA 7 MUMMICHOG WHOLE BODY NJCMC007 ET 09/06/01	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM DETECTION	AVERAGE OF ALL POSITIVE RESULTS	AVERAGE OF ALL ANALYTICAL RESULTS[2]
SEMIVOLATILE ORGANICS (UG/KG)										
4-METHYLPHENOL	660		84	J	2/2	660		MTCSS006	370	370
BENZALDEHYDE	320	J	410		2/2	410		NJCMC007	360	360
PHENOL	330	U	98	J	1/2	98	J	NJCMC007	98	130
PESTICIDES/PCBS (UG/KG)										
4,4'-DDE	6.8	J	3.3	U	1/2	6.8	J	MTCSS006	6.8	4.2
AROCLOR-1260	59	J	33	U	1/2	59	J	MTCSS006	59	38
INORGANICS (MG/KG)										
ALUMINUM	6.3		15.9		2/2	15.9		NJCMC007	11.1	11.1
ARSENIC	1.5	K	1.4	K	2/2	1.5	K	MTCSS006	1.5	1.5
BARIUM	6.2		2.6		2/2	6.2		MTCSS006	4.4	4.4
CALCIUM	7990		6920		2/2	7990		MTCSS006	7460	7460
CHROMIUM	1.2	K	0.33	B	1/2	1.2	K	MTCSS006	1.2	0.68
IRON	17.9		35.2		2/2	35.2		NJCMC007	26.6	26.6
MAGNESIUM	308		260		2/2	308		MTCSS006	280	280
MANGANESE	5	K	21.5		2/2	21.5		NJCMC007	13.3	13.3
POTASSIUM	2050		1400		2/2	2050		MTCSS006	1720	1720
SODIUM	533		655		2/2	655		NJCMC007	590	590
VANADIUM	0.08	U	0.1		1/2	0.10		NJCMC007	0.10	0.07
ZINC	35.1		22.7		2/2	35.1		MTCSS006	28.9	28.9
MISCELLANEOUS PARAMETERS										
LIPIDS (%)	0.87		0.94		2/2	0.94		NJCMC007	0.91	0.91

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

PCB = Polychlorinated Biphenyl

TABLE 4-6

SUMMARY OF POSITIVE RESULTS-BACKGROUND SHINER, PUMPKINSEED AND MUMMICHOG SAMPLES[1)]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES FILET OR WHOLE BODY SAMPLE ID MATRIX SAMPLE DATE	MATTAWOMAN CREEK AREA 6 PUMPKINSEED WHOLE BODY MTCFS006 ET 09/06/01	QUAL	MATTAWOMAN CREEK AREA 6 SPOTTAIL SHINER WHOLE BODY MTCSS006 ET 09/07/01	QUAL	NANJEMOY CREEK AREA 7 PUMPKINSEED WHOLE BODY NJCFS007 ET 09/06/01	QUAL	NANJEMOY CREEK AREA 7 MUMMICHOG WHOLE BODY NJCMC007 ET 09/06/01	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM DETECTION	AVERAGE OF ALL POSITIVE RESULTS	AVERAGE OF ALL ANALYTICAL RESULTS[(2)]
SEMIVOLATILE ORGANICS (UG/KG)														
4-METHYLPHENOL	310	J	660		61	J	84	J	4/4	660		MTCSS006	280	280
BENZALDEHYDE	330	U	320	J	120	J	410		3/4	410		NJCMC007	280	250
BIS(2-ETHYLHEXYL)PHTHALATE	260	J	330	UR	330	U	330	UJ	1/3	260	J	MTCFS006	260	200
PHENOL	65	J	330	U	330	U	98	J	2/4	98	J	NJCMC007	82	120
PESTICIDES/PCBS (UG/KG)														
4,4'-DDE	4.7		6.8	J	3.3	U	3.3	U	2/4	6.8	J	MTCSS006	5.8	3.7
AROCLOR-1260	33	U	59	J	36	J	33	U	2/4	59	J	MTCSS006	48	32
INORGANICS (MG/KG)														
ALUMINUM	7.2		6.3		6.4		15.9		4/4	15.9		NJCMC007	8.95	8.95
ARSENIC	1.4	K	1.5	K	1.7	K	1.4	K	4/4	1.7	K	NJCFS007	1.5	1.5
BARIUM	1.6		6.2		1.1		2.6		4/4	6.2		MTCSS006	2.9	2.9
CALCIUM	8210		7990		13300		6920		4/4	13300		NJCFS007	9100	9100
CHROMIUM	0.29	B	1.2	K	0.3	B	0.33	B	1/4	1.2	K	MTCSS006	1.2	0.42
IRON	19.1		17.9		40.5		35.2		4/4	40.5		NJCFS007	28.2	28.2
MAGNESIUM	247		308		358		260		4/4	358		NJCFS007	293	293
MANGANESE	5.8	K	5	K	11.7		21.5		4/4	21.5		NJCMC007	11.0	11.0
POTASSIUM	1310		2050		1600		1400		4/4	2050		MTCSS006	1590	1590
SODIUM	443		533		667		655		4/4	667		NJCFS007	575	575
VANADIUM	0.087		0.08	U	0.14		0.1		3/4	0.14		NJCFS007	0.11	0.09
ZINC	15.1		35.1		17.4		22.7		4/4	35.1		MTCSS006	22.6	22.6
MISCELLANEOUS PARAMETERS														
LIPIDS (%)	1.4		0.87		1		0.94		4/4	1.4		MTCFS006	1.1	1.1

PCB = Polychlorintaed Biphenyl

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UR = The data are unusable. (Note: The analyte may or may not be present.)
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-7

SUMMARY OF POSITIVE DETECTIONS-BACKGROUND HYDRILLA SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES SAMPLE ID MATRIX SAMPLE DATE	MATTAWOMAN CREEK AREA 6 HYDRILLA MTCVG006 ET 09/06/01	QUAL	NANJEMOY CREEK AREA 7 HYDRILLA NJCVG007 ET 09/05/01	QUAL	FREQUENCY OF DETECTION	MAXIMUM CONCENTRATION	MAXIMUM QUALIFIER	LOCATION OF MAXIMUM DETECT	AVERAGE OF ALL POSITIVE RESULTS	AVERAGE OF ALL ANALYTICAL RESULTS[2]
INORGANICS (MG/KG)										
ALUMINUM	286		134		2/2	286		MTCVG006	210	210
ARSENIC	0.82	UJ	2	J	1/2	2.0	J	NJCVG007	2.0	1.2
BARIUM	14.6		35.1		2/2	35.1		NJCVG007	24.9	24.9
BERYLLIUM	0.044		0.029		2/2	0.04		MTCVG006	0.04	0.04
CADMIUM	0.18	J	0.39	J	2/2	0.39	J	NJCVG007	0.29	0.29
CALCIUM	616		372		2/2	616		MTCVG006	494	494
CHROMIUM	0.98	K	0.067	U	1/2	0.98	K	MTCVG006	0.98	0.51
COBALT	0.92	K	1.7	K	2/2	1.7	K	NJCVG007	1.3	1.3
IRON	990		2260		2/2	2260		NJCVG007	1620	1620
MAGNESIUM	369		427		2/2	427		NJCVG007	398	398
MANGANESE	338	J	1970	J	2/2	1970	J	NJCVG007	1150	1150
NICKEL	1.2	K	2.1	K	2/2	2.1	K	NJCVG007	1.7	1.7
POTASSIUM	2560		2040		2/2	2560		MTCVG006	2300	2300
SILVER	0.12	UL	0.11	L	1/2	0.11	L	NJCVG007	0.11	0.09
SODIUM	321	J	1420	J	2/2	1420	J	NJCVG007	871	871
VANADIUM	1.2	K	1.1	K	2/2	1.2	K	MTCVG006	1.2	1.2
ZINC	18.3	J	14.8	J	2/2	18.3	J	MTCVG006	16.6	16.6

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic.
Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.

TABLE 4-8

SUMMARY OF HUMAN HEALTH AND ECOLOGICAL CRITERIA FOR SURFACE WATER SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	HUMAN HEALTH CRITERIA	ECOLOGICAL CRITERIA				
	EPA REGION 3 RBC-TAP WATER (UG/L)	FEDERAL AMBIENT WATER QUALITY CRITERIA-FRESHWATER (UG/L)	FEDERAL AMBIENT WATER QUALITY CRITERIA-SALTWATER (UG/L)	EPA REGION 3 BTAG SURFACE WATER CRITERIA-FRESHWATER (UG/L)	EPA REGION 3 BTAG SURFACE WATER CRITERIA-MARINE (UG/L)	MINIMUM ECOLOGICAL CRITERIA(1) (UG/L)
1,3-DINITROBENZENE	3.7	NA	NA	1200	NA	1200
2-METHYLNAPHTHALENE	120	NA	NA	NA	300	300
4-NITROTOLUENE	61	NA	NA	NA	NA	NA
ACETONE	610	NA	NA	9000000	NA	9000000
ALUMINUM	37000	87	NA	25	NA	25
AMMONIUM PERCHLORATE	NA	NA	NA	NA	NA	NA
ARSENIC	0.045	150	36	48	10	10
BARIUM	2600	NA	NA	10000	10000	10000
BENZENE	0.32	NA	NA	5300	700	700
BERYLLIUM	73	NA	NA	5.3	1500	5.3
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	NA	NA	30	360	30
BROMOFORM	8.5	NA	NA	11000	1000	1000
CADMIUM	18	0.27	8.8	0.53	9.3	0.27
CALCIUM	NA	NA	NA	NA	NA	NA
CHLORIDE	NA	230000	NA	NA	NA	230000
CHROMIUM	110	11	50	2	50	2
CIS-1,2-DICHLOROETHENE	61	NA	NA	11600	224000	11600
COBALT	730	NA	NA	35000	NA	35000
COPPER	1500	9	3.1	6.5	2.9	2.9
CYANIDE	730	5.2	1	5.2	1	1
DIESEL RANGE ORGANICS	NA	NA	NA	NA	NA	NA
DIETHYL ETHER	1200	NA	NA	NA	NA	NA
DISSOLVED OXYGEN	NA	NA	NA	NA	NA	NA
ETHYLBENZENE	3.3	NA	NA	32000	430	430
FLUORIDE	NA	NA	NA	2000	NA	2000
HARDNESS	NA	NA	NA	NA	NA	NA
HMX	1800	NA	NA	NA	NA	330(2)
IRON	11000	1000	NA	320	NA	320
LEAD	15	2.5	8.1	3.2	5.1	2.5
LOW MOLECULAR WEIGHT PAHS	NA	NA	NA	NA	NA	NA
MAGNESIUM	NA	NA	NA	NA	NA	NA
MANGANESE	730	NA	NA	14500	10	10
METHYL TERT-BUTYL ETHER	2.6	NA	NA	NA	NA	NA
NAPHTHALENE	6.5	NA	NA	100	2300	100
NICKEL	730	52	8.2	160	8.3	8.2
NITRATE	58000	NA	NA	NA	NA	NA
NITRITE	3700	NA	NA	NA	NA	NA
NITROBENZENE	3.5	NA	NA	27000	6680	6680
PERCHLORATE	NA	NA	NA	NA	NA	NA
POTASSIUM	NA	NA	NA	NA	NA	NA
SALINITY	NA	NA	NA	NA	NA	NA
SELENIUM	180	5	71	5	35	5
SILVER	180	NA	NA	0.0001	0.0001	0.0001
SODIUM	NA	NA	NA	NA	NA	NA
SPECIFIC CONDUCTANCE	NA	NA	NA	NA	NA	NA
SULFATE	NA	NA	NA	NA	NA	NA
TEMPERATURE	NA	NA	NA	NA	NA	NA
TOLUENE	750	NA	NA	17000	1050	1050
TOTAL 1,2-DICHLOROETHENE	55	NA	NA	NA	NA	590(3)
TOTAL DISSOLVED SOLIDS	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON	NA	NA	NA	NA	NA	NA
TOTAL PAHS	NA	NA	NA	NA	NA	NA
TOTAL SUSPENDED SOLIDS	NA	NA	NA	NA	NA	NA
TOTAL XYLENES	12000	NA	NA	6000	6000	6000
TRICHLOROETHENE	0.026	NA	NA	21900	2000	2000
VANADIUM	260	NA	NA	10000	10000	10000
ZINC	11000	120	81	30	19	19

Footnotes:

1 The Minimum Ecological Criteria is the minimum value of the preceding four sets (Federal Ambient Water Quality Criteria-Freshwater, Federal Ambient Water Quality Criteria-Saltwater, EPA Region 3 BTAG Surface Water Criteria-Freshwater and EPA Region 3 BTAG Surface Water Criteria-Marine) of criteria.
2 Criteria presented for HMX is from Talmage, Sylvia S., Dennis M. Opresko, Christopher J. Maxwell, Christopher J.E. Welsh, F. Michael Cretella, Patricia H. Reno, and F. Bernard Daniel, 1999. "Nitroaromatic Munition Compounds: Environmental Effects and Screening Values." Rev. Environmen. Contam. Toxicol. 161:1-156.
3 Criteria presented for total 1,2-dichloroethene is from Suter, G.W. II. and C.L. Tsao. 1996. Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1996 Revision. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-96/R2.

EPA = Environmental Protection Agency
BTAG = Biological Technical Assistance Group
RBC = Risk-Based Criteria

TABLE 4-9

SUMMARY OF HUMAN HEALTH AND ECOLOGICAL CRITERIA FOR SEDIMENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	HUMAN HEALTH CRITERIA		ECOLOGICAL CRITERIA			
	EPA REGION 3 RBC-SOIL, RESIDENTIAL	UNITS	EPA REGION 3 BTAG SEDIMENT CRITERIA	UNITS	MINIMUM ECOLOGICAL CRITERIA[1]	UNITS
1,3,5-TRINITROBENZENE	2300000	UG/KG	NA		2[2]	UG/KG
1,3-DINITROBENZENE	7800	UG/KG	NA		7[2]	UG/KG
2,4,6-TRINITROTOLUENE	21000	UG/KG	NA		90[2]	UG/KG
2,6-DINITROTOLUENE	78000	UG/KG	NA		294[3]	UG/KG
2-AMINO-4,6-DINITROTOLUENE	4700	UG/KG	NA		NA	
2-BUTANONE	47000000	UG/KG	NA		9330[3]	UG/KG
2-METHYLNAPHTHALENE	1600000	UG/KG	70	UG/KG	70	UG/KG
3-NITROTOLUENE	1600000	UG/KG	NA		NA	
4,4'-DDD	2700	UG/KG	16	UG/KG	16	UG/KG
4,4'-DDE	1900	UG/KG	2.2	UG/KG	2.2	UG/KG
4-METHYLPHENOL	390000	UG/KG	670	UG/KG	670	UG/KG
4-NITROTOLUENE	780000	UG/KG	NA		NA	
ACENAPHTHENE	4700000	UG/KG	16	UG/KG	16	UG/KG
ACENAPHTHYLENE	4700000	UG/KG	44	UG/KG	44[3]	UG/KG
ACETONE	7800000	UG/KG	NA		1000[3]	UG/KG
ACID VOLATILE SULFIDE	NA		NA		NA	
ALPHA-BHC	100	UG/KG	NA		NA	
ALUMINUM	78000	MG/KG	NA		18000[4]	MG/KG
ANTHRACENE	23000000	UG/KG	85.3	UG/KG	85.3	UG/KG
ANTIMONY	31	MG/KG	150	MG/KG	150	MG/KG
AROCLOR-1248	320	UG/KG	22.7	UG/KG	22.7	UG/KG
ARSENIC	0.43	MG/KG	8.2	MG/KG	8.2	MG/KG
BAP EQUIVALENT	NA		NA		NA	
BARIUM	5500	MG/KG	NA		48[4]	MG/KG
BENZO(A)ANTHRACENE	870	UG/KG	261	UG/KG	261	UG/KG
BENZO(A)PYRENE	87	UG/KG	430	UG/KG	430	UG/KG
BENZO(B)FLUORANTHENE	870	UG/KG	3200	UG/KG	3200[3]	UG/KG
BENZO(G,H,I)PERYLENE	2300000	UG/KG	670	UG/KG	670	UG/KG
BENZO(K)FLUORANTHENE	8700	UG/KG	NA		240[5]	UG/KG
BERYLLIUM	160	MG/KG	NA		NA	
BIS(2-ETHYLHEXYL)PHTHALATE	46000	UG/KG	1300	UG/KG	1300	UG/KG
CADMIUM	78	MG/KG	1.2	MG/KG	1.2	MG/KG
CALCIUM	NA		NA		NA	
CARBAZOLE	32000	UG/KG	NA		NA	
CARBON DISULFIDE	7800000	UG/KG	NA		1.9[3]	UG/KG
CHLOROFORM	780000	UG/KG	NA		62.9[3]	UG/KG
CHLOROMETHANE	49000	UG/KG	NA		NA	
CHROMIUM	230	MG/KG	81	MG/KG	81	MG/KG
CHRYSENE	87000	UG/KG	384	UG/KG	384[3]	UG/KG
CIS-1,2-DICHLOROETHENE	780000	UG/KG	NA		1030[3]	UG/KG
COBALT	1600	MG/KG	NA		10[4]	MG/KG
COPPER	3100	MG/KG	34	MG/KG	34	MG/KG
CYANIDE	1600	MG/KG	NA		0.667[3]	MG/KG
DIBENZO(A,H)ANTHRACENE	87	UG/KG	63.4	UG/KG	63.4	UG/KG
DIBENZOFURAN	310000	UG/KG	540	UG/KG	540	UG/KG
DIESEL RANGE ORGANICS	NA		NA		NA	
DIETHYL ETHER	16000000	UG/KG	NA		NA	
DIETHYL PHTHALATE	63000000	UG/KG	200	UG/KG	200	UG/KG
DI-N-BUTYL PHTHALATE	7800000	UG/KG	1400	UG/KG	1400	UG/KG
FLUORANTHENE	3100000	UG/KG	600	UG/KG	600[3]	UG/KG
FLUORENE	3100000	UG/KG	19	UG/KG	19	UG/KG
HIGH MOLECULAR WEIGHT PAHS	NA		NA		1700[6]	UG/KG

TABLE 4-9

SUMMARY OF HUMAN HEALTH AND ECOLOGICAL CRITERIA FOR SEDIMENT SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	HUMAN HEALTH CRITERIA		ECOLOGICAL CRITERIA			
	EPA REGION 3 RBC-SOIL, RESIDENTIAL	UNITS	EPA REGION 3 BTAG SEDIMENT CRITERIA	UNITS	MINIMUM ECOLOGICAL CRITERIA[1]	UNITS
HMX	3900000	UG/KG	NA		5[2]	UG/KG
INDENO(1,2,3-CD)PYRENE	870	UG/KG	600	UG/KG	600	UG/KG
IRON	23000	MG/KG	NA		20000[5]	MG/KG
LEAD	400	MG/KG	46.7	MG/KG	46.7	MG/KG
LOW MOLECULAR WEIGHT PAHS	NA		NA		552[6]	UG/KG
MAGNESIUM	NA		NA		NA	
MANGANESE	1600	MG/KG	NA		260[4]	MG/KG
MERCURY	23	MG/KG	0.15	MG/KG	0.15	MG/KG
METHYL TERT-BUTYL ETHER	160000	UG/KG	NA		NA	
NAPHTHALENE	1600000	UG/KG	160	UG/KG	160	UG/KG
NICKEL	1600	MG/KG	20.9	MG/KG	20.9	MG/KG
NITROCELLULOSE	NA		NA		NA	
N-NITROSODIPHENYLAMINE	130000	UG/KG	28	UG/KG	28	UG/KG
PERCENT CLAY	NA		NA		NA	
PERCENT GRAVEL	NA		NA		NA	
PERCENT MOISTURE	NA		NA		NA	
PERCENT SAND	NA		NA		NA	
PERCENT SILT	NA		NA		NA	
PERCENT SOLIDS	NA		NA		NA	
PH	NA		NA		NA	
PHENANTHRENE	2300000	UG/KG	240	UG/KG	240	UG/KG
POTASSIUM	NA		NA		NA	
PYRENE	2300000	UG/KG	665	UG/KG	665	UG/KG
SELENIUM	390	MG/KG	NA		1[4]	MG/KG
SILVER	390	MG/KG	1	MG/KG	1	MG/KG
SODIUM	NA		NA		NA	
THALLIUM	5.5	MG/KG	NA		NA	
TOLUENE	16000000	UG/KG	NA		123[3]	UG/KG
TOTAL ORGANIC CARBON	NA		NA		NA	
TOTAL PAHS	NA		NA		4022[6]	UG/KG
TOTAL SEM-AVS	NA		NA		NA	
TRICHLOROETHENE	1600	UG/KG	NA		450[3]	UG/KG
VANADIUM	550	MG/KG	NA		57[4]	MG/KG
ZINC	23000	MG/KG	150	MG/KG	150	MG/KG

Footnotes:

1 The Combined Ecological Criteria are the EPA Region 3 BTAG Sediment Criteria, supplemented with criteria from other sources, where no BTAG criteria exist for a particular analyte.
2 Criteria presented are from Talmage, Sylvia S., Dennis M. Opresko, Christopher J. Maxwell, Christopher J.E. Welsh, F. Michael Cretella, Patricia H. Reno, and F. Bernard Daniel, 1999. "Nitroaromatic Munition Compounds: Environmental Effects and Screening Values." Rev. Environmen. Contam. Toxicol. 161:1-156.
3 Criteria are calculated as noted and listed in Appendix B.
4 Criteria presented are from Buchman, M. F., 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html
5 Criteria presented are from OMOE, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.
6 Criteria presented are from Long, Edward, R., D.D. MacDonald, S.L. Smith, F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. 1995.

EPA = Environmental Protection Agency
RBC = Risk-Based Criteria
BTAG = Biological Technical Assistance Group

TABLE 4-10

SUMMARY OF HUMAN HEALTH CRITERIA FOR FILET SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	REGION 3 RBC FOR FISH	UNITS
1,3-DINITROBENZENE	140	UG/KG
2-AMINO-4,6-DINITROTOLUENE	81	UG/KG
4,4'-DDE	9.3	UG/KG
4-METHYLPHENOL	6800	UG/KG
ALUMINUM	1400	MG/KG
AROCLOR-1260	1.6	UG/KG
ARSENIC	0.0021	MG/KG
BARIUM	95	MG/KG
BENZALDEHYDE	140000	UG/KG
BIS(2-ETHYLHEXYL)PHTHALATE	230	UG/KG
CADMIUM	1.4	MG/KG
CALCIUM	NA	
CHROMIUM	4.1	MG/KG
COPPER	54	MG/KG
CYANIDE	27	MG/KG
DIELDRIN	0.2	UG/KG
ENDOSULFAN I	8100	UG/KG
ENDRIN	410	UG/KG
GAMMA-CHLORDANE	9	UG/KG
HMX	68000	UG/KG
IRON	410	MG/KG
LEAD	NA	
LIPIDS	NA	
MAGNESIUM	NA	
MANGANESE	27	MG/KG
MERCURY	0.14	MG/KG
NITROCELLULOSE	NA	
NITROGUANIDINE	NA	
PERCHLORATE	NA	
PHENOL	810000	UG/KG
POTASSIUM	NA	
SODIUM	NA	
ZINC	410	MG/KG

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	IS11SW01 SW 327410.223 1256703.53 SITE11 IS11SW01 AREA 1 7/20/2000	QUAL	IS11SW02 SW 327450.538 1256510.02 SITE11 IS11SW02 AREA 1 7/20/2000	QUAL	IS11SW03 SW 327423.661 1256429.39 SITE11 IS11SW03 AREA 1 7/20/2000	QUAL	IS11SW04 SW 327416.9417 1256260.062 SITE11 IS11SW04 AREA 1 7/20/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01 AREA 1 7/21/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01P AREA 1 7/21/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01-AVG AREA 1 7/21/2000	QUAL	IS17SW02 SW 328030.815 1257636.92 SITE17 IS17SW02 AREA 1 7/20/2000	QUAL
VOLATILE ORGANICS (UG/L)																			
BENZENE	700	0.32	ND	10	U	10	U	10	U	10	U								
BROMOFORM	1000	8.5	ND	10	U	10	U	10	U	10	U								
ETHYLBENZENE	430	3.3	ND	10	U	10	U	10	U	10	U								
METHYL TERT-BUTYL ETHER	NA	2.6	ND	1	J	10	U	10	U	10	U								
TOLUENE	1050	750	ND	10	U	10	U	10	U	10	U								
TOTAL XYLENES	6000	12000	ND	10	U	10	U	10	U	10	U								
SEMIVOLATILE ORGANICS (UG/L)																			
BIS(2-ETHYLHEXYL)PHTHALATE	30	4.8	ND	1	J	10	U	10	U	10	U								
INORGANICS (UG/L)																			
ALUMINUM	25	37000	587	457		239		276		366		25.1	B	161	B	93.05	B	664	
ARSENIC	10	0.045	ND	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
BARIUM	10000	2600	57	29	J	24	J	24.7	J	26	J	19	J	23.4	J	21.2	J	24.7	J
CALCIUM	NA	NA	50300	11500		10400		10700		10100		10600		10200		10400		10000	
CHROMIUM	2	110	1.8	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U
COPPER	2.9	1500	ND	4.3	B	1.9	U	4.2	J	5.2	J	1.9	U	1.9	U	1.9	U	3.9	J
CYANIDE	1	730	36.8	1.6	B	4.9	B	1.5	B	1.5	B	6.2	L	2.2	L	4.2	L	10	L
IRON	320	11000	577	772		475		564		726		32.3	B	453		234.575		725	
LEAD	2.5	15	ND	38.4		1.6	J	1.3	J	6.1		1.3	U	1.3	U	1.3	U	1.3	U
MAGNESIUM	NA	NA	153000	5920		5380		5360		5190		5690		5500		5595		5300	
MANGANESE	10	730	1190	127		98.3		103		111		1.6	B	93.9		47.35		87.4	
NICKEL	8.2	730	ND	3.5	B	2.6	B	2.6	B	3.1	B	1.9	U	2.5	K	1.725	K	2	B
POTASSIUM	NA	NA	64400	2950	J	2670	J	2630	J	2650	J	2770	J	2790	J	2780	J	2670	J
SELENIUM	5	180	ND	4.3	U	4.3	U	4.3	U	4.3	U	860	U	4.3	U	432.15	U	860	U
SODIUM	NA	NA	1230000	13300		12200		12000		11900		13400		12200		12800		12200	
VANADIUM	10000	260	ND	2	J	1.5	J	1.5	J	2.1	B	1.4	U	1.4	U	1.4	U	2.1	J
ZINC	19	11000	ND	42.3	B	10.8	B	18.5	B	53.5	B	7.4	B	15.2	B	11.3	B	9.4	B
FILTERED INORGANICS (UG/L)																			
ARSENIC	10	0.045	ND	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
BARIUM	10000	2600	ND	23.6	J	21.2	J	22	J	22.9	J	21.8	J	18.4	J	20.1	J	17	J
BERYLLIUM	5.3	73	ND	0.2	U	0.2	U	0.2	U	0.2	U	0.31	J	0.2	U	0.205	J	0.2	U
CADMIUM	0.27	18	ND	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U
CALCIUM	NA	NA	49700	12000		11600		11900		11400		9120		10400		9760		10100	
CHROMIUM	2	110	ND	4.4	B	2	U	2	U	2	U	2	U	2	U	2	U	2	U
COPPER	2.9	1500	ND	1.9	U	1.9	U	2.4	J	1.9	U	4.8	J	1.9	U	2.875	J	1.9	U

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	IS11SW01 SW 327410.223 1256703.53 SITE11 IS11SW01 AREA 1 7/20/2000	QUAL	IS11SW02 SW 327450.538 1256510.02 SITE11 IS11SW02 AREA 1 7/20/2000	QUAL	IS11SW03 SW 327423.661 1256429.39 SITE11 IS11SW03 AREA 1 7/20/2000	QUAL	IS11SW04 SW 327416.9417 1256260.062 SITE11 IS11SW04 AREA 1 7/20/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01 AREA 1 7/21/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01P AREA 1 7/21/2000	QUAL	IS17SW01 SW 328117.1663 1257859.44 SITE17 IS17SW01-AVG AREA 1 7/21/2000	QUAL	IS17SW02 SW 328030.815 1257636.92 SITE17 IS17SW02 AREA 1 7/20/2000	QUAL
IRON	320	11000	ND	47.3	B	27.3	U	32.3	B	34	B	456		29.4	B	235.35		27.3	U
LEAD	2.5	15	ND	1.3		1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U
MAGNESIUM	NA	NA	149000	6050	B	5960	B	5980		5910		4840	J	5660		5250		5320	
MANGANESE	10	730	249	4.5	J	2.2	J	3.6	B	2.5	B	86.7		1.7	J	44.2	J	1.6	B
NICKEL	8.2	730	ND	5.3	B	3.7	B	2.2	B	1.9	U	17.9	J	1.9	U	9.425	J	1.9	U
POTASSIUM	NA	NA	64800	2940	J	2910	J	2870	J	2910	J	2400	J	2800	J	2600	J	2550	J
SELENIUM	5	180	ND	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U
SODIUM	NA	NA	1150000	13900		14000		13900		14300		11300		12800		12050		12300	
VANADIUM	10000	260	ND	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U
ZINC	19	11000	ND	33.8	B	24	B	15.2	B	7.2	B	15.7	B	6.2	B	10.95	B	7.2	B
MISCELLANEOUS PARAMETERS (MG/L)																			
AMMONIUM PERCHLORATE (UG/L)	NA	NA	NA	4	U	1.6	J	2.9	J	3.6	J	4	U	4	U	4	U	4	U
CHLORIDE	230000	NA	2420																
DIESEL RANGE ORGANICS (UG/L)	NA	NA	NA	160		160		100		120									
FLUORIDE	2000	NA	0.19																
HARDNESS	NA	NA	760									42		48		45		44	
NITRATE	NA	58	0.5																
PERCHLORATE (UG/L)	NA	1.1	ND	3.39	U	1.36	J	2.46	J	3.05	J	3.39	U	3.39	U	3.39	U	3.39	U
PH (S.U.)	NA	NA	7.88																
SULFATE	NA	NA	299																
TOTAL DISSOLVED SOLIDS	NA	NA	4000																
TOTAL ORGANIC CARBON	NA	NA	8																
TOTAL SUSPENDED SOLIDS	NA	NA	38																
EXPLOSIVES (UG/L)																			
1,3-DINITROBENZENE	1200	3.7	ND	0.075	J	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
4-NITROTOLUENE	NA	61	ND	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.11	J
FIELD PARAMETERS																			
DISSOLVED OXYGEN (MG/L)	NA	NA	26.0																
PH (S.U.)	NA	NA	7.9																
SPECIFIC CONDUCTANCE (MS/CM)	NA	NA	8.9																
TEMPERATURE (C)	NA	NA	28.0																

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1)]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	IS17SW03		IS17SW04		IS17SW05		IS17SW06		MTC001		MTC002		MTC002		MTC002	
LOCATION TYPE	SW		SW		SW		SW		SWSD		SWSD		SWSD		SWSD	
NORTHING	327941.1417		327795.0081		327680.4261		327549.2379		326600.34		327189.67		327189.67		327189.67	
EASTING	1257442.627		1257264.942		1257142.056		1256995.923		1255101.17		1255150.97		1255150.97		1255150.97	
SITE	SITE17		SITE17		SITE17		SITE17		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	IS17SW03		IS17SW04		IS17SW05		IS17SW06		MTCSW00101 / MTCSW00101-F		MTCSW00201 / MTCSW00201-F		MTCSW00201-D / MTCSW00201-F-D		MTCSW00201-AVG / MTCSW00201-F-AVG	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	7/21/2000	QUAL	7/24/2000	QUAL	7/24/2000	QUAL	7/24/2000	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
VOLATILE ORGANICS (UG/L)																
BENZENE									1	U	1	U			1	U
BROMOFORM									1	U	1	U			1	U
ETHYLBENZENE									1	U	1	U			1	U
METHYL TERT-BUTYL ETHER																
TOLUENE									1	U	1	U			1	U
TOTAL XYLENES									1	U	1	U			1	U
SEMIVOLATILE ORGANICS (UG/L)																
BIS(2-ETHYLHEXYL)PHTHALATE									5	U	5	U	5	U	5	U
INORGANICS (UG/L)																
ALUMINUM	553	J	258		171	B	124	B	85.6	B	140		124		132	
ARSENIC	3.6	U	3.6	U	3.6	U	3.6	U	4.2	U	4.2	U	4.2	U	4.2	U
BARIUM	25.8	J	24	J	25.2	J	24.4	J	29.7		26.2		36.3		31.25	
CALCIUM	10100		9750		10800		11800		15900		13200		13100		13150	
CHROMIUM	2	U	2	U	2	U	2	U	0.65	B	0.53	B	2.3	B	1.415	B
COPPER	2.4	J	4.5	J	5	J	5.4	J	3.6	B	1.3	B	1.7	B	1.5	B
CYANIDE	1.1	L	2.7	B	0.98	B	2.7	B	3	U	3	U	3	U	3	U
IRON	981		576		362		227		130		192		211		201.5	
LEAD	1.3	K	1.3	U	1.9	J	7.3		1.2	U	1.2	U	3	B	2.1	B
MAGNESIUM	5310		5140		5600		5900		8520		8600		8570		8585	
MANGANESE	106		105		105		95.9		28.3	K	38.8		40.7		39.75	
NICKEL	2.7	J	3.5	J	2.8	J	2.8	J	2.7	B	2.5	B	2.9	B	2.7	B
POTASSIUM	2700	J	2650	J	2920	J	3030	J	4030		3760		3870		3815	
SELENIUM	4.3	U	4.3	U	5.8		4.3	U	4.3	U	4.3	U	4.3	U	4.3	U
SODIUM	12100		15000		15800		15900		20100		22100		22000		22050	
VANADIUM	2.1	J	1.7	J	1.5	J	1.4	U	1.3	K	1.2	K	1.4	K	1.3	K
ZINC	32.8	B	24.2		26		32.7		5.8	B	0.7	U	1	B	0.85	B
FILTERED INORGANICS (UG/L)																
ARSENIC	3.6	U	3.6	U	3.6	U	3.6	U	4.2	U	4.2	U	4.2	U	4.2	U
BARIUM	17.8	J	20.4	J	20.7	J	21	J	39.3		25.9		24.4		25.15	
BERYLLIUM	0.2	U	0.2	U	0.2	U	0.2	U	0.1	U	0.1	U	0.1	U	0.1	U
CADMIUM	0.4	U	0.4	U	0.4	U	0.4	U	0.22	K	0.17	K	0.1	U	0.11	K
CALCIUM	10200		10000		10700		12200		15800		13000		13200		13100	
CHROMIUM	2	U	2	U	2	U	2	U	0.73	B	1.1	B	9.7	K	5.125	K
COPPER	1.9	U	2.8	J	2.2	J	1.9	U	4.3	B	1	B	2	B	1.5	B

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1)]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	IS17SW03		IS17SW04		IS17SW05		IS17SW06		MTC001		MTC002		MTC002		MTC002	
LOCATION TYPE	SW		SW		SW		SW		SWSD		SWSD		SWSD		SWSD	
NORTHING	327941.1417		327795.0081		327680.4261		327549.2379		326600.34		327189.67		327189.67		327189.67	
EASTING	1257442.627		1257264.942		1257142.056		1256995.923		1255101.17		1255150.97		1255150.97		1255150.97	
SITE	SITE17		SITE17		SITE17		SITE17		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	IS17SW03		IS17SW04		IS17SW05		IS17SW06		MTCSW00101 / MTCSW00101-F		MTCSW00201 / MTCSW00201-F		MTCSW00201-D / MTCSW00201-F-D		MTCSW00201-AVG / MTCSW00201-F-AVG	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	7/21/2000	QUAL	7/24/2000	QUAL	7/24/2000	QUAL	7/24/2000	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
IRON	28.2	J	59.2	J	47.6	B	37.5	J	19.5	B	21.7	B	136		73.425	
LEAD	1.3	U	1.3	U	1.3	U	1.3	U	1.2	U	1.2	U	1.2	U	1.2	U
MAGNESIUM	5470		5230		5630		6180		8450		8430		8470		8450	
MANGANESE	2.2	B	5.1	B	4.4	B	4.2	B	2.3	B	1.6	B	2	B	1.8	B
NICKEL	1.9	U	3.1	J	3.7	J	3.3	J	3.3	B	2.6	B	16.2	K	8.75	K
POTASSIUM	2710	J	2640	J	2840	J	3090	J	3700		3660		3610		3635	
SELENIUM	4.3	U	4.9	J	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U
SODIUM	12900		14900		13700		14200		20200		21900		22000		21950	
VANADIUM	1.4	U	1.4	U	1.4	U	1.4	U	1.2	K	1	K	0.81	K	0.905	K
ZINC	8	B	29.9		19.8	B	19.2	B	11.7	B	5.3	B	13.5	B	9.4	B
MISCELLANEOUS PARAMETERS (MG/L)																
AMMONIUM PERCHLORATE (UG/L)	4	U	4	U	4	U	4	U								
CHLORIDE									36.4		37.3		35.7		36.5	
DIESEL RANGE ORGANICS (UG/L)																
FLUORIDE									0.19		0.2		0.19		0.195	
HARDNESS	46		40		36		42		75		67		68		67.5	
NITRATE									0.077	J	0.05	UJ	0.05	UJ	0.05	UJ
PERCHLORATE (UG/L)	3.39	U	3.39	U	3.39	U	3.39	U	5	U	5	U	5	U	5	U
PH (S.U.)									8.8	J	9	J	9	J	9	J
SULFATE									31.5		29.8		28.5		29.15	
TOTAL DISSOLVED SOLIDS									160		150		140		145	
TOTAL ORGANIC CARBON									7		6				6	
TOTAL SUSPENDED SOLIDS									10	U	10	U	11		8	
EXPLOSIVES (UG/L)																
1,3-DINITROBENZENE	0.2	U	0.2	U	0.2	U	0.2	U	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ
4-NITROTOLUENE	0.2	U	0.2	U	0.2	U	0.2	U	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ
FIELD PARAMETERS																
DISSOLVED OXYGEN (MG/L)									13.9		13.8					
PH (S.U.)									9.3		9.4					
SPECIFIC CONDUCTANCE (MS/CM)									0.26		0.26					
TEMPERATURE (C)									26.8		27.2					

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1)]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC003		MTC004		MTC005		MTC029		MTC030	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD		SWSD	
NORTHING	327401.28		327403.21		328220.38		324317.72		324577.98	
EASTING	1255740.44		1256268.56		1258899.46		1256000.16		1257980.5	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSW00301 / MTCSW00301-F		MTCSW00401 / MTCSW00401-F		MTCSW00501 / MTCSW00501-F		MTCSW02901 / MTCSW02901-F		MTCSW03001 / MTCSW03001-F	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	9/9/2001	QUAL	9/9/2001	QUAL	9/8/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
VOLATILE ORGANICS (UG/L)										
BENZENE	0.7	J	1	U	1	U	1	U	1	U
BROMOFORM	0.5	J	1	U	1	U	1	U	1	U
ETHYLBENZENE	0.6	J	1	U	1	U	1	U	1	U
METHYL TERT-BUTYL ETHER										
TOLUENE	3		1	U	1	U	1	U	1	U
TOTAL XYLENES	4		1	U	1	U	1	U	1	U
SEMIVOLATILE ORGANICS (UG/L)										
BIS(2-ETHYLHEXYL)PHTHALATE	5	U	5	U	1	J	5	U	5	U
INORGANICS (UG/L)										
ALUMINUM	347		231		351		24.3	B	4.6	U
ARSENIC	6.5	K	4.2	U	4.2	U	4.2	U	4.4	K
BARIUM	33.6		31.9		28.3		21.5		23.1	
CALCIUM	14800		15300		12900		13600		10000	
CHROMIUM	1.2	B	3.4	K	1	B	0.6	B	0.71	B
COPPER	1.8	B	3	B	2.4	B	1.7	B	1.9	B
CYANIDE	3	U	3	U	10		3	U	4	
IRON	457		263		669		193		102	
LEAD	1.2	U	1.2	U	2	B	1.2	U	1.2	U
MAGNESIUM	8600		8650		8490		8810		6900	
MANGANESE	68.9		47.9		147		27.5	K	9.3	K
NICKEL	2.7	B	2.8	B	2.9	B	2.3	B	2	B
POTASSIUM	4230		4020		3820		3600		3010	
SELENIUM	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U
SODIUM	22000		20500		23000		23300		17800	
VANADIUM	1.7	K	1.6	K	2.6	K	1.4	K	0.73	K
ZINC	1.1	B	2.7	B	6.1	B	1.1	B	2.9	B
FILTERED INORGANICS (UG/L)										
ARSENIC	4.2	U	4.5	K	4.2	U	4.2	U	4.2	U
BARIUM	32.9		34.7		22.4	B	37.5		27.5	
BERYLLIUM	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
CADMIUM	0.3	K	0.16	K	0.1	U	0.1	U	0.1	U
CALCIUM	13700		15700		12200		13000		9250	
CHROMIUM	0.8	B	0.78	B	0.87	B	0.77	B	0.65	B
COPPER	1.5	B	2.8	B	3.9	B	1.1	B	1.4	B

TABLE 4-11

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC003		MTC004		MTC005		MTC029		MTC030	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD		SWSD	
NORTHING	327401.28		327403.21		328220.38		324317.72		324577.98	
EASTING	1255740.44		1256268.56		1258899.46		1256000.16		1257980.5	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSW00301 / MTCSW00301-F		MTCSW00401 / MTCSW00401-F		MTCSW00501 / MTCSW00501-F		MTCSW02901 / MTCSW02901-F		MTCSW03001 / MTCSW03001-F	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	9/9/2001	QUAL	9/9/2001	QUAL	9/8/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
IRON	133		14.5	B	35.2	B	36.6	B	39.9	B
LEAD	1.2	U	1.6	B	1.2	U	1.2	U	1.2	U
MAGNESIUM	7790		8780		8090		8430		6360	
MANGANESE	3.4	B	1	B	2	B	2.5	B	1.8	B
NICKEL	3	B	3.9	B	2.7	B	2.5	B	2	B
POTASSIUM	3730		3980		3490		3370		2690	
SELENIUM	4.3	U	4.3	U	4.3	U	4.3	U	4.3	U
SODIUM	20600		21000		22000		21900		16500	
VANADIUM	1.3	K	0.98	K	1.5	K	0.94	K	0.74	K
ZINC	5.8	B	8.7	B	19.4	B	6.5	B	7.1	B
MISCELLANEOUS PARAMETERS (MG/L)										
AMMONIUM PERCHLORATE (UG/L)										
CHLORIDE	35.6		36.6		38.7		38.5		29.5	
DIESEL RANGE ORGANICS (UG/L)										
FLUORIDE	0.2		0.2		0.2		0.2		0.17	
HARDNESS	72		73		66		70		53	
NITRATE	0.05	UJ	0.076	J	0.05	UJ	0.05	UJ	0.05	UJ
PERCHLORATE (UG/L)	5	U	5	U	5	U	5	U	5	U
PH (S.U.)	9.1	J	8.2	J	8.9	J	9.1	J	10	J
SULFATE	28.6		31.5		30.3		27.9		23.2	
TOTAL DISSOLVED SOLIDS	170		510		150		140		120	
TOTAL ORGANIC CARBON	7		8		6		7		6	
TOTAL SUSPENDED SOLIDS	10	U	11		48		10	U	10	U
EXPLOSIVES (UG/L)										
1,3-DINITROBENZENE	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ
4-NITROTOLUENE	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ
FIELD PARAMETERS										
DISSOLVED OXYGEN (MG/L)	10.9		9.9		12.1		11.9		16.7	
PH (S.U.)	9.2		7.3		10.0		10.1		10.9	
SPECIFIC CONDUCTANCE (MS/CM)	0.26		0.26		0.25		0.25		0.23	
TEMPERATURE (C)	28.2		26.1		28.4		26.6		28.2	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Surface Water Criteria or the Region 3 RBC for Tap Water.

TABLE 4-12

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC006 SWSD 329298.47 1259041.41 MATTAWOMAN CREEK MTCSW00601 / MTCSW00601-F AREA 2 9/8/2001	QUAL	MTC007 SWSD 329016.99 1258314.94 MATTAWOMAN CREEK MTCSW00701 / MTCSW00701-F AREA 2 9/8/2001	QUAL	MTC008 SWSD 330390.01 1258888.66 MATTAWOMAN CREEK MTCSW00801 / MTCSW00801-F AREA 2 9/8/2001	QUAL	MTC009 SWSD 330505.76 1258552.33 MATTAWOMAN CREEK MTCSW00901 / MTCSW00901-F AREA 2 9/8/2001	QUAL	MTC010 SWSD 331849.97 1259621.28 MATTAWOMAN CREEK MTCSW01001 / MTCSW01001-F AREA 2 9/8/2001	QUAL
VOLATILE ORGANICS (UG/L)													
ACETONE	9000000	610	ND	5	UR	5	UR	5	J	5	UR	5	UR
BENZENE	700	0.32	ND	1	U	1	U	1		1	U	8	
ETHYLBENZENE	430	3.3	ND	1	U	1	U	0.8	J	1	U	7	
TOLUENE	1050	750	ND	1		1	U	5		1	U	23	
TOTAL XYLENES	6000	12000	ND	1		1	U	6		1	U	48	
SEMIVOLATILE ORGANICS (UG/L)													
2-METHYLNAPHTHALENE	300	120	ND	5	U	5	U	5	U	5	U	2	J
LOW MOLECULAR WEIGHT PAHS	NA	NA	ND									4	
NAPHTHALENE	100	6.5	ND	5	U	5	U	5	U	5	U	2	J
TOTAL PAHS	NA	NA	ND									4	
INORGANICS (UG/L)													
ALUMINUM	25	37000	587	126		125		22.1	B	24.2	B	97.1	B
ARSENIC	10	0.045	ND	4.2	U	4.2	U	4.2	U	5.1	K	5.6	K
BARIUM	10000	2600	57	28.4		29.8		23.9		25.3		22.2	
BERYLLIUM	5.3	73	ND	0.12		0.1	U	0.1	U	0.1	U	0.1	U
CADMIUM	0.27	18	0.17	0.14	K	0.1	U	0.1	U	0.1	U	0.1	U
CALCIUM	NA	NA	50300	13300		12500		12400		12500		9970	
IRON	320	11000	577	134		224		128		84.8		352	
MAGNESIUM	NA	NA	153000	8720		8460		9010		8810		7860	
MANGANESE	10	730	1190	28.5	K	58.2		46.2		15.5	K	82	
POTASSIUM	NA	NA	64400	3450		4030		3440		3370		3680	
SODIUM	NA	NA	1230000	22200		23500		24600		25200		27100	
VANADIUM	10000	260	ND	1.2	K	1.7	K	1	K	1.1	K	0.82	K
FILTERED INORGANICS (UG/L)													
ARSENIC	10	0.045	ND	4.2	U	4.2	U	4.2	U	4.8	K	4.2	U
BARIUM	10000	2600	ND	30.3		31.5		29		24.8		24.3	
CADMIUM	0.27	18	ND	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
CALCIUM	NA	NA	49700	13000		11800		12000		12000		9740	
IRON	320	11000	ND	28.5	B	12.8	B	39.1	B	33.6	B	80.7	
MAGNESIUM	NA	NA	149000	8480		7820		8740		8560		7640	
MANGANESE	10	730	249	1.8	B	0.81	B	4.9	B	3.2	B	6	K
POTASSIUM	NA	NA	64800	3270		3700		3350		3210		3360	
SODIUM	NA	NA	1150000	22000		23000		24200		24800		26500	

TABLE 4-12

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC006 SWSD 329298.47 1259041.41 MATTAWOMAN CREEK MTCSW00601 / MTCSW00601-F AREA 2 9/8/2001	QUAL	MTC007 SWSD 329016.99 1258314.94 MATTAWOMAN CREEK MTCSW00701 / MTCSW00701-F AREA 2 9/8/2001	QUAL	MTC008 SWSD 330390.01 1258888.66 MATTAWOMAN CREEK MTCSW00801 / MTCSW00801-F AREA 2 9/8/2001	QUAL	MTC009 SWSD 330505.76 1258552.33 MATTAWOMAN CREEK MTCSW00901 / MTCSW00901-F AREA 2 9/8/2001	QUAL	MTC010 SWSD 331849.97 1259621.28 MATTAWOMAN CREEK MTCSW01001 / MTCSW01001-F AREA 2 9/8/2001	QUAL
VANADIUM	10000	260	ND	1.4	K	1.6	K	0.94	K	1	K	0.75	K
MISCELLANEOUS PARAMETERS (MG/L)													
CHLORIDE	230000	NA	2420	39.1		38.7		43.5		43.3		44.2	
FLUORIDE	2000	NA	0.19	0.19		0.2		0.19		0.2		0.19	
HARDNESS	NA	NA	760	69		66		67		67		58	
NITRATE	NA	58	0.5	0.05	UJ	0.05	UJ	0.09	J	0.05	UJ	0.05	UJ
PH (S.U.)	NA	NA	7.88	9.6	J	9.9	J	9.7	J	9.7	J	9	J
SULFATE	NA	NA	299	30.6		28.9		30.4		28.2		23.8	
TOTAL DISSOLVED SOLIDS	NA	NA	4000	160		170		160		150		140	
TOTAL ORGANIC CARBON	NA	NA	8	6		6		6		11		8	
EXPLOSIVES (UG/L)													
HMX	330	1800	ND	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ	0.15	J
FIELD PARAMETERS													
DISSOLVED OXYGEN (MG/L)	NA	NA	26.0	14.7		14.2		11.6		13.0		12.8	
PH (S.U.)	NA	NA	7.9	11.2		9.0		10.9		11.0		10.7	
SPECIFIC CONDUCTANCE (MS/CM)	NA	NA	8.9	0.27		0.31		0.27		0.28		0.26	
TEMPERATURE (C)	NA	NA	28.0	28.3		31.0		27.0		27.1		26.86	

TABLE 4-12

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC011		MTC012		MTC012		MTC012	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD	
NORTHING	330868.23		330879.62		330879.62		330879.62	
EASTING	1260476.85		1260918.38		1260918.38		1260918.38	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSW01101 / MTCSW01101-F		MTCSW01201 / MTCSW01201-F		MTCSW01201-D / MTCSW01201-F-D		MTCSW01201-AVG / MTCSW01201-F-AVG	
AREA OF CONCERN	AREA 2		AREA 2		AREA 2		AREA 2	
SAMPLE DATE	9/8/2001	QUAL	9/8/2001	QUAL	9/8/2001	QUAL	9/8/2001	QUAL
VOLATILE ORGANICS (UG/L)								
ACETONE	5	UR	5	UR	5	UR	5	UR
BENZENE	1		1	U	1	U	1	U
ETHYLBENZENE	1		1	U	1	U	1	U
TOLUENE	6		1	U	1	U	1	U
TOTAL XYLENES	7		1	U	1	U	1	U
SEMIVOLATILE ORGANICS (UG/L)								
2-METHYLNAPHTHALENE	5	U	5	U	5	U	5	U
LOW MOLECULAR WEIGHT PAHS								
NAPHTHALENE	5	U	5	U	5	U	5	U
TOTAL PAHS								
INORGANICS (UG/L)								
ALUMINUM	181		111	B	102	B	107	B
ARSENIC	4.2	U	4.2	U	6.9	K	4.5	K
BARIUM	27.6		27		30.3		28.7	
BERYLLIUM	0.1	U	0.1	U	0.1	U	0.1	U
CADMIUM	0.1	U	0.1	U	0.1	U	0.1	U
CALCIUM	12900		12200		12400		12300	
IRON	240		184		176		180	
MAGNESIUM	8690		8430		8550		8490	
MANGANESE	51.2		39.6		37.2		38.4	
POTASSIUM	3650		3500		3610		3555	
SODIUM	22800		23000		23400		23200	
VANADIUM	1.2	K	0.95	K	0.85	K	0.9	K
FILTERED INORGANICS (UG/L)								
ARSENIC	4.2	U	5.4	K	4.2	U	3.75	K
BARIUM	30.6		26.1		27.6		26.9	
CADMIUM	0.1	U	0.1	U	0.68	K	0.37	K
CALCIUM	12900		11800		12100		11950	
IRON	23.4	B	26.5	B	27.2	B	26.9	B
MAGNESIUM	8560		8270		8430		8350	
MANGANESE	0.87	B	0.98	B	1.9	B	1.4	B
POTASSIUM	3560		3320		3480		3400	
SODIUM	22700		22700		23200		22950	

TABLE 4-12

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC011		MTC012		MTC012		MTC012	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD	
NORTHING	330868.23		330879.62		330879.62		330879.62	
EASTING	1260476.85		1260918.38		1260918.38		1260918.38	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSW01101 / MTCSW01101-F		MTCSW01201 / MTCSW01201-F		MTCSW01201-D / MTCSW01201-F-D		MTCSW01201-AVG / MTCSW01201-F-AVG	
AREA OF CONCERN	AREA 2	QUAL	AREA 2	QUAL	AREA 2	QUAL	AREA 2	QUAL
SAMPLE DATE	9/8/2001		9/8/2001		9/8/2001		9/8/2001	
VANADIUM	0.62	K	0.55	K	0.73	K	0.64	K
MISCELLANEOUS PARAMETERS (MG								
CHLORIDE	39.3		42.9		40		41.5	
FLUORIDE	0.18		0.19		0.19		0.19	
HARDNESS	68		65		65		65	
NITRATE	0.05	UJ	0.05	UJ	0.05	UJ	0.05	UJ
PH (S.U.)	8.4	J	8.6	J	9.3	J	9.0	J
SULFATE	30.3		32.2		30.1		31.2	
TOTAL DISSOLVED SOLIDS	160		140		140		140	
TOTAL ORGANIC CARBON	8		7		7		7	
EXPLOSIVES (UG/L)								
HMX	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ
FIELD PARAMETERS								
DISSOLVED OXYGEN (MG/L)	10.7		10.3					
PH (S.U.)	9.6		7.0					
SPECIFIC CONDUCTANCE (MS/CM)	0.25		0.25					
TEMPERATURE (C)	26.4		24.8					

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration
PAH = Polyaromatic Hydrocarbons

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Surface Water Criteria or the Region 3 RBC for Tap Water.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
UR= The analyte was analyzed for, but was not detected. The data are considered to be unusable.

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN AREA 3 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC013 SWSD 330304.28 1261707.03 MATTAWOMAN CREEK MTCSW01301 / MTCSW01301-F AREA 3 9/7/2001	QUAL	MTC014 SWSD 331387.89 1261625.22 MATTAWOMAN CREEK MTCSW01401 / MTCSW01401-F AREA 3 9/7/2001	QUAL	MTC015 SWSD 332415.51 1262267.1 MATTAWOMAN CREEK MTCSW01501 / MTCSW01501-F AREA 3 9/7/2001	QUAL	MTC016 SWSD 332464.04 1262770.26 MATTAWOMAN CREEK MTCSW01601 / MTCSW01601-F AREA 3 9/7/2001	QUAL
VOLATILE ORGANICS (UG/L)											
BENZENE	700	0.32	ND	1	U	1	U	5		1	U
ETHYLBENZENE	430	3.3	ND	1	U	1	U	6		1	U
TOLUENE	1050	750	ND	1	U	1	U	30		1	U
TOTAL XYLENES	6000	12000	ND	1	U	1	U	40		1	U
INORGANICS (UG/L)											
BARIUM	10000	2600	57	28.2		25.7		28.6		26.1	
CADMIUM	0.27	18	0.17	0.1	U	0.1	U	0.11	K	0.1	U
CALCIUM	NA	NA	50300	11300		12500		11300		11700	
IRON	320	11000	577	220		125		214		184	
MAGNESIUM	NA	NA	153000	8640		8420		8420		8200	
MANGANESE	10	730	1190	29.7	K	30.1		59.7		37	
POTASSIUM	NA	NA	64400	3690	K	3620	K	3330	K	3530	K
SODIUM	NA	NA	1230000	19000		18500		18800		17800	
VANADIUM	10000	260	ND	0.87		1.1		0.91		1.1	
FILTERED INORGANICS (UG/L)											
BARIUM	10000	2600	ND	21.7		23.8		27.8		24.7	
CADMIUM	0.27	18	ND	0.57	K	0.1	U	1.1	K	0.91	K
CALCIUM	NA	NA	49700	10000		12100		11000		11800	
IRON	320	11000	ND	74.9	B	37.2	B	84.1		39.6	B
MAGNESIUM	NA	NA	149000	7450		8090		8130		8240	
MANGANESE	10	730	249	8.9	K	2.5	B	10.1	K	3.3	B
POTASSIUM	NA	NA	64800	3790		3540		3360		3540	
SODIUM	NA	NA	1150000	16400		17700		18600		17900	
VANADIUM	10000	260	ND	0.58		0.84		0.63		0.56	
MISCELLANEOUS PARAMETERS (MG/L)											
CHLORIDE	230000	NA	2420	42.6		40.3		42.7		40.3	
FLUORIDE	2000	NA	0.19	0.31		0.31		0.29		0.29	
HARDNESS	NA	NA	760	63		66		61	U	63	
NITRATE	NA	58	0.5	0.047	J	0.05	UJ	0.05	UJ	0.05	UJ
PH (S.U.)	NA	NA	7.88	9	J	9.5	J	9	J	7.5	J
SULFATE	NA	NA	299	29.1		29		29.4		29.7	

TABLE 4-13

SUMMARY OF POSITIVE DETECTIONS IN AREA 3 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC013 SWSD 330304.28 1261707.03 MATTAWOMAN CREEK MTCSW01301 / MTCSW01301-F AREA 3 9/7/2001	QUAL	MTC014 SWSD 331387.89 1261625.22 MATTAWOMAN CREEK MTCSW01401 / MTCSW01401-F AREA 3 9/7/2001	QUAL	MTC015 SWSD 332415.51 1262267.1 MATTAWOMAN CREEK MTCSW01501 / MTCSW01501-F AREA 3 9/7/2001	QUAL	MTC016 SWSD 332464.04 1262770.26 MATTAWOMAN CREEK MTCSW01601 / MTCSW01601-F AREA 3 9/7/2001	QUAL
TOTAL DISSOLVED SOLIDS	NA	NA	4000	150		160				110	
TOTAL ORGANIC CARBON	NA	NA	8	7		6				7	
FIELD PARAMETERS											
DISSOLVED OXYGEN (MG/L)	NA	NA	26.0	8.5		12.5		11.4		10.6	
PH (S.U.)	NA	NA	7.9	10.4		10.5		9.8		9.0	
SPECIFIC CONDUCTANCE (MS	NA	NA	8.9	0.26		0.27		0.26		0.25	
TEMPERATURE (C)	NA	NA	28.0	27.0		30.0		28.0		27.0	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Surface Water Criteria or the Region 3 RBC for Tap Water.

TABLE 4-14

SUMMARY OF POSITIVE DETECTIONS IN AREA 4 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC017 SWSD 333712.68 1263026.98 MATTAWOMAN CREEK MTCSW01701 / MTCSW01701-F AREA 4 9/7/2001	QUAL	MTC018 SWSD 333940.86 1263462.35 MATTAWOMAN CREEK MTCSW01801 / MTCSW01801-F AREA 4 9/7/2001	QUAL	MTC019 SWSD 333623.25 1264439.07 MATTAWOMAN CREEK MTCSW01901 / MTCSW01901-F AREA 4 9/7/2001	QUAL	MTC020 SWSD 333717.68 1264638.88 MATTAWOMAN CREEK MTCSW02001 / MTCSW02001-F AREA 4 9/7/2001	QUAL	MTC021 SWSD 333790.95 1264888.8 MATTAWOMAN CREEK MTCSW02101 / MTCSW02101-F AREA 4 9/7/2001	QUAL	S39SD/SW01 SWSD 333870.82 1263146.93 39 S39SW0010001 AREA 4 10/21/1997	QUAL	S39SD03/SW02 SWSD 333965.84 1263213.02 39 S39SW0020001 AREA 4 10/21/1997	QUAL	S39SD03/SW02 SWSD 333965.84 1263213.02 39 S39SW0020001-D AREA 4 10/21/1997	QUAL	S39SD03/SW02 SWSD 333965.84 1263213.02 39 S39SW0020001-AVG AREA 4 10/21/1997	QUAL	S39SD05/SW03 SWSD 334087.73 1263535.69 39 S39SW0030001 AREA 4 10/21/1997	QUAL	S39SD06/SW04 SWSD 334080.9 1263724.64 39 S39SW0040001 AREA 4 10/21/1997	QUAL	S39SD07/SW05 SWSD 334006.71 1264038.08 39 S39SW0050001 AREA 4 10/21/1997	QUAL	S39SD08/SW06 SWSD 333872.54 1264422.12 39 S39SW0060001 AREA 4 10/21/1997	QUAL
VOLATILE ORGANICS (UG/L)																															
CIS-1,2-DICHLOROETHENE	11600	61	ND	1	U	1	U	1	U	1	U	4		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
DIETHYL ETHER	NA	1200	ND	1	UJ	1	UJ	1	UJ	1	UJ	6	J																		
TOLUENE	1050	750	ND	1	U	0.6	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
TRICHLOROETHENE	2000	0.026	ND	1	U	1	U	1	U	1	U	6		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	
SEMIVOLATILE ORGANICS (UG/L)																															
BIS(2-ETHYLHEXYL)PHTHALATE	30	4.8	ND	5	U	5	U	5	U	5	U	5	U	5	U	1	J	6	U	1	J	5	U	1	J	5	U	5	U		
INORGANICS (UG/L)																															
ALUMINUM	25	37000	587	104	B	95.8	B	204		215		200		139	B	410		918		664		133	B	131	B	292	K	190	B		
ARSENIC	10	0.045	ND	4.2	U	4.2	U	4.2	U	4.2	K	8.3	K	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U		
BARIUM	10000	2600	57	31.4		28.7		29		29.9		42.7		72.3		64.7		64.8		64.8		72.8		74.2		76.8		63.9			
CALCIUM	NA	NA	50300	13300		13000		12900		12600		18300		34200		26900		26600		26750		34400		34300		33800		31100			
COBALT	35000	730	ND	1.1	B	0.86	B	1.2	B	1.2	B	1.6	B	0.55	B	4.4	B	6.3		4.3		0.5	B	0.4	U	0.94	B	0.52	B		
COPPER	2.9	1500	ND	1.9	B	1.5	B	2.3	B	1.8	B	28.1	K	2.8	B	4.5	B	6	B	5.3	B	6.1	B	2.5	B	3.6	B	4.5	B		
IRON	320	11000	577	218		206		296		339		522		300	K	1060	K	1620	K	1340	K	326	K	382	K	976	K	410	K		
LEAD	2.5	15	ND	1.2	U	1.2	U	1.2	U	1.2	U	1.3	K	1.6	B	5.2	L	5	L	5.1	L	2.1	B	1.9	B	2.7	B	4.1	B		
MAGNESIUM	NA	NA	153000	8790		8670		8580		8670		7080		34200		27300		25500		26400		34300		33900		33100		28500			
MANGANESE	10	730	1190	44.5		46.1		45.7		53.5		35.7		75.8		153		202		178		78		83.4		143		67.2			
NICKEL	8.2	730	ND	2.5	B	2.6	B	2.9	B	2.9	B	8.2	B	3.1		2.4		4		3.2		2.5		1.9		3		2.9			
POTASSIUM	NA	NA	64400	3800	K	3740	K	3600	K	3600	K	4220	K	12400		10400		9360		9880		12400		12400		12200		11000			
SILVER	0.0001	180	ND	0.6	UL	0.6	UL	0.6	UL	0.6	UL	0.64	B	0.8	U	1.1		6		3.6		0.8	U	0.8	U	0.8	U	0.8	U		
SODIUM	NA	NA	1230000	18400		17800		17900		18400		24900		210000	J	172000	J	155000	J	163500	J	211000	J	210000	J	206000	J	181000	J		
VANADIUM	10000	260	ND	1.2		0.88		1.1		1.5		7.4		1.1	U	1.1	U	2.5		1.5		1.1	U	1.1	U	1.3		1.1	U		
ZINC	19	11000	ND	7.6	B	6.6	B	9.6	B	11.8	B	24	B	8.2	B	31.5		42.5		37		11.2	B	6.5	B	90.4		16			
FILTERED INORGANICS (UG/L)																															
ARSENIC	10	0.045	ND	4.2	U	4.2	U	4.2	U	4.2	U	4.9																			
BARIUM	10000	2600	ND	26		27.2		62.3		30.5		55.8	K																		
CADMIUM	0.27	18	ND	1.4	K	0.1	U	0.48	K	1	K	2.5	K																		
CALCIUM	NA	NA	49700	12100		12500		12900		12900		16300																			
COPPER	2.9	1500	ND	5	B	2.2	B	8.7	B	29.7	B	69.1																			
IRON	320	11000	ND	61.1	B	26.1	B	53.4	B	65.6	B	227																			
LEAD	2.5	15	ND	1.2	U	1.2	U	1.2	U	2.5	K	32																			
MAGNESIUM	NA	NA	149000	8130		8210		8600		8080		6940																			
MANGANESE	10	730	249	22.3	K	14	K	3.6	K	6.4	K	26.4	K																		
POTASSIUM	NA	NA	64800	3560		3630		3710		3660		3980																			
SODIUM	NA	NA	1150000	17600		17100		18400		18300		22600																			
VANADIUM	10000	260	ND	0.55		0.7		0.66		0.93		3.4																			
MISCELLANEOUS PARAMETERS (MG/L)																															
CHLORIDE	230000	NA	2420	36.1		39.6		39		40		30.5																			
FLUORIDE	2000	NA	0.19	0.3		0.28		0.28		0.28		0.31																			
HARDNESS	NA	NA	760	69		54		54		67		74																			
NITRATE	NA	58	0.5	0.05	UJ	0.05	UJ	0.05	UJ	0.05	UR	0.19	J																		
PH (S.U.)	NA	NA	7.88	7.4	J	7.4	J	6.8	J	7.2	J	7	J																		
SULFATE	NA	NA	299	27.7		30.6		30		30.1		30.2																			
TOTAL DISSOLVED SOLIDS	NA	NA	4000	150		140		140		110		170																			
TOTAL ORGANIC CARBON	NA	NA	8	7		7		8		7		9																			
TOTAL SUSPENDED SOLIDS	NA	NA	38	10	U	10	U	10		11		47																			
FIELD PARAMETERS																															
DISSOLVED OXYGEN (MG/L)	NA	NA	26.0	14.1		11.9		8.9		9.8		8.1																			
PH (S.U.)	NA	NA	7.9	8.3		8.9		7.5		7.7		5.4																			
SPECIFIC CONDUCTANCE (MS/CM)	NA	NA	8.9	0.25		0.25		0.25		0.25		0.28																			
TEMPERATURE (C)	NA	NA	28.0	26.9		26.3		25.8		25.8		25.7																			

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Surface Water Criteria or the Region 3 RBC for Tap Water.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
UL= The analyte was not detected, and the reported quantitation limit is probably higher than reported.
UR= The analyte was analyzed for, but was not detected. The data are considered to be unusable.

TABLE 4-15

SUMMARY OF POSITIVE DETECTIONS IN AREA 5 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND
PAGE 1 OF 2

LOCATION LOCATION T YPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Surface Water Criteria[2]	Region 3 RBC Tap Water[3]	Maximum Background Concentration	MTC022 SWSD 334449.65 1265916.98 MATTAWOMAN CREEK MTCSW02201 / MTCSW02201-F AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSW02301 / MTCSW02301-F AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSW02301-D / MTCSW02301-F-D AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSW02301-AVG / MTCSW02301-F-AVG AREA 5 9/6/2001	QUAL
VOLATILE ORGANICS (UG/L)											
TOLUENE	1050	750	ND	1	U	1	U	1	U	1	U
TOTAL XYLENES	6000	12000	ND	1	U	1	U	1	U	1	U
SEMIVOLATILE ORGANICS (UG/L)											
BIS(2-ETHYLHEXYL)PHTHALATE	30	4.8	ND	5	U	5	U	1	J	1	J
INORGANICS (UG/L)											
ALUMINUM	25	37000	587	161		158		298		228	
BARIUM	10000	2600	57	28.9		25.8		25.8		25.8	
CADMIUM	0.27	18	0.17	0.1	U	0.1	U	0.21	K	0.13	K
CALCIUM	NA	NA	50300	9980		9660		9490		9575	
CHROMIUM	2	110	1.8	0.88	B	0.94	B	1.1	B	1.02	B
IRON	320	11000	577	401		384		460		422	
MAGNESIUM	NA	NA	153000	7790		7750		7650		7700	
MANGANESE	10	730	1190	50.3		47.2		41.4		44.3	
POTASSIUM	NA	NA	64400	3190	K	3140	K	3170	K	3155	K
SODIUM	NA	NA	1230000	20700		20500		19900		20200	
VANADIUM	10000	260	ND	1.3		1.4		1		1.2	
FILTERED INORGANICS (UG/L)											
BARIUM	10000	2600	ND	24.7		20.8		22.4		21.6	
CADMIUM	0.27	18	ND	0.66	K	0.26	K	0.14	K	0.2	K
CALCIUM	NA	NA	49700	9810		9170		9680		9425	
IRON	320	11000	ND	50.1	B	58.5	B	73.8	B	66.2	B
LEAD	2.5	15	ND	1.2	U	1.2	U	1.2	U	1.2	U
MAGNESIUM	NA	NA	149000	7490		7380		7580		7480	
MANGANESE	10	730	249	2.3	B	3.3	B	33.6		17.6	
POTASSIUM	NA	NA	64800	3190	K	3050	K	3150		3100	
SODIUM	NA	NA	1150000	20000		19500		19400		19450	
VANADIUM	10000	260	ND	0.61		0.48		0.57		0.53	
MISCELLANEOUS PARAMETERS (MG/L)											
CHLORIDE	230000	NA	2420	43.5		44.5		44.2		44.4	
FLUORIDE	2000	NA	0.19	0.3		0.31		0.31		0.31	
HARDNESS	NA	NA	760	57		56		55		55.5	
PH (S.U.)	NA	NA	7.88	7.1	J	7.2	J	6.7	J	7.0	J
SULFATE	NA	NA	299	28.1		28.6		28.4		28.5	
TOTAL DISSOLVED SOLIDS	NA	NA	4000	150		140		140		140	
TOTAL ORGANIC CARBON	NA	NA	8	7		7		9		8	
TOTAL SUSPENDED SOLIDS	NA	NA	38	10	U	14		13		13.5	
FIELD PARAMETERS											
DISSOLVED OXYGEN (MG/L)	NA	NA	26.0	17.2		13.9					
PH (S.U.)	NA	NA	7.9	8.5		9.0					
SPECIFIC CONDUCTANCE (MS/CM)	NA	NA	8.9	0.23		0.23					
TEMPERATURE (C)	NA	NA	28.0	27.4		27.1					

TABLE 4-15

SUMMARY OF POSITIVE DETECTIONS IN AREA 5 SURFACE WATERS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC024		MTC025		MTC026		MTC026		MTC026	
LOCATION T YPE	SWSD		SWSD		SWSD		SWSD		SWSD	
NORTHING	335618.15		335895.61		336165.78		336165.78		336165.78	
EASTING	1266001.52		1265973.33		1266131.04		1266131.04		1266131.04	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSW02401 / MTCSW02401-F		MTCSW02501 / MTCSW02501-F		MTCSW02601 / MTCSW02601-F		MTCSW02601-D / MTCSW02601-F-D		MTCSW02601-AVG / MTCSW02601-F-AVG	
AREA OF CONCERN	AREA 5		AREA 5		AREA 5		AREA 5		AREA 5	
SAMPLE DATE	9/6/2001	QUAL	9/6/2001	QUAL	9/6/2001	QUAL	9/6/2001	QUAL	9/6/2001	QUAL
VOLATILE ORGANICS (UG/L)										
TOLUENE	1	U	1	U	2		1	U	1.3	
TOTAL XYLENES	1	U	1	U	2		1	U	1.3	
SEMIVOLATILE ORGANICS (UG/L)										
BIS(2-ETHYLHEXYL)PHTHALATE	1	L	5	U	1	J	5	U	1	J
INORGANICS (UG/L)										
ALUMINUM	84.4	B	312		227		70.9	B	131.225	
BARIUM	28.6		31.9		30.5		28.6		29.6	
CADMIUM	0.1	U	0.1	U	0.1	U	0.1	U	0.10	U
CALCIUM	9810		10100		11500		10900		11200	
CHROMIUM	0.57	B	1.3	B	0.93	K	0.57	K	0.75	K
IRON	322		632		324		197		261	
MAGNESIUM	7670		7890		8510		8120		8315	
MANGANESE	46.6		63.6		46.4		39.1		42.8	
POTASSIUM	3140	K	3280	K	3280		3120		3200	
SODIUM	20700		20300		24300		22800		23550	
VANADIUM	1.1		1.7		1.2	B	0.99	B	1.1	B
FILTERED INORGANICS (UG/L)										
BARIUM	28.8		26.1		79.1	B	80.3	B	79.7	B
CADMIUM	5.9	K	6.5	K	0.41	B	0.5	B	0.46	B
CALCIUM	10100		10100		11800		11200		11500	
IRON	77.7		72	B	46.9	B	34.4	B	40.7	B
LEAD	66.9		1.2	U	1.2	U	1.2	U	1.2	U
MAGNESIUM	7440		7730		7950		7830		7890	
MANGANESE	3.7	K	22.5	K	11.6	B	5.4	B	8.5	B
POTASSIUM	3140		3220	K	3350		3220		3285	
SODIUM	20100		20200		24000		22800		23400	
VANADIUM	0.51		0.4	U	0.77	B	0.52	B	0.65	B
MISCELLANEOUS PARAMETERS (MG/L)										
CHLORIDE	43.5		43.2		41.5		40.8		41.2	
FLUORIDE	0.3		0.28		0.18		0.19		0.19	
HARDNESS	56		58		64		60		62	
PH (S.U.)	7.1	J	6.9	J	7.5	J	7.5	J	7.5	J
SULFATE	28.4		29.1		28.9		28.4		28.7	
TOTAL DISSOLVED SOLIDS	140		150		170		160		165	
TOTAL ORGANIC CARBON	7		7		7		7		7	
TOTAL SUSPENDED SOLIDS	10	U	12		23		11		17	
FIELD PARAMETERS										
DISSOLVED OXYGEN (MG/L)	14.1		12.0		26.4					
PH (S.U.)	8.0		6.8		7.1					
SPECIFIC CONDUCTANCE (MS/CM)	0.23		0.23		0.24					
TEMPERATURE (C)	26.9		27.3		11.4					

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Surface Water Criteria or the Region 3 RBC for Tap Water.

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-8.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-16

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 1 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
VOLATILE ORGANICS (UG/L)												
BENZENE	1/11	0.7	MTCSW00301	0.7	2.2	1 - 10	ND	1	700	0	0.32	1
BROMOFORM	1/11	0.5	MTCSW00301	0.5	2.1	1 - 10	ND	1	1000	0	8.5	0
ETHYLBENZENE	1/11	0.6	MTCSW00301	0.6	2.1	1 - 10	ND	1	430	0	3.3	0
METHYL TERT-BUTYL ETHER	1/4	1	IS11SW01	1	4	10	NA	1	NA	0	2.6	0
TOLUENE	1/11	3	MTCSW00301	3	2.4	1 - 10	ND	1	1050	0	750	0
TOTAL XYLENES	1/11	4	MTCSW00301	4	2.5	1 - 10	ND	1	6000	0	12000	0
SEMIVOLATILE ORGANICS (UG/L)												
BIS(2-ETHYLHEXYL)PHTHALATE	2/11	1	IS11SW01, MTCSW00501	1	2.9	5 - 10	ND	2	30	0	4.8	0
INORGANICS (UG/L)												
ALUMINUM	11/17	124 - 664	IS17SW02	352	243	4.6 - 171	587	1	25	11	37000	0
ARSENIC	2/17	4.4 - 6.5	MTCSW00301	5.5	2.3	3.6 - 4.2	ND	2	10	0	0.045	2
BARIUM	17/17	19 - 36.3	MTCSW00201-D	26.4	26.4	--	57	0	10000	0	2600	0
CALCIUM	17/17	9750 - 15900	MTCSW00101	11835	11835	--	50300	0	NA	0	NA	0
CHROMIUM	1/17	3.4	MTCSW00401	3.4	0.95	0.53 - 2.3	1.8	1	2	1	110	0
COPPER	7/17	2.4 - 5.4	IS17SW06	4.4	2.5	1.3 - 4.3	ND	7	2.9	6	1500	0
CYANIDE	5/17	1.1 - 10	MTCSW00501, IS17SW02	5.9	2.6	0.98 - 4.9	36.8	0	1	5	730	0
IRON	17/17	102 - 981	IS17SW03	450	450	32.3	577	5	320	10	11000	0
LEAD	7/17	1.3 - 38.4	IS11SW01	8.3	3.8	1.2 - 3	ND	7	2.5	3	15	1
MAGNESIUM	17/17	5140 - 8810	MTCSW02901	6662	6662	--	153000	0	NA	0	NA	0
MANGANESE	17/17	9.3 - 147	MTCSW00501	79.7	79.7	1.6	1190	0	10	16	730	0
NICKEL	5/17	2.5 - 3.5	IS17SW04	2.7	1.7	1.9 - 3.5	ND	5	8.2	0	730	0
POTASSIUM	17/17	2630 - 4230	MTCSW00301	3187	3187	--	64400	0	NA	0	NA	0
SELENIUM	1/17	5.8	IS17SW05	5.8	40.1	4.3 - 860	ND	1	5	1	180	0
SODIUM	17/17	11900 - 23300	MTCSW02901	16585	16585	--	1230000	0	NA	0	NA	0
VANADIUM	14/17	0.73 - 2.6	MTCSW00501	1.6	1.5	1.4 - 2.1	ND	14	10000	0	260	0
ZINC	3/17	24.2 - 32.7	IS17SW06	27.6	10.7	0.7 - 53.5	ND	3	19	3	11000	0
INORGANICS - FILTERED (UG/L)												
ARSENIC	1/17	4.5	MTCSW00401-F	4.5	2.1	3.6 - 4.2	ND	1	10	0	0.045	1
BARIUM	16/17	17 - 39.3	MTCSW00101-F	25.2	24.4	22.4	ND	16	10000	0	2600	0
BERYLLIUM	1/17	0.31	IS17SW01	0.20	0.09	0.10 - 0.20	ND	1	5.3	0	73	0
CADMIUM	4/17	0.16 - 0.3	MTCSW00301-F	0.20	0.17	0.1 - 0.4	ND	3	0.27	1	18	0
CALCIUM	17/17	9120 - 15800	MTCSW00101-F	11918	11918	--	49700	0	NA	0	NA	0
CHROMIUM	1/17	9.7	MTCSW00201-F-D	5.1	1.1	0.65 - 4.4	ND	1	2	1	110	0
COPPER	4/17	2.2 - 4.8	IS17SW01	2.6	1.4	1 - 4.3	ND	3	2.9	0	1500	0
IRON	6/17	28.2 - 456	IS17SW01	94.4	44.0	14.5 - 47.6	ND	5	320	0	11000	0
LEAD	1/17	1.3	IS11SW01	1.3	0.68	1.2 - 1.6	ND	1	2.5	0	15	0
MAGNESIUM	15/17	4840 - 8780	MTCSW00401-F	6755	6313	5960 - 6050	149000	0	NA	0	NA	0
MANGANESE	3/17	1.7 - 86.7	IS17SW01	17.0	4.1	1 - 5.1	249	0	10	1	730	0
NICKEL	5/17	3.1 - 17.9	IS17SW01	5.7	2.7	1.9 - 5.3	ND	4	8.2	1	730	0
POTASSIUM	17/17	2400 - 3980	MTCSW00401-F	3097	3097	--	64800	0	NA	0	NA	0
SELENIUM	1/17	4.9	IS17SW04	4.9	2.3	4.3	ND	1	5	0	180	0
SODIUM	17/17	11300 - 22000	MTCSW00201-F-D, MTCSW00501-F	16488	16488	--	1150000	0	NA	0	NA	0
VANADIUM	7/17	0.74 - 1.5	MTCSW00501-F	1.1	0.86	1.4	ND	7	10000	0	260	0
ZINC	1/17	29.9	IS17SW04	29.9	8.1	5.3 - 33.8	ND	1	19	1	11000	0
MISCELLANEOUS PARAMETERS (MG/L)												
AMMONIUM PERCHLORATE (UG/L)	3/10	1.6 - 3.6	IS11SW04	2.7	2.2	4	NA	--	NA	0	NA	0
CHLORIDE	7/7	29.5 - 38.7	MTCSW00501	36.0	36.0	--	2420	0	230000	0	NA	0
DIESEL RANGE ORGANICS (UG/L)	4/4	100 - 160	IS11SW01, IS11SW02	135	135	--	NA	--	NA	0	NA	0

TABLE 4-16

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 1 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
FLUORIDE	7/7	0.17 - 0.2	MTCSW00201, MTCSW00301, MTCSW00401, MTCSW00501, MTCSW02901	0.19	0.19	--	0.19	5	2000	0	NA	0
HARDNESS	13/13	36 - 75	MTCSW00101	56.1	56.1	--	760	0	NA	0	NA	0
NITRATE	2/7	0.076 - 0.077	MTCSW00101	0.08	0.04	0.05	0.5	0	NA	0	58	0
PERCHLORATE (UG/L)	3/17	1.36 - 3.05	IS11SW04	2.3	2.1	3.39 - 5	ND	3	NA	0	NA	3
PH (S.U.)	13/13	7.32 - 10.93	MTCSW03001	9.2	9.2	--	7.88	12	NA	0	NA	0
SULFATE	7/7	23.2 - 31.5	MTCSW00101, MTCSW00401	28.9	28.9	--	299	0	NA	0	NA	0
TOTAL DISSOLVED SOLIDS	7/7	120 - 510	MTCSW00401	199	199	--	4000	0	NA	0	NA	0
TOTAL ORGANIC CARBON	7/7	6 - 8	MTCSW00401	6.7	6.7	--	8	0	NA	0	NA	0
TOTAL SUSPENDED SOLIDS	3/7	11 - 48	MTCSW00501	22.3	12.4	10	38	1	NA	0	NA	0
FIELD												
DISSOLVED OXYGEN (MG/L)	6/6	9.9 - 16.7	MTCSW03001	12.6	12.6	--	26.0	0	NA	0	NA	0
SPECIFIC CONDUCTANCE (MS/CM)	6/6	0.23 - 0.26	MTCSW00101, MTCSW00401	0.25	0.25	--	8.9	0	NA	0	NA	0
TEMPERATURE (C)	6/6	26.1 - 28.4	MTCSW00501	27.4	27.4	--	28.0	3	NA	0	NA	0
EXPLOSIVES (UG/L)												
1,3-DINITROBENZENE	1/17	0.075	IS11SW01	0.08	0.08	0.1 - 0.2	ND	1	1200	0	3.7	0
4-NITROTOLUENE	1/17	0.11	IS17SW02	0.11	0.16	0.2 - 0.5	ND	1	NA	0	61	0

ASSOCIATED SAMPLES
IS11SW01
IS11SW02
IS11SW03
IS11SW04
IS17SW01
IS17SW01-AVG
IS17SW01P
IS17SW02
IS17SW03
IS17SW04
IS17SW05
IS17SW06
MTCSW00101
MTCSW00101-F
MTCSW00201
MTCSW00201-AVG
MTCSW00201-D
MTCSW00201-F
MTCSW00201-F-AVG
MTCSW00201-F-D
MTCSW00301
MTCSW00301-F
MTCSW00401
MTCSW00401-F
MTCSW00501
MTCSW00501-F
MTCSW02901
MTCSW02901-F
MTCSW03001
MTCSW03001-F

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-8.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of the associated criteria.

TABLE 4-17

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 2 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
VOLATILE ORGANICS (UG/L)												
ACETONE	1/1	5	MTCSW00801	5	5	--	ND	1	9000000	0	610	0
BENZENE	3/7	1 - 8	MTCSW01001	3	2	1	ND	3	700	0	0.32	3
ETHYLBENZENE	3/7	0.8 - 7	MTCSW01001	3	2	1	ND	3	430	0	3.3	1
TOLUENE	4/7	1 - 23	MTCSW01001	9	5	1	ND	4	1050	0	750	0
TOTAL XYLENES	4/7	1 - 48	MTCSW01001	16	9	1	ND	4	6000	0	12000	0
SEMIVOLATILE ORGANICS (UG/L)												
2-METHYLNAPHTHALENE	1/7	2	MTCSW01001	2	2	5	ND	1	300	0	120	0
LOW MOLECULAR WEIGHT PAHS	1/7	4	MTCSW01001	4	4	--	ND	1	NA	0	NA	0
NAPHTHALENE	1/7	2	MTCSW01001	2	2	5	ND	1	100	0	6.5	0
TOTAL PAHS	1/7	4	MTCSW01001	4	4	--	ND	1	NA	0	NA	0
INORGANICS (UG/L)												
ALUMINUM	3/7	125 - 181	MTCSW01101	144	79.6	22.1 - 111	587	0	25	3	37000	0
ARSENIC	3/7	5.1 - 6.9	MTCSW01201-D	5.1	3.4	4.2	ND	3	10	0	0.045	3
BARIUM	7/7	22.2 - 30.3	MTCSW01201-D	26.6	26.6	--	57	0	10000	0	2600	0
BERYLLIUM	1/7	0.12	MTCSW00601	0.12	0.06	0.1	ND	1	5.3	0	73	0
CADMIUM	1/7	0.14	MTCSW00601	0.14	0.06	0.1	0.17	0	0.27	0	18	0
CALCIUM	7/7	9970 - 13300	MTCSW00601	12267	12267	--	50300	0	NA	0	NA	0
IRON	7/7	84.8 - 352	MTCSW01001	192	192	--	577	0	320	1	11000	0
MAGNESIUM	7/7	7860 - 9010	MTCSW00801	8577	8577	--	153000	0	NA	0	NA	0
MANGANESE	7/7	15.5 - 82	MTCSW01001	45.7	45.7	--	1190	0	10	7	730	0
POTASSIUM	7/7	3370 - 4030	MTCSW00701	3596	3596	--	64400	0	NA	0	NA	0
SODIUM	7/7	22200 - 27100	MTCSW01001	24086	24086	--	1230000	0	NA	0	NA	0
VANADIUM	7/7	0.82 - 1.7	MTCSW00701	1.1	1.1	--	ND	7	10000	0	260	0
INORGANICS - FILTERED (UG/L)												
ARSENIC	2/7	4.8 - 5.4	MTCSW01201-F	4.3	2.7	4.2	ND	2	10	0	0.045	2
BARIUM	7/7	24.3 - 31.5	MTCSW00701-F	28.2	28.2	--	ND	7	10000	0	2600	0
CADMIUM	1/7	0.68	MTCSW01201-F-D	0.37	0.10	0.1	ND	1	0.27	1	18	0
CALCIUM	7/7	9740 - 13000	MTCSW00601-F	11913	11913	--	49700	0	NA	0	NA	0
IRON	1/7	80.7	MTCSW01001-F	80.7	23.3	12.8 - 39.1	ND	1	320	0	11000	0
MAGNESIUM	7/7	7640 - 8740	MTCSW00801-F	8307	8307	--	149000	0	NA	0	NA	0
MANGANESE	1/7	6	MTCSW01001-F	6.0	1.8	0.81 - 4.9	249	0	10	0	730	0
POTASSIUM	7/7	3210 - 3700	MTCSW00701-F	3407	3407	--	64800	0	NA	0	NA	0
SODIUM	7/7	22000 - 26500	MTCSW01001-F	23736	23736	--	1150000	0	NA	0	NA	0
VANADIUM	7/7	0.55 - 1.6	MTCSW00701-F	0.99	0.99	--	ND	7	10000	0	260	0
MISCELLANEOUS PARAMETERS (MG/L)												
CHLORIDE	7/7	38.7 - 44.2	MTCSW01001	41.4	41.4	--	2420	0	230000	0	NA	0
FLUORIDE	7/7	0.18 - 0.2	MTCSW00701, MTCSW00901	0.19	0.19	--	0.19	2	2000	0	NA	0
HARDNESS	7/7	58 - 69	MTCSW00601	65.7	65.7	--	760	0	NA	0	NA	0
NITRATE	1/7	0.09	MTCSW00801	0.09	0.03	0.05	0.5	0	NA	0	58	0
PH (S.U.)	13/13	7 - 11.17	MTCSW00601	9.8	9.8	--	7.88	13	NA	0	NA	0
SULFATE	7/7	23.8 - 32.2	MTCSW01201	29.1	29.1	--	299	0	NA	0	NA	0
TOTAL DISSOLVED SOLIDS	7/7	140 - 170	MTCSW00701	154	154	--	4000	0	NA	0	NA	0
TOTAL ORGANIC CARBON	7/7	6 - 11	MTCSW00901	7.4	7.4	--	8	1	NA	0	NA	0
FIELD												
DISSOLVED OXYGEN (MG/L)	6/6	10.3 - 14.7	MTCSW00601	12.8	12.8	--	26.0	0	NA	0	NA	0
SPECIFIC CONDUCTANCE (MS/CM)	6/6	0.25 - 0.30	MTCSW00701	0.27	0.27	--	8.9	0	NA	0	NA	0
TEMPERATURE (C)	6/6	24.8 - 31.0	MTCSW00701	27.8	27.8	--	28.0	2	NA	0	NA	0
EXPLOSIVES (UG/L)												
HMX	1/7	0.15	MTCSW01001	0.15	0.06	0.1	ND	1	330	0	1800	0

TABLE 4-17

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 2 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER

ASSOCIATED SAMPLES

MTCSW00601	MTCSW01201-AVG
MTCSW00601-F	MTCSW01201-D
MTCSW00701	MTCSW01201-F
MTCSW00701-F	MTCSW01201-F-AVG
MTCSW00801	MTCSW01201-F-D
MTCSW00801-F	
MTCSW00901	
MTCSW00901-F	
MTCSW01001	
MTCSW01001-F	
MTCSW01101	
MTCSW01101-F	
MTCSW01201	

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-8.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Shaded cells indicate an exceedance of the associated criteria.

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration
PAH = Polyaromatic Hydrocarbons

TABLE 4-18

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 3 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
VOLATILE ORGANICS (UG/L)												
BENZENE	1/4	5	MTCSW01501	5	2	1	ND	1	700	0	0.32	1
ETHYLBENZENE	1/4	6	MTCSW01501	6	2	1	ND	1	430	0	3.3	1
TOLUENE	1/4	30	MTCSW01501	30	8	1	ND	1	1050	0	750	0
TOTAL XYLENES	1/4	40	MTCSW01501	40	10	1	ND	1	6000	0	12000	0
INORGANICS (UG/L)												
BARIUM	4/4	25.7 - 28.6	MTCSW01501	27.2	27.2	--	57	0	10000	0	2600	0
CADMIUM	1/4	0.11	MTCSW01501	0.11	0.07	0.1	0.17	0	0.27	0	18	0
CALCIUM	4/4	11300 - 12500	MTCSW01401	11700	11700	--	50300	0	NA	0	NA	0
IRON	4/4	125 - 220	MTCSW01301	186	186	--	577	0	320	0	11000	0
MAGNESIUM	4/4	8200 - 8640	MTCSW01301	8420	8420	--	153000	0	NA	0	NA	0
MANGANESE	4/4	29.7 - 59.7	MTCSW01501	39.1	39.1	--	1190	0	10	4	730	0
POTASSIUM	4/4	3330 - 3690	MTCSW01301	3543	3543	--	64400	0	NA	0	NA	0
SODIUM	4/4	17800 - 19000	MTCSW01301	18525	18525	--	1230000	0	NA	0	NA	0
VANADIUM	4/4	0.87 - 1.1	MTCSW01401, MTCSW01601	1.0	1.0	--	ND	4	10000	0	260	0
INORGANICS - FILTERED (UG/L)												
BARIUM	4/4	21.7 - 27.8	MTCSW01501-F	24.5	24.5	--	ND	4	10000	0	2600	0
CADMIUM	3/4	0.57 - 1.1	MTCSW01501-F	0.86	0.66	0.1	ND	3	0.27	3	18	0
CALCIUM	4/4	10000 - 12100	MTCSW01401-F	11225	11225	--	49700	0	NA	0	NA	0
IRON	1/4	84.1	MTCSW01501-F	84.1	40.0	37.2 - 74.9	ND	1	320	0	11000	0
MAGNESIUM	4/4	7450 - 8240	MTCSW01601-F	7978	7978	--	149000	0	NA	0	NA	0
MANGANESE	2/4	8.9 - 10.1	MTCSW01501-F	9.5	5.5	2.5 - 3.3	249	0	10	1	730	0
POTASSIUM	4/4	3360 - 3790	MTCSW01301-F	3558	3558	--	64800	0	NA	0	NA	0
SODIUM	4/4	16400 - 18600	MTCSW01501-F	17650	17650	--	1150000	0	NA	0	NA	0
VANADIUM	4/4	0.56 - 0.84	MTCSW01401-F	0.65	0.65	--	ND	4	10000	0	260	0
MISCELLANEOUS PARAMETERS (MG/L)												
CHLORIDE	4/4	40.3 - 42.7	MTCSW01501	41.5	41.5	--	2420	0	230000	0	NA	0
FLUORIDE	4/4	0.29 - 0.31	MTCSW01301, MTCSW01401	0.30	0.30	--	0.19	4	2000	0	NA	0
HARDNESS	3/4	63 - 66	MTCSW01401	64	55.6	61	760	0	NA	0	NA	0
NITRATE	1/4	0.047	MTCSW01301	0.05	0.03	0.05	0.5	0	NA	0	58	0
PH (S.U.)	8/8	7.5 - 10.45	MTCSW01401	9.3	9.3	--	7.88	7	NA	0	NA	0
SULFATE	4/4	29 - 29.7	MTCSW01601	29.3	29.3	--	299	0	NA	0	NA	0
TOTAL DISSOLVED SOLIDS	3/3	110 - 160	MTCSW01401	140	140	--	4000	0	NA	0	NA	0
TOTAL ORGANIC CARBON	3/3	6 - 7	MTCSW01301, MTCSW01601	6.7	6.7	--	8	0	NA	0	NA	0
FIELD												
DISSOLVED OXYGEN (MG/L)	4/4	8.5 - 12.5	MTCSW01401	10.8	10.8	--	26.0	0	NA	0	NA	0
SPECIFIC CONDUCTANCE (MS/CM)	4/4	0.25 - 0.27	MTCSW01401	0.26	0.26	--	8.9	0	NA	0	NA	0
TEMPERATURE (C)	4/4	27.0 - 30	MTCSW01401	28.0	28.0	--	28.0	1	NA	0	NA	0

ASSOCIATED SAMPLES
MTCSW01301
MTCSW01301-F
MTCSW01401
MTCSW01401-F
MTCSW01501
MTCSW01501-F
MTCSW01601
MTCSW01601-F

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-8.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of the associated criteria.

TABLE 4-19

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 4 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER COCNCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
VOLATILE ORGANICS (UG/L)												
CIS-1,2-DICHLOROETHENE	1/11	4	MTCSW02101	4	0.8	1	ND	1	11600	0	61	0
DIETHYL ETHER	1/5	6	MTCSW02101	6	1.6	1	ND	1	NA	0	1200	0
TOLUENE	1/11	0.6	MTCSW01801	0.6	0.5	1	ND	1	1050	0	750	0
TRICHLOROETHENE	2/11	1 - 6	MTCSW02101	3.5	1.0	1	ND	2	2000	0	0.026	2
SEMIVOLATILE ORGANICS (UG/L)												
BIS(2-ETHYLHEXYL)PHTHALATE	2/11	1	S39SW0020001, S39SW0040001	1	2	5 - 6	ND	2	30	0	4.8	0
INORGANICS (UG/L)												
ALUMINUM	5/11	200 - 918	S39SW0020001-D	315	179	95.8 - 190	587	1	25	5	37000	0
ARSENIC	2/11	4.2 - 8.3	MTCSW02101	6.3	2.6	3.3 - 4.2	ND	2	10	0	0.045	2
BARIUM	11/11	28.7 - 76.8	S39SW0050001	53.3	53.3	--	57	6	10000	0	2600	0
CALCIUM	11/11	12600 - 34400	S39SW0030001	24059	24059	--	50300	0	NA	0	NA	0
COBALT	1/11	6.3	S39SW0020001-D	4.2	0.80	0.40 - 4.4	ND	1	35000	0	730	0
COPPER	1/11	28.1	MTCSW02101	28.1	4.0	1.5 - 6.1	ND	1	2.9	1	1500	0
IRON	11/11	206 - 1620	S39SW0020001-D	483	483	--	577	2	320	7	11000	0
LEAD	2/11	1.3 - 5.2	S39SW0020001	3.2	1.4	1.2 - 4.1	ND	2	2.5	1	15	0
MAGNESIUM	11/11	7080 - 34300	S39SW0030001	21108	21108	--	153000	0	NA	0	NA	0
MANGANESE	11/11	35.7 - 202	S39SW0020001-D	77.3	77.3	--	1190	0	10	11	730	0
NICKEL	6/11	1.9 - 4	S39SW0020001-D	2.8	2.4	2.5 - 8.2	ND	6	8.2	0	730	0
POTASSIUM	11/11	3600 - 12400	S39SW0010001, S39SW0030001, S39SW0040001	8113	8113	--	64400	0	NA	0	NA	0
SILVER	1/11	1.1 - 6	S39SW0020001-D	3.6	0.64	0.6 - 0.8	ND	1	0.0001	1	180	0
SODIUM	11/11	17800 - 211000	S39SW0030001	116264	116264	--	1230000	0	NA	0	NA	0
VANADIUM	7/11	0.88 - 7.4	MTCSW02101	2.1	1.6	1.1	ND	6	10000	0	260	0
ZINC	3/11	16 - 90.4	S39SW0050001	47.8	16.9	6.5 - 24	ND	3	19	2	11000	0
INORGANICS - FILTERED (UG/L)												
ARSENIC	1/5	4.9	MTCSW02101-F	4.9	2.7	4.2	ND	1	10	0	0.045	1
BARIUM	5/5	26 - 62.3	MTCSW01901-F	40.4	40.4	--	ND	5	10000	0	2600	0
CADMIUM	4/5	0.48 - 2.5	MTCSW02101-F	1.3	1.1	0.1	ND	4	0.27	4	18	0
CALCIUM	5/5	12100 - 16300	MTCSW02101-F	13340	13340	--	49700	0	NA	0	NA	0
COPPER	1/5	69.1	MTCSW02101-F	69.1	18.4	2.2 - 29.7	ND	1	2.9	1	1500	0
IRON	1/5	227	MTCSW02101-F	227	66.0	26.1 - 65.6	ND	1	320	0	11000	0
LEAD	2/5	2.5 - 32	MTCSW02101-F	17.3	7.26	1.2	ND	2	2.5	1	15	1
MAGNESIUM	5/5	6940 - 8600	MTCSW01901-F	7992	7992	--	149000	0	NA	0	NA	0
MANGANESE	5/5	3.6 - 26.4	MTCSW02101-F	14.5	14.5	--	249	0	10	3	730	0
POTASSIUM	5/5	3560 - 3980	MTCSW02101-F	3708	3708	--	64800	0	NA	0	NA	0
SODIUM	5/5	17100 - 22600	MTCSW02101-F	18800	18800	--	1150000	0	NA	0	NA	0
VANADIUM	5/5	0.55 - 3.4	MTCSW02101-F	1.2	1.2	--	ND	5	10000	0	260	0
MISCELLANEOUS PARAMETERS (MG/L)												
CHLORIDE	5/5	30.5 - 40	MTCSW02001	37.0	37.0	--	2420	0	230000	0	NA	0
FLUORIDE	5/5	0.28 - 0.31	MTCSW02101	0.29	0.29	--	0.19	5	2000	0	NA	0
HARDNESS	5/5	54 - 74	MTCSW02101	63.6	63.6	--	760	0	NA	0	NA	0
NITRATE	1/4	0.19	MTCSW02101	0.19	0.07	0.05	0.5	0	NA	0	58	0
PH (S.U.)	10/10	5.43 - 8.91	MTCSW01801	7.4	7.4	--	7.88	2	NA	0	NA	0
SULFATE	5/5	27.7 - 30.6	MTCSW01801	29.7	29.7	--	299	0	NA	0	NA	0
TOTAL DISSOLVED SOLIDS	5/5	110 - 170	MTCSW02101	142	142	--	4000	0	NA	0	NA	0
TOTAL ORGANIC CARBON	5/5	7 - 9	MTCSW02101	7.6	7.6	--	8	1	NA	0	NA	0
TOTAL SUSPENDED SOLIDS	3/5	10 - 47	MTCSW02101	22.7	15.6	10	38	1	NA	0	NA	0
FIELD												
DISSOLVED OXYGEN (MG/L)	5/5	8.1 - 14.1	MTCSW01701	10.6	10.6	--	26.0	0	NA	0	NA	0
SPECIFIC CONDUCTANCE (MS/CM)	5/5	0.25 - 0.28	MTCSW02101	0.26	0.26	--	8.9	0	NA	0	NA	0
TEMPERATURE (C)	5/5	25.7 - 26.9	MTCSW01701	26.1	26.1	--	28.0	0	NA	0	NA	0

ASSOCIATED SAMPLES

MTCSW01701	S39SW0010001
MTCSW01701-F	S39SW0020001
MTCSW01801	S39SW0020001-AVG
MTCSW01801-F	S39SW0020001-D
MTCSW01901	S39SW0030001
MTCSW01901-F	S39SW0040001
MTCSW02001	S39SW0050001
MTCSW02001-F	S39SW0060001
MTCSW02101	
MTCSW02101-F	

Footnotes:

1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.

2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

3 Refer to Table 4-8.

4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Shaded cells indicate an exceedance of the associated criteria.

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

TABLE 4-20

SUMMARY OF DESCRIPTIVE STATISTICS - AREA 5 SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SURFACE WATER COCNCENTRATION	NUMBER OF EXCEEDANCES OF BACKGROUND SURFACE WATER CONCENTRATION	MINIMUM ECOLOGICAL SURFACE WATER CRITERIA[3]	NUMBER OF EXCEEDANCES OF MINIMUM ECOLOGICAL SURFACE WATER CRITERIA	REGION 3 RBC FOR TAP WATER[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR TAP WATER
VOLATILE ORGANICS (UG/L)												
TOLUENE	1/5	2	MTCSW02601	1.3	0.7	1	ND	1	1050	0	750	0
TOTAL XYLENES	1/5	2	MTCSW02601	1.3	0.7	1	ND	1	6000	0	12000	0
SEMIVOLATILE ORGANICS (UG/L)												
BIS(2-ETHYLHEXYL)PHTHALATE	3/5	1	MTCSW02301-D, MTCSW02401, MTCSW02601	1	1.6	5	ND	3	30	0	4.8	0
INORGANICS (UG/L)												
ALUMINUM	4/5	158 - 312	MTCSW02501	208	175	70.9 - 84.4	587	0	25	3	37000	0
BARIUM	5/5	25.8 - 31.9	MTCSW02501	29.0	29.0	--	57	0	10000	0	2600	0
CADMIUM	1/5	0.21	MTCSW02301-D	0.13	0.07	0.1	0.17	0	0.27	0	18	0
CALCIUM	5/5	9490 - 11500	MTCSW02601	10133	10133	--	50300	0	NA	0	NA	0
CHROMIUM	1/5	0.57 - 0.93	MTCSW02601	0.75	0.53	0.57 - 1.3	1.8	0	2	0	110	0
IRON	5/5	197 - 632	MTCSW02501	408	408	--	577	1	320	4	11000	0
MAGNESIUM	5/5	7650 - 8510	MTCSW02601	7873	7873	--	153000	0	NA	0	NA	0
MANGANESE	5/5	39.1 - 63.6	MTCSW02501	49.5	49.5	--	1190	0	10	5	730	0
POTASSIUM	5/5	3120 - 3280	MTCSW02601, MTCSW02501	3193	3193	--	64400	0	NA	0	NA	0
SODIUM	5/5	19900 - 24300	MTCSW02601	21090	21090	--	1230000	0	NA	0	NA	0
VANADIUM	4/5	1 - 1.7	MTCSW02501	1.3	1.2	0.99 - 1.2	ND	4	10000	0	260	0
INORGANICS - FILTERED (UG/L)												
BARIUM	4/5	20.8 - 28.8	MTCSW02401-F	25.3	28.2	79.1 - 80.3	ND	4	10000	0	2600	0
CADMIUM	4/5	0.14 - 6.5	MTCSW02501-F	3.3	2.7	0.41 - 0.5	ND	4	0.27	3	18	0
CALCIUM	5/5	9170 - 11800	MTCSW02601-F	10187	10187	--	49700	0	NA	0	NA	0
IRON	1/5	77.7	MTCSW02401-F	77.7	38.4	34.4 - 73.8	ND	1	320	0	11000	0
LEAD	1/5	66.9	MTCSW02401-F	66.9	13.9	1.2	ND	1	2.5	1	15	1
MAGNESIUM	5/5	7380 - 7950	MTCSW02601-F	7606	7606	--	149000	0	NA	0	NA	0
MANGANESE	3/5	3.7 - 33.6	MTCSW02301-F-D	14.6	9.8	2.3 - 11.6	249	0	10	1	730	0
POTASSIUM	5/5	3050 - 3350	MTCSW02601-F	3187	3187	--	64800	0	NA	0	NA	0
SODIUM	5/5	19400 - 24000	MTCSW02601-F	20630	20630	--	1150000	0	NA	0	NA	0
VANADIUM	3/5	0.48 - 0.61	MTCSW02201-F	0.55	0.43	0.4 - 0.77	ND	3	10000	0	260	0
MISCELLANEOUS PARAMETERS (MG/L)												
CHLORIDE	5/5	40.8 - 44.5	MTCSW02301	43.1	43.1	--	2420	0	230000	0	NA	0
FLUORIDE	5/5	0.18 - 0.31	MTCSW02301, MTCSW02301-D	0.28	0.28	--	0.19	4	2000	0	NA	0
HARDNESS	5/5	55 - 64	MTCSW02601	57.7	57.7	--	760	0	NA	0	NA	0
PH (S.U.)	8/8	6.7 - 9.0299	MTCSW02301	7.4	7.4	--	7.88	2	NA	0	NA	0
SULFATE	5/5	28.1 - 29.1	MTCSW02501	28.6	28.6	--	299	0	NA	0	NA	0
TOTAL DISSOLVED SOLIDS	5/5	140 - 170	MTCSW02601	149	149	--	4000	0	NA	0	NA	0
TOTAL ORGANIC CARBON	5/5	7 - 9	MTCSW02301-D	7.2	7.2	--	8	0	NA	0	NA	0
TOTAL SUSPENDED SOLIDS	3/5	11 - 23	MTCSW02601	14.2	10.5	10	38	0	NA	0	NA	0
FIELD												
DISSOLVED OXYGEN (MG/L)	3/3	12.0 - 26.4	MTCSW02601	14.4	14.4	--	26.0	1	NA	0	NA	0
SPECIFIC CONDUCTANCE (MS/CM)	3/3	0.23 - 0.24	MTCSW02601	0.23	0.23	--	8.9	0	NA	0	NA	0
TEMPERATURE (C)	3/3	11.4 - 27.4	MTCSW02201	27.2	27.2	--	28.0	0	NA	0	NA	0

ASSOCIATED SAMPLES

MTCSW02201
MTCSW02201-F
MTCSW02301
MTCSW02301-AVG
MTCSW02301-D
MTCSW02301-F
MTCSW02301-F-AVG
MTCSW02301-F-D
MTCSW02401
MTCSW02401-F
MTCSW02501
MTCSW02501-F
MTCSW02601
MTCSW02601-AVG
MTCSW02601-D
MTCSW02601-F
MTCSW02601-F-AVG
MTCSW02601-F-D

Footnotes:

1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-8.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:

NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of the associated criteria.

TABLE 4-21

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	IS11SD01 SD 327410.2225 1256703.528 SITE11 IS11SD010001 AREA 1 7/20/2000	QUAL	IS11SD02 SD 327450.5376 1256510.015 SITE11 IS11SD020001 AREA 1 7/20/2000	QUAL	IS11SD03 SD 327423.6608 1256429.385 SITE11 IS11SD030001 AREA 1 7/20/2000	QUAL	IS11SD04 SD 327416.9417 1256260.062 SITE11 IS11SD040001 AREA 1 7/20/2000	QUAL	IS17SD01 SD 328117.1663 1257859.44 SITE17 IS17SD010001 AREA 1 7/21/2000	QUAL	IS17SD02 SD 328030.8146 1257636.918 SITE17 IS17SD020001 AREA 1 7/21/2000	QUAL	IS17SD03 SD 327941.1417 1257442.627 SITE17 IS17SD030001 AREA 1 7/21/2000	QUAL	IS17SD04 SD 327795.0081 1257264.942 SITE17 IS17SD040001 AREA 1 7/24/2000	QUAL	IS17SD05 SD 327680.4261 1257142.056 SITE17 IS17SD050001 AREA 1 7/24/2000	QUAL	IS17SD06 SD 327549.2379 1256995.923 SITE17 IS17SD060001 AREA 1 7/24/2000	QUAL	MTC001 SWSD 326600.34 1255101.17 MATTAWOMAN CREEK MTCSD00101 AREA 1 9/9/2001	QUAL	MTC002 SWSD 327189.67 1255150.97 MATTAWOMAN CREEK MTCSD00201 AREA 1 9/9/2001	QUAL
VOLATILE ORGANICS (UG/KG)																													
2-BUTANONE	93300	47000000	ND	14	J	13	U	13	U	13	U															17	U	17	U
ACETONE	1000	7800000	210	8.7	B	13	U	13	U	13	U															51	J	47	J
CARBON DISULFIDE	1.9	7800000	71	14	U	13	U	13	U	13	U															20		13	J
CHLOROMETHANE	NA	49000	ND	14	J	13	U	13	U	13	U															17	U	17	U
TOLUENE	123	16000000	ND	14	U	13	U	13	U	13	U															17	U	17	U
SEMIVOLATILE ORGANICS (UG/KG)																													
ANTHRACENE	85.3	23000000	ND	450	U	440	U	420	U	420	U															950	U	910	U
BAP EQUIVALENT	NA	NA	NA			208.27		5.146																		9.7		12.098	
BENZO(A)ANTHRACENE	261	870	ND	450	U	250	J	420	U	420	U															950	U	910	U
BENZO(A)PYRENE	430	87	ND	450	U	77	J	420	U	420	U															950	U	910	U
BENZO(B)FLUORANTHENE	3200	870	ND	450	U	400	J	51	J	420	U															97	J	120	J
BENZO(G,H,I)PERYLENE	670	2300000	ND	450	U	440	U	420	U	420	U															950	U	910	U
BENZO(K)FLUORANTHENE	240	8700	ND	450	U	170	J	420	U	420	U															950	U	910	U
BIS(2-ETHYLHEXYL)PHTHALATE	1300	46000	ND	450	U	440	U	150	J	67	J															130	B	95	B
CHRYSENE	384	87000	ND	450	U	370	J	46	J	420	U															950	U	98	J
DI-N-BUTYL PHTHALATE	1400	7800000	ND	450	U	440	U	420	U	420	U															950	U	910	U
DIBENZO(A,H)ANTHRACENE	63.4	87	ND	450	U	55	J	420	U	420	U															950	U	910	U
DIETHYL PHTHALATE	200	63000000	ND	450	U	440	U	420	U	420	U															950	U	910	U
FLUORANTHENE	600	3100000	ND	450	U	300	J	56	J	420	U															110	J	160	J
HIGH MOLECULAR WEIGHT PAHS	1700	NA	NA			1954		201																		307		518	
INDENO(1,2,3-CD)PYRENE	600	870	ND	450	U	92	J	420	U	420	U															950	U	910	U
LOW MOLECULAR WEIGHT PAHS	552	NA	NA			79																						98	
PHENANTHRENE	240	2300000	ND	450	U	79	J	420	U	420	U															950	U	98	J
PYRENE	665	2300000	ND	450	U	240	J	48	J	420	U															100	J	140	J
TOTAL PAHS	4022	NA	NA			2033		201																		307		616	
PESTICIDES/PCBS (UG/KG)																													
AROCLOR-1248	22.7	320	ND																							96	U	91	U
INORGANICS (MG/KG)																													
ALUMINUM	18000	78000	11400	8230		2450		3740		1900		837		5440		5360		1560		13100		11900		12100		9710		
ANTIMONY	150	31	ND	22.8	L	63.9	L	33.6	L	34.4	L	1.1	U	1.1	U	1.1	U	1.3	J	3.5	J	3.2	J	1.1	UL	1.2	UL
ARSENIC	8.2	0.43	4.1	6.7	J	15.2	J	24.5	J	18.9	J	2.1	J	3.4		3.5		7.1		17.8		32.7		7.1	K	6.6	K
BARIUM	48	5500	112	169		86.4		50.4	J	112		7.6	J	56.1		61.1		11	J	95		85.8		124		112	
BERYLLIUM	NA	160	1.3	0.055	U	0.095	B	0.058	B	0.072	B	0.2	J	0.14	B	0.22	B	0.061	J	0.39	J	0.39	J	1.2		0.97	
CADMIUM	1.2	78	3.5	1.2	L	4.5	L	6.5	L	4.9	L	0.13	J	0.1	B	0.12	B	0.71	J	4.2		18.7		0.79	K	0.62	K
CALCIUM	NA	NA	1490	3610	J	22100	J	632	J	1070	J	198	B	349	J	441	J	362	J	1750	J	3350	J	2040		1930	
CHROMIUM	81	230	25	14.2	L	57.2	L	28.8	L	69.7	L	7		10.6		10		27.5		38.8		43.4		28.2		24.1	
COBALT	10	1600	19.8	5.1	B	6.3	J	7.4	J	14		2.5	J	3.9	J	7.4	J	2.9	J	12	J	12.2	J	20		17.5	
COPPER	34	3100	22.7	757	L	149	L	343	L	650	L	3	J	6.5		11.7		80.4		335		483		37.4		29.8	
CYANIDE	0.667	1600	ND	2.7	U	2.6	U	2.6	U	0.12	J	0.66	U	0.62	U	0.67	U	0.65	U	0.35	B	0.42	B	0.24	U	4.7	J
IRON	20000	23000	27900	23100	J	8360	J	134000	J	129000	J	7270		11100		10600		26900		34100		118000		30100		24400	
LEAD	46.7	400	30.7	76400	J	1160	J	375	J	1000	J	4.4	J	10.9	J	21.6	J	138	J	707	J	1140	J	60.5		43.4	
MAGNESIUM	NA	NA	3590	2660	J	3190	J	717	J	688	J	108	J	563	J	516	J	181	J	1550		1510	J	3030		2360	
MANGANESE	260	1600	876	330	J	637	J	432	J	940	J	85.3		73.6		311		172		305		763		799		635	
MERCURY	0.15	23	ND	0.2		0.081	J	0.53		0.11	J	0.066	UL	0.062	J	0.097	J	0.065	U	0.34		0.26		0.2		0.16	
NICKEL	20.9	1600	22.5	14.6	L	45.1	L	29.5	L	46.4	L	2	B	5.6	J	6	J	9.5	J	39.4		35.7		28.4	K	23.6	K
POTASSIUM	NA	NA	1460	454	J	182	J	164	J	131	J	91.7	J	340	J	356	J	94.8	J	796	J	581	J	1270		1060	
SELENIUM	1	390	ND	1.2	UL	1.1	UL	1.7	L	2.2	UL	1.1	U	1.1	U	1.1	U	1.1	U	1.1	U	1.4	U	2	U	2.1	U
SILVER	1	390	0.76	8.7		0.82	U	10.9		7.5		0.82	U	0.77	U	0.82	U	0.8	U	8.3		4.5		1.3	L	1.4	L
SODIUM	NA	NA	3760	428	B	332	B	226	B	378	B	329	B	547	B	437	B	372	J	521	J	604	J	546	B	473	B
THALLIUM	NA	5.5	ND	4.2		1.4	U	1.5	J	2.7	U	1.4	U	1.3	U	1.4	U	1.4	U	1.4	U	1.8	U	1.8	UL	1.9	UL
VANADIUM	57	550	32.9	22.1		16.1		12.9		14.1	J	7.7	J	17		17.5		11.3	J	28.1		33.6		39		32.3	
ZINC	150	23000	142	1310	J	847	J	898	J	1910	J	8.8	J	23.5	J	25.6	J	156	J	712	J	939	J	89.7	J	74.3	J

TABLE 4-21

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	IS11SD01 SD 327410.2225 1256703.528 SITE11 IS11SD010001 AREA 1 7/20/2000	QUAL	IS11SD02 SD 327450.5376 1256510.015 SITE11 IS11SD020001 AREA 1 7/20/2000	QUAL	IS11SD03 SD 327423.6608 1256429.385 SITE11 IS11SD030001 AREA 1 7/20/2000	QUAL	IS11SD04 SD 327416.9417 1256260.062 SITE11 IS11SD040001 AREA 1 7/20/2000	QUAL	IS17SD01 SD 328117.1663 1257859.44 SITE17 IS17SD010001 AREA 1 7/21/2000	QUAL	IS17SD02 SD 328030.8146 1257636.918 SITE17 IS17SD020001 AREA 1 7/21/2000	QUAL	IS17SD03 SD 327941.1417 1257442.627 SITE17 IS17SD030001 AREA 1 7/21/2000	QUAL	IS17SD04 SD 327795.0081 1257264.942 SITE17 IS17SD040001 AREA 1 7/24/2000	QUAL	IS17SD05 SD 327680.4261 1257142.056 SITE17 IS17SD050001 AREA 1 7/24/2000	QUAL	IS17SD06 SD 327549.2379 1256995.923 SITE17 IS17SD060001 AREA 1 7/24/2000	QUAL	MTC001 SWSD 326600.34 1255101.17 MATTAWOMAN CREEK MTCSD00101 AREA 1 9/9/2001	QUAL	MTC002 SWSD 327189.67 1255150.97 MATTAWOMAN CREEK MTCSD00201 AREA 1 9/9/2001	QUAL
MISCELLANEOUS PARAMETERS																													
DIESEL RANGE ORGANICS (MG/KG)	NA	NA	NA	4.1	U	13		26		15																			
PERCENT MOISTURE (%)	NA	NA	NA	26.6		24.3		22.1		21.2		24.1		19		24.8		22.6		21.4		39.6							
PERCENT SOLIDS (%)	NA	NA	NA									79.7		75.3		65.3		81		79.5		60.2							
PH (S.U.)	NA	NA	NA									7.1		5.4		5.8		6.8		7.1		7.5							
TOTAL ORGANIC CARBON (MG/KG)	NA	NA	69200									125	U	133	U	13000		123	U	39200		52100		23400		20800			
AVS/SEM PARAMETERS (UMOL/G)																													
ACID VOLATILE SULFIDE	NA	NA	7.9																					0.53		0.51			
CADMIUM-SEM	NA	NA	ND																					0.004	B	0.003	B		
COPPER-SEM	NA	NA	2.0																					0.30	J	0.23	J		
LEAD-SEM	NA	NA	0.20																					0.17		0.10			
NICKEL-SEM	NA	NA	2.3																					0.17	J	0.15	J		
ZINC-SEM	NA	NA	8.1																					1.4		1.1			
TOTAL SEM[4] - AVS	NA	NA	NA																					1.6		1.0			
EXPLOSIVES (MG/KG)																													
1,3,5-TRINITROBENZENE	0.002	2300	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.094	J	0.25	U	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	UJ		
1,3-DINITROBENZENE	0.007	7.8	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.069	J	0.25	U	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	UJ		
2,4,6-TRINITROTOLUENE	0.09	21	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.1	J	0.25	U	0.25	U	0.066	J	0.25	U	0.25	UJ	0.25	UJ		
2,6-DINITROTOLUENE	0.294	78	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.1	J	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	UJ		
2-AMINO-4,6-DINITROTOLUENE	NA	4.7	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.22	J	0.25	U	0.25	UJ	0.25	UJ		
3-NITROTOLUENE	NA	1600	ND	0.18	J	0.25	U	0.25	U	0.25	U	0.25	U	0.22	J	0.25	U	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	UJ		
4-NITROTOLUENE	NA	780	ND	0.25	U	0.25	U	0.25	U	0.14	J	0.16	B	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	UJ	0.25	UJ		
NITROCELLULOSE	NA	NA	56																					1.8	B	2.7	J		
FIELD PARAMETERS (%)																													
PERCENT CLAY	NA	NA	27.1																					16.5		11.3			
PERCENT GRAVEL	NA	NA	0.6																					0		0			
PERCENT SAND	NA	NA	79.4																					50.9		34.2			
PERCENT SILT	NA	NA	65.2																					32.6		54.5			

TABLE 4-21

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC002		MTC002		MTC003		MTC004		MTC005		MTC029		MTC030	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD		SWSD		SWSD		SWSD	
NORTHING	327189.67		327189.67		327401.28		327403.21		328220.38		324317.72		324577.98	
EASTING	1255150.97		1255150.97		1255740.44		1256268.56		1258899.46		1256000.16		1257980.5	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSD00201-D		MTCSD00201-AVG		MTCSD00301		MTCSD00401		MTCSD00501		MTCSD02901		MTCSD03001	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/8/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
VOLATILE ORGANICS (UG/KG)														
2-BUTANONE	13	U	15	U	10	U	16	U	15	U	10	U	13	U
ACETONE	66	J	56.5	J	11	J	16	U	130	J	7	J	66	J
CARBON DISULFIDE	15		14		2	J	16	U	15	U	10	U	16	
CHLOROMETHANE	13	U	15	U	10	U	16	U	15	U	10	U	13	U
TOLUENE	13	U	15	U	0.8	J	16	U	15	U	10	U	13	U
SEMIVOLATILE ORGANICS (UG/KG)														
ANTHRACENE	900	U	905	U	500	U	76	J	880	U	400	U	690	U
BAP EQUIVALENT			12.098				271.33						7.5	
BENZO(A)ANTHRACENE	900	U	905	U	500	U	210	J	880	U	400	U	690	U
BENZO(A)PYRENE	900	U	905	U	500	U	210	J	880	U	400	U	690	U
BENZO(B)FLUORANTHENE	900	U	120	J	500	U	260	J	880	U	400	U	75	J
BENZO(G,H,I)PERYLENE	900	U	905	U	500	U	120	J	880	U	400	U	690	U
BENZO(K)FLUORANTHENE	900	U	905	U	500	U	110	J	880	U	400	U	690	U
BIS(2-ETHYLHEXYL)PHTHALATE	160	B	127.5	B	500	U	310	B	140	B	400	U	690	U
CHRYSENE	900	U	98	J	500	U	230	J	880	U	400	U	690	U
DI-N-BUTYL PHTHALATE	900	U	905	U	500	U	630		880	U	400	U	690	U
DIBENZO(A,H)ANTHRACENE	900	U	905	U	500	U	520	U	880	U	400	U	690	U
DIETHYL PHTHALATE	900	U	905	U	500	U	99	J	880	U	400	U	690	U
FLUORANTHENE	900	U	160	J	500	U	410	J	880	U	400	U	81	J
HIGH MOLECULAR WEIGHT PAHS			518				2030						254	
INDENO(1,2,3-CD)PYRENE	900	U	905	U	500	U	130	J	880	U	400	U	690	U
LOW MOLECULAR WEIGHT PAHS			98				366							
PHENANTHRENE	900	U	98	J	500	U	290	J	880	U	400	U	690	U
PYRENE	900	U	140	J	500	U	350	J	880	U	400	U	98	J
TOTAL PAHS			616				2396						254	
PESTICIDES/PCBS (UG/KG)														
AROCLOR-1248	90	U	90.5	U	49	U	170		89	U	41	U	68	U
INORGANICS (MG/KG)														
ALUMINUM	8630		9170		2510		3660		4070		245		5300	
ANTIMONY	1.9	B	1.55	B	0.49	UL	1.8	B	0.95	UL	0.4	UL	1.1	B
ARSENIC	4.2	K	5.4	K	1.1	K	20		2.7	K	0.69	U	3.1	K
BARIUM	101		106.5		32		102		42.6		5.5		59.2	
BERYLLIUM	0.86		0.915		0.28		0.98		0.37		0.13		0.59	
CADMIUM	0.64	K	0.63	K	1	K	0.77	K	0.66	K	0.59	K	1.9	K
CALCIUM	1710		1820		483		1520		2330		85		980	
CHROMIUM	21.4		22.75		7.2		13.8		7.9		2.5	K	13.4	
COBALT	15.2		16.35		6		12.6	K	2.2		1.5		10.2	
COPPER	25.7		27.75		8.6		18.4	L	4.7	B	0.3	B	11.5	
CYANIDE	0.24	UJ	2.41	J	0.15	U	0.18	U	0.3	U	0.14	U	0.41	U
IRON	21600		23000		8000		37100		6000		6100		15800	
LEAD	38.3		40.85		15.8		53.4		6.1		1.7		19	
MAGNESIUM	2090		2225		550		939		1050		56.2	B	977	
MANGANESE	575		605		157		1120		109		71.3		393	
MERCURY	0.14	U	0.115		0.069	U	0.13		0.14	U	0.056	U	0.099	U
NICKEL	20.5	K	22.05	K	6.9	K	13.5	K	4.9		1.3	K	11.2	K
POTASSIUM	1060		1060		299		403	K	409		44.8	B	596	
SELENIUM	2.1	U	2.1	U	0.89	U	1.2	U	1.7	U	0.71	U	1.8	U
SILVER	1.2	L	1.3	L	0.34	L	3.2	J	0.24	UL	0.099	UL	0.4	L
SODIUM	329	B	401	B	149	B	271	B	155	B	101	B	371	B
THALLIUM	1.9	UL	1.9	UL	0.8	UL	2.9	L	1.6	UL	0.64	UL	1.6	UL
VANADIUM	29.1		30.7		9.1		23.1		11.2		6.4		18.7	
ZINC	72.2	J	73.25	J	7.8	B	37.1	J	16.4	B	3.5	B	22	B

TABLE 4-21

SUMMARY OF POSITIVE DETECTIONS IN AREA 1 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION	MTC002		MTC002		MTC003		MTC004		MTC005		MTC029		MTC030	
LOCATION TYPE	SWSD		SWSD		SWSD		SWSD		SWSD		SWSD		SWSD	
NORTHING	327189.67		327189.67		327401.28		327403.21		328220.38		324317.72		324577.98	
EASTING	1255150.97		1255150.97		1255740.44		1256268.56		1258899.46		1256000.16		1257980.5	
SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
SAMPLE ID	MTCSD00201-D		MTCSD00201-AVG		MTCSD00301		MTCSD00401		MTCSD00501		MTCSD02901		MTCSD03001	
AREA OF CONCERN	AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1		AREA 1	
SAMPLE DATE	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL	9/8/2001	QUAL	9/9/2001	QUAL	9/9/2001	QUAL
MISCELLANEOUS PARAMETERS														
DIESEL RANGE ORGANICS (MG/KG)														
PERCENT MOISTURE (%)														
PERCENT SOLIDS (%)														
PH (S.U.)														
TOTAL ORGANIC CARBON (MG/KG)	21400		21100		5170		15300		69900		550		16000	
AVS/SEM PARAMETERS (UMOL/G)														
ACID VOLATILE SULFIDE	0.14		0.33		0.29		0.14		0.01	U	0.01	U	0.009	
CADMIUM-SEM	0.004	B	0.004	B	0.002	B	0.004		0.0005	B	0.0004	B	0.003	B
COPPER-SEM	0.22	J	0.22	J	0.09	J	2.6	J	0.15	J	0.02	B	0.16	J
LEAD-SEM	0.13		0.12		0.06		0.15		0.01		0.003	B	0.08	
NICKEL-SEM	0.13	B	0.11	J	0.05	B	5.9	J	0.90	J	0.04	B	0.09	B
ZINC-SEM	1.3		1.2		0.57		1.3		0.06	B	0.04	B	0.88	
TOTAL SEM[4] - AVS	1.5		1.2		0.43		9.8		1.1		0		1.1	
EXPLOSIVES (MG/KG)														
1,3,5-TRINITROBENZENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
1,3-DINITROBENZENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
2,4,6-TRINITROTOLUENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
2,6-DINITROTOLUENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
2-AMINO-4,6-DINITROTOLUENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
3-NITROTOLUENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
4-NITROTOLUENE	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ	0.25	UJ
NITROCELLULOSE	2.5	J	2.6	J	1.5	B	3.6	J	1.3	B	0.52	B	2	J
FIELD PARAMETERS (%)														
PERCENT CLAY	19.8		15.6		5.6		4							
PERCENT GRAVEL	0		0		12		2.4							
PERCENT SAND	50		42.1		67.1		79.4							
PERCENT SILT	30.2		42.4		15.3		14.2							

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the level of the associated value.
The associated value is either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-22

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	MTC006 SWSD 329298.47 1259041.41 MATTAWOMAN CREEK MTCSD00601 AREA 2 9/8/2001	QUAL	MTC007 SWSD 329016.99 1258314.94 MATTAWOMAN CREEK MTCSD00701 AREA 2 9/8/2001	QUAL	MTC008 SWSD 330390.01 1258888.66 MATTAWOMAN CREEK MTCSD00801 AREA 2 9/8/2001	QUAL	MTC009 SWSD 330505.76 1258552.33 MATTAWOMAN CREEK MTCSD00901 AREA 2 9/8/2001	QUAL	MTC010 SWSD 331849.97 1259621.28 MATTAWOMAN CREEK MTCSD01001 AREA 2 9/8/2001	QUAL	MTC011 SWSD 330868.23 1260476.85 MATTAWOMAN CREEK MTCSD01101 AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201 AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201-D AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201-AVG AREA 2 9/8/2001	QUAL
VOLATILE ORGANICS (UG/KG)																						
ACETONE	1000	7800000	210	72	J	13	J	140	J	160	J	110	J	170	J	11	U	12	U	11.5	U
CARBON DISULFIDE	1.9	7800000	71	21	J	2	J	37	J	45	J	27	J	28	J	11	J	37	J	24	J
TOLUENE	123	16000000	ND	19	UJ	10	U	3	J	26	UJ	19	UJ	33	UJ	11	U	12	U	11.5	U
SEMIVOLATILE ORGANICS (UG/KG)																						
4-METHYLPHENOL	670	390000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	80	J	80	J
ACENAPHTHYLENE	44	4700000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	52	J	340	J	196	J
ANTHRACENE	85.3	23000000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	69	J	540	J	304.5	J
BAP EQUIVALENT	NA	NA	NA			94.9						14				392.6		2509		1451	
BENZO(A)ANTHRACENE	261	870	ND	1100	UJ	76	J	1600	UJ	1600	UJ	1100	UJ	1200	UJ	290	J	1700	J	995	J
BENZO(A)PYRENE	430	87	ND	1100	UJ	78	J	1600	UJ	1600	UJ	1100	UJ	1200	UJ	310	J	1800	J	1055	J
BENZO(B)FLUORANTHENE	3200	870	ND	1100	UJ	92	J	1600	UJ	1600	UJ	140	J	1200	UJ	340	J	2000	J	1170	J
BENZO(G,H,I)PERYLENE	670	2300000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	170	J	1100	J	635	J
BENZO(K)FLUORANTHENE	240	8700	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	130	J	730		430	
CARBAZOLE	NA	32000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	110	J	110	J
CHRYSENE	384	87000	ND	1100	UJ	77	J	1600	UJ	1600	UJ	1100	UJ	1200	UJ	300	J	1700	J	1000	J
DIBENZO(A,H)ANTHRACENE	63.4	87	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	220	J	220	J
DIBENZOFURAN	540	310000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	80	J	80	J
DIETHYL PHTHALATE	200	63000000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	65	J	65	J
FLUORANTHENE	600	3100000	ND	1100	UJ	140	J	1600	UJ	1600	UJ	130	J	1200	UJ	520	J	4000	J	2260	J
FLUORENE	19	3100000	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	460	U	180	J	180	J
HIGH MOLECULAR WEIGHT PAHS	1700	NA	NA			583						410				2810		18350		10580	
INDENO(1,2,3-CD)PYRENE	600	870	ND	1100	UJ	550	U	1600	UJ	1600	UJ	1100	UJ	1200	UJ	180	J	1100	J	640	J
LOW MOLECULAR WEIGHT PAHS	552	NA	NA			77										311		3660		1986	
PHENANTHRENE	240	2300000	ND	1100	UJ	77	J	1600	UJ	1600	UJ	1100	UJ	1200	UJ	190	J	2600	J	1395	J
PYRENE	665	2300000	ND	1100	UJ	120	J	1600	UJ	1600	UJ	140	J	1200	UJ	570	J	4000	J	2285	J
TOTAL PAHS	4022	NA	NA			660						410				3121		22010		12566	
INORGANICS (MG/KG)																						
ALUMINUM	18000	78000	11400	11100	J	2790		10700	J	13400	J	9130	J	12400	J	3170		2800		2985	
ARSENIC	8.2	0.43	4.1	4.2	J	1.9	K	7.5	J	6.8	J	14.6	J	5	J	5.6		3.6	K	4.6	K
BARIUM	48	5500	112	129	J	32.4		130	J	152	J	130	J	143	J	24.5		26.5		25.5	
BERYLLIUM	NA	160	1.3	1.1	J	0.29		1.2	J	1.4	J	1.1	J	1.3	J	0.39		0.32		0.355	
CADMIUM	1.2	78	3.5	3.2	J	0.95	K	3.5	J	4.1	J	1.1	J	1.1	J	0.074	K	0.084	K	0.079	K
CALCIUM	NA	NA	1490	1790	J	1070		3250	J	2730	J	2370	J	2300	J	378		523		450.5	
CHROMIUM	81	230	25	25.4	J	7		26.9	J	31.6	J	22.4	J	28.2	J	16.5		12		14.25	
COBALT	10	1600	19.8	16.8	J	6.7		18.4	J	22.2	J	22.6	J	18.8	J	5.9		5.5		5.7	
COPPER	34	3100	22.7	26.1	J	6.9		33.3	J	36.3	J	27.7	J	30.2	J	4.4		5.1		4.75	
CYANIDE	0.667	1600	ND	0.36	UJ	0.19	U	0.62	UJ	0.63	UJ	0.45	UJ	0.49	UJ	0.2	UJ	3.8	J	1.95	J
IRON	20000	23000	27900	26500	J	7470		26200	J	32800	J	26600	J	30700	J	13800		11800		12800	
LEAD	46.7	400	30.7	35.5	J	11.2		50.2	J	47.2	J	54.2	J	43.5	J	10.3		12.9		11.6	
MAGNESIUM	NA	NA	3590	2430	J	611		2540	J	2850	J	1670	J	2650	J	655		498		576.5	
MANGANESE	260	1600	876	703	J	123		596	J	945	J	530	J	1030	J	135		164		149.5	
MERCURY	0.15	23	ND	0.23	J	0.083	U	0.22	J	0.24	J	0.54	J	0.17	UJ	0.071	U	0.071	U	0.071	U
NICKEL	20.9	1600	22.5	24.2	J	6.9	K	27.9	J	30.6	J	25	J	27.1	J	5.3		4.2		4.75	
POTASSIUM	NA	NA	1460	1210	J	299		1240	J	1530	J	871	J	1360	J	263		347		305	
SILVER	1	390	0.76	1.2	J	0.24	L	1.3	J	1.4	J	0.76	J	1.3	J	0.15	UL	0.16	UL	0.155	UL
THALLIUM	NA	5.5	ND	2.5	UJ	0.95	UL	3.4	UJ	3.6	UJ	2.2	J	2.9	J	0.98	UL	1.1	UL	1.04	UL
VANADIUM	57	550	32.9	35.1	J	9.3		37.5	J	43.5	J	37	J	38.6	J	16		16.3		16.15	
ZINC	150	23000	142	146	J	43	J	148	J	143	J	107	J	39.3	B	19.2	B	46.1	J	27.85	J

TABLE 4-22

SUMMARY OF POSITIVE DETECTIONS IN AREA 2 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	MTC006 SWSD 329298.47 1259041.41 MATTAWOMAN CREEK MTCSD00601 AREA 2 9/8/2001	QUAL	MTC007 SWSD 329016.99 1258314.94 MATTAWOMAN CREEK MTCSD00701 AREA 2 9/8/2001	QUAL	MTC008 SWSD 330390.01 1258888.66 MATTAWOMAN CREEK MTCSD00801 AREA 2 9/8/2001	QUAL	MTC009 SWSD 330505.76 1258552.33 MATTAWOMAN CREEK MTCSD00901 AREA 2 9/8/2001	QUAL	MTC010 SWSD 331849.97 1259621.28 MATTAWOMAN CREEK MTCSD01001 AREA 2 9/8/2001	QUAL	MTC011 SWSD 330868.23 1260476.85 MATTAWOMAN CREEK MTCSD01101 AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201 AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201-D AREA 2 9/8/2001	QUAL	MTC012 SWSD 330879.62 1260918.38 MATTAWOMAN CREEK MTCSD01201-AVG AREA 2 9/8/2001	QUAL
MISCELLANEOUS PARAMETERS (MG/KG)																					
TOTAL ORGANIC CARBON	NA	NA	69200	26700	J	8240		74200	J	56100	J	40800	J	34600	J	5350		8780		7065	
AVS/SEM PARAMETERS (UMOL/G)																					
ACID VOLATILE SULFIDE	NA	NA	7.9	0.02	U	0.53		2.1		2.2		0.30		0.53		0.16	U	0.57		0.32	
CADMIUM-SEM	NA	NA	ND	0.005	B	0.008		0.007	B	0.007	B	0.008		0.005	B	0.0004	B	0.0007	B	0.0005	B
COPPER-SEM	NA	NA	2.0	2.06	J	0.35	J	0.32	J	0.46	J	4.6	J	0.64	J	0.05	B	5.3	J	2.6	J
LEAD-SEM	NA	NA	0.20	0.14		0.06		0.17		0.20		0.23		0.11		0.04		0.06		0.05	
NICKEL-SEM	NA	NA	2.3	6.1	J	1.1	J	0.30	J	0.78	J	12.9	J	1.6	J	0.03	B	3.5	J	1.7	J
ZINC-SEM	NA	NA	8.1	1.5		1.9		1.9		2.1		2.6		1.3		0.32		0.57		0.45	
TOTAL SEM[4] - AVS	NA	NA	10	9.9		2.9		0.59		1.4		20.1		3.1		0.36		8.8		4.6	
EXPLOSIVES (MG/KG)																					
NITROCELLULOSE	NA	NA	56	7	J	2.5	J	4	J	3.8	J	2.4	J	9.2	J	1.6	B	2	J	1.4	J
FIELD PARAMETERS (%)																					
PERCENT CLAY	NA	NA	27.1							14.8		6.2		26.7		1.6		6.1		3.9	
PERCENT GRAVEL	NA	NA	0.6							0		0		0		3.5		2.2		2.9	
PERCENT SAND	NA	NA	79.4							7.2		21.4		4		88.4		85.8		87.1	
PERCENT SILT	NA	NA	65.2							78		72.4		69.3		6.5		5.9		6.2	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the level of the associated value.
The associated value is either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-23

SUMMARY OF POSITIVE DETECTIONS IN AREA 3 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	MTC013 SWSD 330304.28 1261707.03 MATTAWOMAN CREEK MTCSD01301 AREA 3 9/7/2001	QUAL	MTC014 SWSD 331387.89 1261625.22 MATTAWOMAN CREEK MTCSD01401 AREA 3 9/7/2001	QUAL	MTC015 SWSD 332415.51 1262267.1 MATTAWOMAN CREEK MTCSD01501 AREA 3 9/7/2001	QUAL	MTC016 SWSD 332464.04 1262770.26 MATTAWOMAN CREEK MTCSD01601 AREA 3 9/7/2001	QUAL
VOLATILE ORGANICS (UG/KG)											
ACETONE	1000	7800000	210	13	J	170	J	53	J	100	J
CARBON DISULFIDE	1.9	7800000	71	3	J	17	J	10	J	20	J
CHLOROFORM	62.9	780000	ND	10	U	50	UJ	10	J	22	UJ
TOLUENE	123	16000000	ND	10	U	50	UJ	3	J	22	UJ
SEMIVOLATILE ORGANICS (UG/KG)											
BAP EQUIVALENT	NA	NA	NA			15		118.12			
BENZO(A)ANTHRACENE	261	870	ND	530	U	1200	UJ	100	J	1200	UJ
BENZO(A)PYRENE	430	87	ND	530	U	1200	UJ	96	J	1200	UJ
BENZO(B)FLUORANTHENE	3200	870	ND	530	U	150	J	120	J	1200	UJ
CHRYSENE	384	87000	ND	530	U	1200	UJ	120	J	1200	UJ
DIETHYL PHTHALATE	200	63000000	ND	530	U	1200	UJ	840		1200	UJ
FLUORANTHENE	600	3100000	ND	530	U	160	J	110	J	1200	UJ
HIGH MOLECULAR WEIGHT PAHS	1700	NA	NA			480		676		130	
PYRENE	665	2300000	ND	530	U	170	J	130	J	130	J
TOTAL PAHS	4022	NA	NA			480		676		130	
INORGANICS (MG/KG)											
ALUMINUM	18000	78000	11400	5590		10400	J	3290		12400	J
ARSENIC	8.2	0.43	4.1	9.6		5.7	B	1.7	B	7.5	B
BARIUM	48	5500	112	106		120	J	41.3		154	J
BERYLLIUM	NA	160	1.3	1		1.2	J	0.43		1.5	J
CADMIUM	1.2	78	3.5	0.15	B	0.93	J	1.4	K	1.5	J
CALCIUM	NA	NA	1490	1330		1950	J	637		2200	J
CHROMIUM	81	230	25	17.6		24.5	J	10.1		29	J
COBALT	10	1600	19.8	5.5	K	17.3	J	7.4	K	21.7	J
COPPER	34	3100	22.7	15	L	28.7	J	9.9		37.1	J
IRON	20000	23000	27900	27400		25900	J	9190		31500	J
LEAD	46.7	400	30.7	19.3		36.5	J	13.4		45.8	J
MAGNESIUM	NA	NA	3590	1020		2240	J	656		2400	J
MANGANESE	260	1600	876	144		693	J	208		851	J
MERCURY	0.15	23	ND	0.082	U	0.24	J	0.076	U	0.22	J
NICKEL	20.9	1600	22.5	7.4	K	24	J	7.8	K	28.4	J
POTASSIUM	NA	NA	1460	547		1050	J	355		1270	J
SILVER	1	390	0.76	0.14	UL	2	J	4.8	L	2.7	J
VANADIUM	57	550	32.9	34.6		35.1	J	12	K	40.3	J
ZINC	150	23000	142	36.5		149	B	59.7		204	J

TABLE 4-23

SUMMARY OF POSITIVE DETECTIONS IN AREA 3 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential-Soil[3]	Maximum Background Concentration	MTC013 SWSD 330304.28 1261707.03 MATTAWOMAN CREEK MTCSD01301 AREA 3 9/7/2001	QUAL	MTC014 SWSD 331387.89 1261625.22 MATTAWOMAN CREEK MTCSD01401 AREA 3 9/7/2001	QUAL	MTC015 SWSD 332415.51 1262267.1 MATTAWOMAN CREEK MTCSD01501 AREA 3 9/7/2001	QUAL	MTC016 SWSD 332464.04 1262770.26 MATTAWOMAN CREEK MTCSD01601 AREA 3 9/7/2001	QUAL
MISCELLANEOUS PARAMETERS (MG/KG)											
TOTAL ORGANIC CARBON	NA	NA	69200	4310		33000		11300		42400	
AVS/SEM PARAMETERS (UMOL/G)											
ACID VOLATILE SULFIDE	NA	NA	7.9	0.02		0.18		0.16		5.3	
COPPER-SEM	NA	NA	2.0	0.12		1.1		0.09		0.33	
LEAD-SEM	NA	NA	0.20	0.06		0.16		0.05		0.17	
NICKEL-SEM	NA	NA	2.3	0.05	B	2.4	J	0.05	B	0.27	J
ZINC-SEM	NA	NA	8.1	0.30	B	1.8		0.74	B	2.5	
TOTAL SEM[4] - AVS	NA	NA	10	0.16		5.3		-0.02		-2.0	
EXPLOSIVES (MG/KG)											
NITROCELLULOSE	NA	NA	56	4.2		65.7		23.2		122	
FIELD PARAMETERS (%)											
PERCENT CLAY	NA	NA	27.1	30.3		35.6		6		14.6	
PERCENT GRAVEL	NA	NA	0.6	4.8		0		3		0	
PERCENT SAND	NA	NA	79.4	34.9		18		81.9		25	
PERCENT SILT	NA	NA	65.2	30		46.4		9.1		60.4	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-24

SUMMARY OF POSITIVE DETECTIONS IN AREA 4 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential Soil[3]	Maximum Background Concentration	MTC017 SWSD 333712.68 1263026.98 MATTAWOMAN CREEK MTCSD01701 AREA 4 9/7/2001	QUAL	MTC018 SWSD 333940.86 1263462.35 MATTAWOMAN CREEK MTCSD01801 AREA 4 9/7/2001	QUAL	MTC019 SWSD 333623.25 1264439.07 MATTAWOMAN CREEK MTCSD01901 AREA 4 9/7/2001	QUAL	MTC020 SWSD 333717.68 1264638.88 MATTAWOMAN CREEK MTCSD02001 AREA 4 9/7/2001	QUAL	MTC021 SWSD 333790.95 1264888.8 MATTAWOMAN CREEK MTCSD02101 AREA 4 9/7/2001	QUAL	S39SD/SW01 SWSD 333870.82 1263146.93 39 S39SD0010001 AREA 4 10/21/1997	QUAL	S39SD02 SD 333963.51 1263193.31 39 S39SD0020001 AREA 4 10/21/1997	QUAL	S39SD03/SW02 SWSD 333965.84 1263213.02 39 S39SD0030001 AREA 4 10/21/1997	QUAL	S39SD04 SD 333971.64 1263213.68 39 S39SD0040001 AREA 4 10/21/1997	QUAL	S39SD05/SW03 SWSD 334087.73 1263535.69 39 S39SD0050001 AREA 4 10/21/1997	QUAL	S39SD06/SW04 SWSD 334080.9 1263724.64 39 S39SD0060001 AREA 4 10/21/1997	QUAL	S39SD07/SW05 SWSD 334006.71 1264038.08 39 S39SD0070001 AREA 4 10/21/1997	QUAL	S39SD08/SW06 SWSD 333872.54 1264422.12 39 S39SD0080001 AREA 4 10/21/1997	QUAL
VOLATILE ORGANICS (UG/KG)																															
2-BUTANONE	9330	47000000	ND	10	U	27	UJ	25	UJ	11	U	10	U	13	U	12	U	12	U	12	U	14	U	19	U	390		200	J
ACETONE	1000	7800000	210	10	U	110	J	25	UJ	19	J	34	J	13	U	12	U	12	U	12	U	14	U	160	B	2400	J	1100	J
CARBON DISULFIDE	1.9	7800000	71	10	U	7	J	16	J	3	J	10	U	13	U	12	U	12	U	12	U	4	J	10	J	23	J	14	J
CIS-1,2-DICHLOROETHENE	1030	780000	ND	10	U	27	UJ	25	UJ	11	U	2	J																
DIETHYL ETHER	NA	16000000	ND	10	UJ	27	UJ	25	UJ	6	J	57	J																
TOLUENE	123	16000000	ND	10	U	27	UJ	4	J	11	U	10	U	13	U	12	U	12	U	12	U	14	U	19	U	31	U	25	UJ
TRICHLOROETHENE	450	1600	ND	10	U	27	UJ	25	UJ	11	U	5	J	13	U	12	U	12	U	12	U	14	U	19	U	31	U	25	UJ
SEMIVOLATILE ORGANICS (UG/KG)																															
2-METHYLNAPHTHALENE	70	1600000	ND	410	U	1300	UJ	1200	UJ	48	J	85	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
ACENAPHTHENE	16	4700000	ND	410	U	1300	UJ	1200	UJ	50	J	120	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
ACENAPHTHYLENE	44	4700000	ND	410	U	1300	UJ	1200	UJ	440	U	83	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
ANTHRACENE	85.3	23000000	ND	410	U	1300	UJ	1200	UJ	160	J	480	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
BAP EQUIVALENT	NA	NA	NA	190.68				25.22		998.29		1476.4												11.12		13.16		22.6	
BENZO(A)ANTHRACENE	261	870	ND	150	J	1300	UJ	1200	UJ	720		1400		420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	95	J
BENZO(A)PYRENE	430	87	ND	150	J	1300	UJ	1200	UJ	700		1000	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
BENZO(B)FLUORANTHENE	3200	870	ND	170	J	1300	UJ	250	J	1100		1500	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	110	J	130	J	130	J
BENZO(G,H,I)PERYLENE	670	2300000	ND	71	J	1300	UJ	1200	UJ	270	J	330	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
BENZO(K)FLUORANTHENE	240	8700	ND	83	J	1300	UJ	1200	UJ	350	J	1500	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
BIS(2-ETHYLHEXYL)PHTHALATE	1300	46000	ND	82	B	150	B	300	B	79	B	150	B	420	UJ	390	UJ	48	J	410	J	480	UJ	86	J	1000	UJ	88	J
CARBAZOLE	NA	32000	ND	410	U	1300	UJ	1200	UJ	96	J	140	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
CHRYSENE	384	87000	ND	150	J	1300	UJ	220	J	790		1400		420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	120	J	160	J	100	J
DI-N-BUTYL PHTHALATE	1400	7800000	ND	410	U	1300	UJ	1200	UJ	440	U	580	U	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	470	J	620	J	640	J
DIBENZO(A,H)ANTHRACENE	63.4	87	ND	410	U	1300	UJ	1200	UJ	83	J	130	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
DIBENZOFURAN	540	310000	ND	410	U	1300	UJ	1200	UJ	440	U	94	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
FLUORANTHENE	600	3100000	ND	200	J	1300	UJ	170	J	1100		2600		420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	97	J	190	J	170	J
FLUORENE	19	3100000	ND	410	U	1300	UJ	1200	UJ	64	J	200	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
HIGH MOLECULAR WEIGHT PAHS	1700	NA	NA	1241				820		6403		12560												437		720		655	
INDENO(1,2,3-CD)PYRENE	600	870	ND	77	J	1300	UJ	1200	UJ	290	J	400	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
LOW MOLECULAR WEIGHT PAHS	552	NA	NA							942		2539												77		150		150	
N-NITROSODIPHENYLAMINE	28	130000	ND	410	U	1300	UJ	140	J	270	J	4800	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	180	J	2000	J	3100	J
NAPHTHALENE	160	1600000	ND	410	U	1300	UJ	1200	UJ	50	J	71	J	420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	620	UJ	1000	UJ	830	UJ
PHENANTHRENE	240	2300000	ND	410	U	1300	UJ	1200	UJ	570		1500		420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	77	J	150	J	150	J
PYRENE	665	2300000	ND	190	J	1300	UJ	180	J	1000		2300		420	UJ	390	UJ	410	UJ	410	UJ	480	UJ	110	J	240	J	160	J
TOTAL PAHS	4022	NA	NA	1241				820		7345		15099												514		870		805	
PESTICIDES/PCBS (UG/KG)																															
4,4'-DDD	16	2700	ND	4.1	U	13	UJ	13	UJ	4.5	U	5.8	U	4.2	UJ	3.9	UJ	4.1	UJ	4	UJ	4.8	UJ	6.1	UJ	7.7	J	6	J
4,4'-DDE	2.2	1900	ND	4.1	U	13	UJ	13	UJ	4.5	U	5.8	U	4.2	UJ	3.9	UJ	4.1	UJ	4	UJ	4.8	UJ	6.1	UJ	6	J	4.1	J
ALPHA-BHC	NA	100	ND	2.1	U	6.7	UJ	6.5	UJ	2.3	U	3	U	2.1	UJ	1.9	UJ	0.7	J	2	UJ	2.4	UJ	3.1	UJ	5.3	UJ	4.1	UJ
INORGANICS (MG/KG)																															
ALUMINUM	18000	78000	11400	975		9010	J	13900	J	2140		4200		3670		1310		990		834		3000		1920		19600		13400	
ANTIMONY	150	31	ND	0.41	U	1.3	UJ	2.4	B	0.7	B	1.2	B	0.64	UL	0.6	UL	0.63	UL	0.69	L	0.74	UL	0.94	UL	1.6	UL	1.3	UL
ARSENIC	8.2	0.43	4.1	0.97	B	5.4	B	10.3	B	13.9		16.1		3.2		3.6		3.6	K	1.8		1.6		5		16.6		12.2	
BARIUM	48	5500	112	8.8		119	J	163	J	92.6		114		16.3		35.4		7.8		7.6		22.4		32.7		98.9		92.6	
BERYLLIUM	NA	160	1.3	0.25		1.1	J	1.6	J	0.79		0.8		0.18		0.44		0.61		0.29		0.17		0.19		1		0.44	
CADMIUM	1.2	78	3.5	0.42	K	1.3	J	1.7	J	0.35	K	1.2	K	0.07	U	0.21		0.81	K	0.28	B	0.21	B	0.15	B	0.8	B	0.88	
CALCIUM	NA	NA	1490	123		1760	J	2200	J	874		2980		230	K	262	K	220	K	151	B	604	K	836	K	2930	K	4730	
CHROMIUM	81	230	25	5.6		21.6	J	30.7	J	9.7		18.6		7.4	J	8.9	J	27.8	J	12.3	J	5.9	J	5.4	J	32.3	J	24.3	J
COBALT	10	1600	19.8	2	K	15.7	J	21.2	J	10.7	K	17	K	24.1		34.7		13.8		8.1		5		2.6		15.7		10.4	
COPPER	34	3100	22.7	6.8	K	25.7	J	35.2	J	15.6		120		5.4		4.8		27.6		6.7		3.8		6.6		49.1		28.2	
CYANIDE	0.667	1600	ND	0.17	U	0.54	UJ	0.48	UJ	0.18		0.15	U	0.18	U	0.25	U	0.27	U	0.17	U	0.28	U	0.31	U	0.72	U	0.61	U
IRON	20000	23000	27900	3840		24100	J	34000	J	15600		21600		11300		9860		20700		14200		4960		5510		43800		23600	
LEAD	46.7	400	30.7	10.5		34.4	J	46.5	J	16.3		85.7		7.5		15.6		87.9		15.9		6.7		14.5		58.1		61.4	
MAGNESIUM	NA	NA	3590	104	B	1790	J	2540	J	491		2140		247	J	148	J	1900	J	1910	J	465	J	347	J	2290	J	2180	J
MANGANESE	260	1600	876	28.2		932	J	1470	J	101		294		162		620		121		83.3		48.7		46.6		384		310	
MERCURY	0.15	23	ND	0.05	U	0.37	J	0.26	J	0.13		0.7		0.02		0.02		0.1		0.05		0.03		0.29		8.7		2	
NICKEL	20.9	1600	22.5	3.1	K	20.6	J	28.6	J	16.8	K	37.6		4.4		7.7		39.8		21.1		4.5		4.2		25.6		17.1	
POTASSIUM	NA	NA	1460	91.6		822	J	1360	J	190		473		304	J	195	J	102	J	111	J	408	J	205	J	1350	J	1160	J
SILVER	1	390	0.76	0.1	UL	1.5	J	1.6	J	0.14	UL	1.2	L	0.2	U	2.6		66.4		308		0.27		1.7		26.8		6.8	
THALLIUM	NA	5.5	ND	0.67	U	2.1	UJ	2.7	J	1.3		1.9		0.71	UL	0.67	UL	0.7	UL	0.7	UL	0.82	UL	1	UL	1.8	UL	1.4	UL
VANADIUM	57	550	32.9	6.2	K	30	J	41.7	J	31.7		53.4		11.2		8.7		8.1		9.3		8.9		6.8		49.7		33.5	
ZINC	150	23000	142	13.3		158	J	210	J	59.4		216		18.7	K	65.2	K	151	K	63.4	K	21	K	27.3	K	273	K	188	K
AVS/SEM PARAMETERS (UMOL/G)																															
ACID VOLATILE SULFIDE	NA	NA	7.9	0.006	U	0.12		0.08		0.86		0.26		0.01	U	0.02		0.03		0.08		0.16		0.26		21.8		39.3	
CADMIUM-SEM	NA	NA	ND	0.002	B	0.02	B	0.02	B	0.003	B	0.008	B	0.001	U	0.001	U	0.004	J	0.001	U	0.002	U	0.002	U	0.004	U	0.006	J
COPPER-SEM	NA	NA	2.0	1.2		0.37		0.35		0.37		1.6		0.02		0.03		0.19		0.04		0.05		0.14		0.03	U	0.16	
LEAD-SEM	NA	NA	0.20	0.07		0.18		0.18		0.06		0.29		0.02		0.06		0.26		0.05		0.04		0.12		0.29		0.28	
NICKEL-SEM	NA	NA	2.3	1.5	J	0.21	B	0.24	J	0.90	J	3.6	J	0.02	U	0.03	K	0.08	B	0.02	U	0.04		0.04		0.17		0.12	B
ZINC-SEM	NA	NA	8.1	0.37	B	2.4		2.4		0.82		2.0		0.11		0.26		1.4		0.39		0.26		1.5		3.4		1.3	
TOTAL SEM[4]- AVS	NA	NA	10	2.7		2.8		3.0		1.3		7.2		0.15		0.36		1.8		0.39		0.24		1.6		-17.9		-37.5	

TABLE 4-24

SUMMARY OF POSITIVE DETECTIONS IN AREA 4 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential Soil[3]	Maximum Background Concentration	MTC017 SWSD 333712.68 1263026.98 MATTAWOMAN CREEK MTCSD01701 AREA 4 9/7/2001	QUAL	MTC018 SWSD 333940.86 1263462.35 MATTAWOMAN CREEK MTCSD01801 AREA 4 9/7/2001	QUAL	MTC019 SWSD 333623.25 1264439.07 MATTAWOMAN CREEK MTCSD01901 AREA 4 9/7/2001	QUAL	MTC020 SWSD 333717.68 1264638.88 MATTAWOMAN CREEK MTCSD02001 AREA 4 9/7/2001	QUAL	MTC021 SWSD 333790.95 1264888.8 MATTAWOMAN CREEK MTCSD02101 AREA 4 9/7/2001	QUAL	S39SD/SW01 SWSD 333870.82 1263146.93 39 S39SD0010001 AREA 4 10/21/1997	QUAL	S39SD02 SD 333963.51 1263193.31 39 S39SD0020001 AREA 4 10/21/1997	QUAL	S39SD03/SW02 SWSD 333965.84 1263213.02 39 S39SD0030001 AREA 4 10/21/1997	QUAL	S39SD04 SD 333971.64 1263213.68 39 S39SD0040001 AREA 4 10/21/1997	QUAL	S39SD05/SW03 SWSD 334087.73 1263535.69 39 S39SD0050001 AREA 4 10/21/1997	QUAL	S39SD06/SW04 SWSD 334080.9 1263724.64 39 S39SD0060001 AREA 4 10/21/1997	QUAL	S39SD07/SW05 SWSD 334006.71 1264038.08 39 S39SD0070001 AREA 4 10/21/1997	QUAL	S39SD08/SW06 SWSD 333872.54 1264422.12 39 S39SD0080001 AREA 4 10/21/1997	QUAL
MISCELANEOUS PARAMETERS																																				
PH (S.U.)	NA	NA	NA											6.37		7.06		6.74		6.61		7.21		6.55		6.85		6.99	
TOTAL ORGANIC CARBON (MG/KG)	NA	NA	69200	2370		45700		44000		43400		40200		1480		1070		1400		1460		9800		29200		40500		37700	
EXPLOSIVES (MG/KG)																																				
NITROCELLULOSE	NA	NA	56	2.6		226		213		80.7		4780		14.5	U	16.4	U	23.5		139		27.4		158		1460		1580	
FIELD PARAMETERS (%)																																				
PERCENT CLAY	NA	NA	27.1	0.2		17.8		19.8		1.2		6.7																								
PERCENT GRAVEL	NA	NA	0.6	44.3		0		0		3.4		1																								
PERCENT SAND	NA	NA	79.4	52.3		55.1		8.4		92.6		82.7																								
PERCENT SILT	NA	NA	65.2	3.2		27.1		71.8		2.8		9.6																								

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the level of the associated value.
The associated value is either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-25

SUMMARY OF POSITIVE DETECTIONS IN AREA 5 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential Soil[3]	Maximum Background Concentration	MTC022 SWSD 334449.65 1265916.98 MATTAWOMAN CREEK MTCSD02201 AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301 AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301-D AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301-AVG AREA 5 9/6/2001	QUAL	MTC024 SWSD 335618.15 1266001.52 MATTAWOMAN CREEK MTCSD02401 AREA 5 9/6/2001	QUAL	MTC025 SWSD 335895.61 1265973.33 MATTAWOMAN CREEK MTCSD02501 AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601 / MTCSD02601-A AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601-D / MTCSD02601-A-D AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601-AVG / MTCSD02601-A-AVG AREA 5 9/6/2001	QUAL
VOLATILE ORGANICS (UG/KG)																						
ACETONE	1000	7800000	210	140	J	100	J	150	J	125	J	150	J	18	J	42		32		37		
CARBON DISULFIDE	1.9	7800000	71	21	J	7	J	16	J	11.5	J	13	J	5	J	12	U	11	U	11.5	U
CHLOROFORM	62.9	780000	ND	26	U	19	U	12	J	12	J	34	U	11	U	12	U	11	U	11.5	U
METHYL TERT-BUTYL ETHER	NA	160000	ND	3	J	19	U	31	U	25	U	34	U	11	U	12	U	11	U	11.5	U
SEMIVOLATILE ORGANICS (UG/KG)																						
BAP EQUIVALENT	NA	NA	NA	140.14				117.18		117.18				137.1								
BENZO(A)ANTHRACENE	261	870	ND	120	J	840	U	910	U	875	U	760	U	70	J	410	U	390	U	400	U	
BENZO(A)PYRENE	430	87	ND	110	J	840	U	95	J	95	J	760	U	110	J	410	U	390	U	400	U	
BENZO(B)FLUORANTHENE	3200	870	ND	180	J	840	U	220	J	220	J	760	U	140	J	410	U	390	U	400	U	
BENZO(G,H,I)PERYLENE	670	2300000	ND	1000	U	840	U	910	U	875	U	760	U	51	J	410	U	390	U	400	U	
BENZO(K)FLUORANTHENE	240	8700	ND	1000	U	840	U	910	U	875	U	760	U	50	J	410	U	390	U	400	U	
CHRYSENE	384	87000	ND	140	J	840	U	180	J	180	J	760	U	100	J	410	U	390	U	400	U	
FLUORANTHENE	600	3100000	ND	170	J	840	U	180	J	180	J	760	U	63	J	410	U	390	U	400	U	
HIGH MOLECULAR WEIGHT PAHS	1700	NA	NA	960				855		855				759								
INDENO(1,2,3-CD)PYRENE	600	870	ND	1000	U	840	U	910	U	875	U	760	U	55	J	410	U	390	U	400	U	
N-NITROSODIPHENYLAMINE	28	130000	ND	240	J	840	U	500	J	500	J	120	J	420	U	410	U	42	J	42	J	
PYRENE	665	2300000	ND	240	J	840	U	180	J	180	J	760	U	120	J	410	U	390	U	400	U	
TOTAL PAHS	4022	NA	NA	960				855		855				759								
INORGANICS (MG/KG)																						
ALUMINUM	18000	78000	11400	9450		9860		9710		9785		7210		545		1130		993		1061.5		
ARSENIC	8.2	0.43	4.1	9.4	B	7.1	B	9.6	B	8.35	B	2.8	B	13.8		70.7	J	45.5	J	58.1	J	
BARIUM	48	5500	112	122		103		112		107.5		84.9		8.7		29.6		19.1		24.35		
BERYLLIUM	NA	160	1.3	1.2		1		1.1		1.05		0.8		0.11		0.16		0.16		0.16		
CADMIUM	1.2	78	3.5	1.7	K	1.3	K	1.4	K	1.35	K	2.3	K	0.4	K	116	J	43.8	J	79.9	J	
CALCIUM	NA	NA	1490	1970		1770		2170		1970		1400		131		248		132		190		
CHROMIUM	81	230	25	23.1		21.3		22.6		21.95		16.2		1.8	K	10.9	K	7.6	K	9.25	K	
COBALT	10	1600	19.8	15.9	K	11.3	K	13.1	K	12.2	K	9.7	K	1.4	B	3.2	K	1.6	K	2.4	K	
COPPER	34	3100	22.7	28.3		24.1		25.9		25		12.7		1.6	B	229	J	92.4	J	160.7	J	
IRON	20000	23000	27900	23300		22300		25200		23750		15400		1710		14000		9620		11810		
LEAD	46.7	400	30.7	43.6		43.5		47.2		45.35		18.7		16		3010	J	1330	J	2170	J	
MAGNESIUM	NA	NA	3590	1770		1770		1890		1830		1300		106	B	244		217		230.5		
MANGANESE	260	1600	876	691		522		684		603		401		33.9		80.2	J	46.1	J	63.15	J	
MERCURY	0.15	23	ND	0.34		0.12		0.21		0.165		0.12		0.059	U	0.06	UR	0.048	UR	0.054	UR	
NICKEL	20.9	1600	22.5	22	K	16.2	K	17.8	K	17	K	11.9	K	1.2	B	8.7	K	3.7	K	6.2	K	
POTASSIUM	NA	NA	1460	889		867		855		861		639		85.5		8.9	U	74.7		39.575		
SILVER	1	390	0.76	1.4	L	3.3	L	5.9	L	4.6	L	0.43	L	0.15	UL	0.4	L	0.12	L	0.26	L	
SODIUM	NA	NA	3760	375	B	278	B	372	B	325	B	296	B	119	B	23000	J	16200	J	19600	J	
THALLIUM	NA	5.5	ND	1.7	U	1.9	U	1.7	U	1.8	U	1.5	U	0.98	U	2.4	K	1.1	K	1.75	K	
VANADIUM	57	550	32.9	33.6	K	29.5	K	32	K	30.75	K	23	K	3.5	K	7.4	K	6.9	K	7.15	K	
ZINC	150	23000	142	183		117		128		122.5		74.2		35.3		71000	J	52800	J	61900	J	
AVS/SEM PARAMETERS (UMOL/G)																						
ACID VOLATILE SULFIDE	NA	NA	7.9	1.0		0.90		0.69		0.79		0.38		0.50		0.16		0.06		0.11		
CADMIUM-SEM	NA	NA	ND	0.01	B	0.01	B	0.01	B	0.01	B	0.007	B	0.003	B	0.68	J	0.65	J	0.67	J	
COPPER-SEM	NA	NA	2.0	0.35		0.34		0.24		0.29		1.1		0.03	B	7.7	J	6.2	J	6.9	J	
LEAD-SEM	NA	NA	0.20	0.18		0.19		0.18		0.19		0.06		0.07		6.8		10.0		8.4		
NICKEL-SEM	NA	NA	2.3	0.51	J	0.41	J	0.10	B	0.23	J	2.6	J	0.02	B	5.7	J	0.05	B	2.8	J	
ZINC-SEM	NA	NA	8.1	2.3		1.6		1.2	B	1.1		0.86	B	0.61	B	714		946		830		
TOTAL SEM[4] - AVS	NA	NA	10	2.3		1.6		-0.27		0.68		3.4		-0.43		735		963		849		

TABLE 4-25

SUMMARY OF POSITIVE DETECTIONS IN AREA 5 SEDIMENTS[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

LOCATION LOCATION TYPE NORTHING EASTING SITE SAMPLE ID AREA OF CONCERN SAMPLE DATE	Minimum Ecological Sediment Criteria[2]	Region 3 RBC Residential Soil[3]	Maximum Background Concentration	MTC022 SWSD 334449.65 1265916.98 MATTAWOMAN CREEK MTCSD02201 AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301 AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301-D AREA 5 9/6/2001	QUAL	MTC023 SWSD 335186.55 1265947.96 MATTAWOMAN CREEK MTCSD02301-AVG AREA 5 9/6/2001	QUAL	MTC024 SWSD 335618.15 1266001.52 MATTAWOMAN CREEK MTCSD02401 AREA 5 9/6/2001	QUAL	MTC025 SWSD 335895.61 1265973.33 MATTAWOMAN CREEK MTCSD02501 AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601 / MTCSD02601-A AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601-D / MTCSD02601-A-D AREA 5 9/6/2001	QUAL	MTC026 SWSD 336165.78 1266131.04 MATTAWOMAN CREEK MTCSD02601-AVG / MTCSD02601-A-AVG AREA 5 9/6/2001	QUAL
MISCELLANEOUS PARAMETERS (MG/KG)																					
TOTAL ORGANIC CARBON	NA	NA	69200	46000		38100		41600		39850		44700		1800		5040	J	2640	J	3840	J
EXPLOSIVES (MG/KG)																					
HMX	0.005	3900	0.17	0.25	U	0.25	U	0.25	U	0.25	U	0.1	J	0.25	U	0.25	UJ	0.25	U	0.25	U
NITROCELLULOSE	NA	NA	56	399		265		277		271		112		6.9		57.5	J	27.4	J	42.45	J
FIELD PARAMETERS (%)																					
PERCENT CLAY	NA	NA	27.1			13.4		12.8		13.1		20.1		5.1		0.4		2		1.2	
PERCENT GRAVEL	NA	NA	0.6			0		0		0		1.7		11.6		43.6		37.7		40.7	
PERCENT SAND	NA	NA	79.4			31.7		29.2		30.5		47.2		81.4		54.6		59.1		56.9	
PERCENT SILT	NA	NA	65.2			54.9		58		56.5		31		1.9		1.4		1.2		1.3	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 Refer to Table 4-9.
3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Minimum Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the level of the associated value.
The associated value is either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UR = The data are unusable. (Note: The analyte may or may not be present.)
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
L = The analyte is present. The reported value may be biased low.
The actual value is expected to be higher than reported.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-26

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 1 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION(1)	RANGE OF POSITIVE DETECTS(1)	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS(2)	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA(3)	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL(4)	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
VOLATILE ORGANICS (UG/KG)												
2-BUTANONE	1/11	14	IS11SD010001	14	7.4	10 - 17	ND	1	9330	0	47000000	0
ACETONE	6/11	7 - 130	MTCSD00501	54	32	8.7 - 16	210	0	1000	0	7800000	0
CARBON DISULFIDE	4/11	2 - 20	MTCSD00101	13	9	10 - 16	71	0	1.9	4	7800000	0
CHLOROMETHANE	1/11	14	IS11SD010001	14	7.4	10 - 17	ND	1	NA	0	49000	0
TOLUENE	1/11	0.8	MTCSD00301	0.8	6.4	10 - 17	ND	1	123	0	16000000	0
SEMIVOLATILE ORGANICS (UG/KG)												
ANTHRACENE	1/11	76	MTCSD00401	76	282	400 - 950	ND	1	85.3	0	23000000	0
BAP EQUIVALENT	6/11	5 - 271	MTCSD00401	86	86	NA	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	2/11	210 - 250	IS11SD020001	230	297	400 - 950	ND	2	261	0	870	0
BENZO(A)PYRENE	2/11	77 - 210	MTCSD00401	144	281	400 - 950	ND	2	430	0	87	1
BENZO(B)FLUORANTHENE	6/11	51 - 400	IS11SD020001	167	212	400 - 900	ND	6	3200	0	870	0
BENZO(G,H,I)PERYLENE	1/11	120	MTCSD00401	120	286	400 - 950	ND	1	670	0	2300000	0
BENZO(K)FLUORANTHENE	2/11	110 - 170	IS11SD020001	140	281	400 - 950	ND	2	240	0	8700	0
BIS(2-ETHYLHEXYL)PHTHALATE	2/11	67 - 150	IS11SD030001	109	165	95 - 690	ND	2	1300	0	46000	0
CHRYSENE	4/11	46 - 370	IS11SD020001	186	263	400 - 950	ND	4	384	0	87000	0
DI-N-BUTYL PHTHALATE	1/11	630	MTCSD00401	630	333	400 - 950	ND	1	1400	0	7800000	0
DIBENZO(A,H)ANTHRACENE	1/11	55	IS11SD020001	55	284	400 - 950	ND	1	63.4	0	87	0
DIETHYL PHTHALATE	1/11	99	MTCSD00401	99	284	400 - 950	ND	1	200	0	63000000	0
FLUORANTHENE	6/11	56 - 410	MTCSD00401	186	222	400 - 900	ND	6	600	0	3100000	0
HIGH MOLECULAR WEIGHT PAHS	6/11	201 - 2030	MTCSD00401	877	877	NA	NA	0	1700	2	NA	0
INDENO(1,2,3-CD)PYRENE	2/11	92 - 130	MTCSD00401	111	275	400 - 950	ND	2	600	0	870	0
LOW MOLECULAR WEIGHT PAHS	3/11	79 - 366	MTCSD00401	181	181	NA	NA	0	552	0	NA	0
PHENANTHRENE	3/11	79 - 290	MTCSD00401	156	257	400 - 950	ND	3	240	1	2300000	0
PYRENE	6/11	48 - 350	MTCSD00401	163	209	400 - 900	ND	6	665	0	2300000	0
TOTAL PAHS	6/11	201 - 2396	MTCSD00401	968	968	NA	NA	0	4022	0	NA	0
PESTICIDES/PCBS (UG/KG)												
AROCLOR-1248	1/7	170	MTCSD00401	170	55	41 - 96	ND	1	22.7	1	320	0
INORGANICS (MG/KG)												
ALUMINUM	17/17	245 - 13100	IS17SD050001	5387	5387	--	11400	3	18000	0	78000	0
ANTIMONY	7/17	1.3 - 63.9	IS11SD020001	23.2	9.9	0.4 - 1.9	ND	7	150	0	31	3
ARSENIC	16/17	1.1 - 32.7	IS17SD060001	10.7	10.1	0.69	4.1	10	8.2	6	0.43	16
BARIUM	17/17	5.5 - 169	IS11SD010001	71.0	71.0	--	112	2	48	12	5500	0
BERYLLIUM	11/17	0.061 - 1.2	MTCSD00101	0.5	0.34	0.055 - 0.22	1.3	0	NA	0	160	0
CADMIUM	15/17	0.13 - 18.7	IS17SD060001	3.1	2.8	0.1 - 0.12	3.5	5	1.2	6	78	0
CALCIUM	16/17	85 - 22100	IS11SD020001	2683	2531	198	1490	8	NA	0	NA	0
CHROMIUM	17/17	2.5 - 69.7	IS11SD040001	23.7	23.7	--	25	7	81	0	230	0
COBALT	16/17	1.5 - 20	MTCSD00101	8.6	8.2	5.1	19.8	1	10	7	1600	0
COPPER	15/17	3 - 757	IS11SD010001	195	172	0.3 - 4.7	22.7	9	34	8	3100	0
CYANIDE	2/17	0.12 - 4.7	MTCSD00201	1.3	0.52	0.14 - 2.7	ND	2	0.667	1	1600	0
IRON	17/17	6000 - 134000	IS11SD030001	36972	36972	--	27900	6	20000	9	23000	8
LEAD	17/17	1.7 - 76400	IS11SD010001	4774	4774	--	30.7	10	46.7	9	400	5
MAGNESIUM	16/17	108 - 3190	IS11SD020001	1278	1205	56.2	3590	0	NA	0	NA	0
MANGANESE	17/17	71.3 - 1120	MTCSD00401	430	430	--	876	2	260	11	1600	0
MERCURY	11/17	0.062 - 0.53	IS11SD030001	0.19	0.14	0.056 - 0.14	ND	10	0.15	5	23	0
NICKEL	16/17	1.3 - 46.4	IS11SD040001	20.0	18.9	2	22.5	6	20.9	7	1600	0
POTASSIUM	16/17	91.7 - 1270	MTCSD00101	452	426	44.8	1460	0	NA	0	NA	0
SELENIUM	1/17	1.7	IS11SD030001	1.7	0.74	0.71 - 2.2	ND	1	1	1	390	0
SILVER	10/17	0.34 - 10.9	IS11SD030001	4.6	2.9	0.099 - 0.82	0.76	8	1	8	390	0
SODIUM	3/17	372 - 604	IS17SD060001	499	225	101 - 547	3760	0	NA	0	NA	0

TABLE 4-26

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 1 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION(1)	RANGE OF POSITIVE DETECTS(1)	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS(2)	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA(3)	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL(4)	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
THALLIUM	3/17	1.5 - 4.2	IS11SD010001	2.9	1.1	0.64 - 2.7	ND	3	NA	0	5.5	0
VANADIUM	17/17	6.4 - 39	MTCSD00101	18.7	18.7	--	32.9	2	57	0	550	0
ZINC	13/17	8.8 - 1910	IS11SD040001	541	415	3.5 - 22	142	7	150	7	23000	0
AVS/SEM PARAMETERS (UMO/G)												
ACID VOLATILE SULFIDE	5/7	0.010 - 0.53	MTCSD00101	0.26	0.19	0.006 - 0.012	7.9	0	NA	0	NA	0
CADMIUM-SEM	1/7	0.004	MTCSD00401	0.004	0.002	0.0004 - 0.004	ND	1	NA	0	NA	0
COPPER-SEM	6/7	0.09 - 2.6	MTCSD00401	0.58	0.50	0.02	2.0	1	NA	0	NA	0
LEAD-SEM	6/7	0.01 - 0.16	MTCSD00101	0.10	0.08	0.003	0.22	0	NA	0	NA	0
NICKEL-SEM	4/7	0.15 - 5.9	MTCSD00401	1.8	1.0	0.04 - 0.13	2.3	1	NA	0	NA	0
TOTAL SEM(5)-AVS	6/6	0.42 - 9.8	MTCSD00401	2.5	2.5	--	10.0	0	NA	0	NA	0
ZINC-SEM	5/7	0.57 - 1.5	MTCSD00101	1.1	0.77	0.04 - 0.06	8.1	0	NA	0	NA	0
MISCELLANEOUS PARAMETERS												
DIESEL RANGE ORGANICS (MG/KG)	3/4	13 - 26	IS11SD030001	18	14.0	4.1	NA	0	NA	0	NA	0
PERCENT MOISTURE (%)	10/10	19 - 39.6	IS17SD060001	24.6	24.6	--	NA	0	NA	0	NA	0
PERCENT SOLIDS (%)	6/6	60.2 - 81	IS17SD040001	73.5	73.5	--	NA	0	NA	0	NA	0
PH (S.U.)	6/6	5.4 - 7.5	IS17SD060001	6.6	6.6	--	NA	0	NA	0	NA	0
TOTAL ORGANIC CARBON (MG/KG)	10/13	550 - 69900	MTCSD00501	25572	19685	123 - 133	69200	1	NA	0	NA	0
FIELD (%)												
PERCENT CLAY	4/4	4 - 19.8	MTCSD00201-D	10.4	10.4	--	27.1	0	NA	0	NA	0
PERCENT GRAVEL	4/4	0 - 12	MTCSD00301	3.6	3.6	--	0.6	2	NA	0	NA	0
PERCENT SAND	4/4	34.2 - 79.4	MTCSD00401	59.9	59.9	--	79.4	0	NA	0	NA	0
PERCENT SILT	4/4	14.2 - 54.5	MTCSD00201	26.1	26.1	--	65.2	0	NA	0	NA	0
EXPLOSIVES (MG/KG)												
1,3,5-TRINITROBENZENE	1/17	0.094	IS17SD020001	0.09	0.12	0.25	ND	1	0.002	1	2300	0
1,3-DINITROBENZENE	1/17	0.069	IS17SD020001	0.07	0.12	0.25	ND	1	0.007	1	7.8	0
2,4,6-TRINITROTOLUENE	2/17	0.066 - 0.1	IS17SD020001	0.08	0.12	0.25	ND	2	0.09	1	21	0
2,6-DINITROTOLUENE	1/17	0.1	IS17SD030001	0.1	0.12	0.25	ND	1	0.294	0	78	0
2-AMINO-4,6-DINITROTOLUENE	1/17	0.22	IS17SD050001	0.22	0.13	0.25	ND	1	NA	0	4.7	0
3-NITROTOLUENE	2/17	0.18 - 0.22	IS17SD020001	0.2	0.13	0.25	ND	2	NA	0	1600	0
4-NITROTOLUENE	1/17	0.14	IS11SD040001	0.14	0.12	0.16 - 0.25	ND	1	NA	0	780	0
NITROCELLULOSE	3/7	2 - 3.6	MTCSD00401	2.7	1.5	0.52 - 1.8	56	0	NA	0	NA	0

ASSOCIATED SAMPLES
IS11SD010001
IS11SD020001
IS11SD030001
IS11SD040001
IS17SD010001
IS17SD020001
IS17SD030001
IS17SD040001
IS17SD050001
IS17SD060001
MTCSD00101
MTCSD00201
MTCSD00201-AVG
MTCSD00201-D
MTCSD00301
MTCSD00401
MTCSD00501
MTCSD02901
MTCSD03001

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-9.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
5 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of the associated criteria.

TABLE 4-27

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 2 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
VOLATILE ORGANICS (UG/KG)												
ACETONE	6/7	13 - 170	MTCSD01101	111	96	11 - 12	210	0	1000	0	7800000	0
CARBON DISULFIDE	7/7	2 - 45	MTCSD00901	26	26	--	71	0	1.9	7	7800000	0
TOLUENE	1/7	3	MTCSD00801	3	9	10 - 33	ND	1	123	0	16000000	0
SEMIVOLATILE ORGANICS (UG/KG)												
4-METHYLPHENOL	1/7	80	MTCSD01201-D	80	522	460 - 1600	ND	1	670	0	390000	0
ACENAPHTHYLENE	1/7	52 - 340	MTCSD01201-D	196	539	550 - 1600	ND	1	44	1	4700000	0
ANTHRACENE	1/7	69 - 540	MTCSD01201-D	305	554	550 - 1600	ND	1	85.3	1	23000000	0
BAP EQUIVALENT	3/7	14 - 2509	MTCSD01201-D	520	520	NA	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	2/7	76 - 1700	MTCSD01201-D	536	624	1100 - 1600	ND	2	261	1	870	1
BENZO(A)PYRENE	2/7	78 - 1800	MTCSD01201-D	567	633	1100 - 1600	ND	2	430	1	87	1
BENZO(B)FLUORANTHENE	3/7	92 - 2000	MTCSD01201-D	467	593	1100 - 1600	ND	3	3200	0	870	1
BENZO(G,H,I)PERYLENE	1/7	170 - 1100	MTCSD01201-D	635	601	550 - 1600	ND	1	670	0	2300000	0
BENZO(K)FLUORANTHENE	1/7	130 - 730	MTCSD01201-D	430	572	550 - 1600	ND	1	240	1	8700	0
CARBAZOLE	1/7	110	MTCSD01201-D	110	526	460 - 1600	ND	1	NA	0	32000	0
CHRYSENE	2/7	77 - 1700	MTCSD01201-D	539	625	1100 - 1600	ND	2	384	1	87000	0
DIBENZO(A,H)ANTHRACENE	1/7	220	MTCSD01201-D	220	542	460 - 1600	ND	1	63.4	1	87	1
DIBENZOFURAN	1/7	80	MTCSD01201-D	80	522	460 - 1600	ND	1	540	0	310000	0
DIETHYL PHTHALATE	1/7	65	MTCSD01201-D	65	520	460 - 1600	ND	1	200	0	63000000	0
FLUORANTHENE	3/7	130 - 4000	MTCSD01201-D	843	754	1100 - 1600	ND	3	600	1	3100000	0
FLUORENE	1/7	180	MTCSD01201-D	180	536	460 - 1600	ND	1	19	1	3100000	0
HIGH MOLECULAR WEIGHT PAHS	3/7	410 - 18350	MTCSD01201-D	3858	3858	NA	NA	0	1700	1	NA	0
INDENO(1,2,3-CD)PYRENE	1/7	180 - 1100	MTCSD01201-D	640	602	550 - 1600	ND	1	600	1	870	0
LOW MOLECULAR WEIGHT PAHS	2/7	77 - 3660	MTCSD01201-D	1031	1031	NA	NA	0	552	1	NA	0
PHENANTHRENE	2/7	77 - 2600	MTCSD01201-D	736	682	1100 - 1600	ND	2	240	1	2300000	0
PYRENE	3/7	120 - 4000	MTCSD01201-D	848	756	1100 - 1600	ND	3	665	1	2300000	0
TOTAL PAHS	3/7	410 - 22010	MTCSD01201-D	4545	4545	NA	NA	0	4022	1	NA	0
INORGANICS (MG/KG)												
ALUMINUM	7/7	2790 - 13400	MTCSD00901	8929	8929	--	11400	2	18000	0	78000	0
ARSENIC	7/7	1.9 - 14.6	MTCSD01001	6.4	6.4	--	4.1	6	8.2	1	0.43	7
BARIUM	7/7	24.5 - 152	MTCSD00901	106	106	--	112	5	48	5	5500	0
BERYLLIUM	7/7	0.29 - 1.4	MTCSD00901	1.0	1.0	--	1.3	1	NA	0	160	0
CADMIUM	7/7	0.074 - 4.1	MTCSD00901	2.0	2.0	--	3.5	1	1.2	3	78	0
CALCIUM	7/7	378 - 3250	MTCSD00801	1994	1994	--	1490	5	NA	0	NA	0
CHROMIUM	7/7	7 - 31.6	MTCSD00901	22.3	22.3	--	25	4	81	0	230	0
COBALT	7/7	5.5 - 22.6	MTCSD01001	15.9	15.9	--	19.8	2	10	5	1600	0
COPPER	7/7	4.4 - 36.3	MTCSD00901	23.6	23.6	--	22.7	5	34	1	3100	0
CYANIDE	1/7	3.8	MTCSD01201-D	2.0	0.47	0.19 - 0.63	ND	1	0.667	1	1600	0
IRON	7/7	7470 - 32800	MTCSD00901	23296	23296	--	27900	2	20000	5	23000	5
LEAD	7/7	10.3 - 54.2	MTCSD01001	36.2	36.2	--	30.7	5	46.7	3	400	0
MAGNESIUM	7/7	498 - 2850	MTCSD00901	1904	1904	--	3590	0	NA	0	NA	0
MANGANESE	7/7	123 - 1030	MTCSD01101	582	582	--	876	2	260	5	1600	0
MERCURY	4/7	0.22 - 0.54	MTCSD01001	0.31	0.20	0.071 - 0.17	ND	4	0.15	4	23	0
NICKEL	7/7	4.2 - 30.6	MTCSD00901	20.9	20.9	--	22.5	5	20.9	5	1600	0
POTASSIUM	7/7	263 - 1530	MTCSD00901	974	974	--	1460	1	NA	0	NA	0
SILVER	6/7	0.24 - 1.4	MTCSD00901	1.0	0.90	0.15 - 0.16	0.76	4	1	4	390	0
THALLIUM	2/7	2.2 - 2.9	MTCSD01101	2.6	1.5	0.95 - 3.6	ND	2	NA	0	5.5	0
VANADIUM	7/7	9.3 - 43.5	MTCSD00901	31.0	31.0	--	32.9	5	57	0	550	0
ZINC	6/7	43 - 148	MTCSD00801	102	90.6	19.2 - 39.3	142	3	150	0	23000	0

TABLE 4-27

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 2 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
AVS/SEM PARAMETERS (UMO/G)												
ACID VOLATILE SULFIDE	6/7	0.30 - 2.2	MTCSD00901	1.0	0.86	0.02 - 0.16	7.9	0	NA	0	NA	0
CADMIUM-SEM	2/7	0.0078 - 0.0082	MTCSD01001	0.008	0.004	0.0004 - 0.007	ND	2	NA	0	NA	0
COPPER-SEM	7/7	0.32 - 5.3	MTCSD01201-D	1.6	1.6	0.05	2.0	3	NA	0	NA	0
LEAD-SEM	7/7	0.04 - 0.23	MTCSD01001	0.14	0.14	--	0.22	1	NA	0	NA	0
NICKEL-SEM	7/7	0.30 - 12.9	MTCSD01001	3.5	3.5	0.03	2.3	2	NA	0	NA	0
TOTAL SEM[5]-AVS	7/7	0.36 - 20.1	MTCSD01001	6.1	6.1	--	10.0	1	NA	0	NA	0
ZINC-SEM	7/7	0.32 - 2.6	MTCSD01001	1.7	1.7	--	8.1	0	NA	0	NA	0
MISCELLANEOUS PARAMETERS (MG/KG)												
TOTAL ORGANIC CARBON	7/7	5350 - 74200	MTCSD00801	35386	35386	--	69200	1	NA	0	NA	0
FIELD (%)												
PERCENT CLAY	4/4	1.6 - 26.7	MTCSD01101	12.9	12.9	--	27.1	0	NA	0	NA	0
PERCENT GRAVEL	3/4	2.2 - 3.5	MTCSD01201	0.71	0.71	--	0.6	0	NA	0	NA	0
PERCENT SAND	4/4	4 - 88.4	MTCSD01201	29.9	29.9	--	79.4	0	NA	0	NA	0
PERCENT SILT	4/4	5.9 - 78	MTCSD00901	56.5	56.5	--	65.2	3	NA	0	NA	0
EXPLOSIVES (MG/KG)												
NITROCELLULOSE	7/7	2 - 9.2	MTCSD01101	4.3	4.3	1.6	56	0	NA	0	NA	0

ASSOCIATED SAMPLES
MTCSD00601
MTCSD00701
MTCSD00801
MTCSD00901
MTCSD01001
MTCSD01101
MTCSD01201
MTCSD01201-AVG
MTCSD01201-D

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-9.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
5 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or the associated criteria.

TABLE 4-28

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 3 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
VOLATILE ORGANICS (UG/KG)												
ACETONE	4/4	13 - 170	MTCSD01401	84	84	--	210	0	1000	0	7800000	0
CARBON DISULFIDE	4/4	3 - 20	MTCSD01601	13	13	--	71	0	1.9	4	7800000	0
CHLOROFORM	1/4	10	MTCSD01501	10	13	10 - 50	ND	1	62.9	0	780000	0
TOLUENE	1/4	3	MTCSD01501	3	11	10 - 50	ND	1	123	0	16000000	0
SEMIVOLATILE ORGANICS (UG/KG)												
BAP EQUIVALENT	2/4	15 - 118	MTCSD01501	67	67	--	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	1/4	100	MTCSD01501	100	391	530 - 1200	ND	1	261	0	870	0
BENZO(A)PYRENE	1/4	96	MTCSD01501	96	390	530 - 1200	ND	1	430	0	87	1
BENZO(B)FLUORANTHENE	2/4	120 - 150	MTCSD01401	135	284	530 - 1200	ND	2	3200	0	870	0
CHRYSENE	1/4	120	MTCSD01501	120	396	530 - 1200	ND	1	384	0	87000	0
DIETHYL PHTHALATE	1/4	840	MTCSD01501	840	576	530 - 1200	ND	1	200	1	63000000	0
FLUORANTHENE	2/4	110 - 160	MTCSD01401	135	284	530 - 1200	ND	2	600	0	3100000	0
HIGH MOLECULAR WEIGHT PAHS	3/4	130 - 676	MTCSD01501	429	429	--	NA	0	1700	0	NA	0
PYRENE	3/4	130 - 170	MTCSD01401	143	174	530	ND	3	665	0	2300000	0
TOTAL PAHS	3/4	130 - 676	MTCSD01501	429	429	--	NA	0	4022	0	NA	0
INORGANICS (MG/KG)												
ALUMINUM	4/4	3290 - 12400	MTCSD01601	7920	7920	--	11400	1	18000	0	78000	0
ARSENIC	1/4	9.6	MTCSD01301	9.6	4.3	1.7 - 7.5	4.1	1	8.2	1	0.43	1
BARIUM	4/4	41.3 - 154	MTCSD01601	105	105	--	112	2	48	3	5500	0
BERYLLIUM	4/4	0.43 - 1.5	MTCSD01601	1.0	1.0	--	1.3	1	NA	0	160	0
CADMIUM	3/4	0.93 - 1.5	MTCSD01601	1.3	1.0	0.15	3.5	0	1.2	2	78	0
CALCIUM	4/4	637 - 2200	MTCSD01601	1529	1529	--	1490	2	NA	0	NA	0
CHROMIUM	4/4	10.1 - 29	MTCSD01601	20.3	20.3	--	25	1	81	0	230	0
COBALT	4/4	5.5 - 21.7	MTCSD01601	13.0	13.0	--	19.8	1	10	2	1600	0
COPPER	4/4	9.9 - 37.1	MTCSD01601	22.7	22.7	--	22.7	2	34	1	3100	0
IRON	4/4	9190 - 31500	MTCSD01601	23498	23498	--	27900	1	20000	3	23000	3
LEAD	4/4	13.4 - 45.8	MTCSD01601	29	29	--	30.7	2	46.7	0	400	0
MAGNESIUM	4/4	656 - 2400	MTCSD01601	1579	1579	--	3590	0	NA	0	NA	0
MANGANESE	4/4	144 - 851	MTCSD01601	474	474	--	876	0	260	2	1600	0
MERCURY	2/4	0.22 - 0.24	MTCSD01401	0.23	0.13	0.076 - 0.082	ND	2	0.15	2	23	0
NICKEL	4/4	7.4 - 28.4	MTCSD01601	16.9	16.9	--	22.5	2	20.9	2	1600	0
POTASSIUM	4/4	355 - 1270	MTCSD01601	806	806	--	1460	0	NA	0	NA	0
SILVER	3/4	2 - 4.8	MTCSD01501	3.2	2.4	0.14	0.76	3	1	3	390	0
VANADIUM	4/4	12 - 40.3	MTCSD01601	30.5	30.5	--	32.9	3	57	0	550	0
ZINC	3/4	36.5 - 204	MTCSD01601	100	93.7	149	142	1	150	1	23000	0
AVS/SEM PARAMETERS (UMO/G)												
ACID VOLATILE SULFIDE	4/4	0.02 - 5.3	MTCSD01601	1.4	1.4	--	7.9	0	NA	0	NA	0
COPPER-SEM	4/4	0.09 - 1.1	MTCSD01401	0.42	0.42	--	2.0	0	NA	0	NA	0
LEAD-SEM	4/4	0.05 - 0.17	MTCSD01601	0.11	0.11	--	0.22	0	NA	0	NA	0
NICKEL-SEM	2/4	0.27 - 2.4	MTCSD01401	1.3	0.68	0.048 - 0.051	2.3	1	NA	0	NA	0
TOTAL SEM[5]-AVS	4/4	-7.3	MTCSD01401	0.86	0.86	--	10.0	0	NA	0	NA	0
ZINC-SEM	2/4	1.8 - 2.5	MTCSD01601	2.2	1.2	0.30 - 0.74	8.1	0	NA	0	NA	0
MISCELLANEOUS PARAMETERS (MG/KG)												
TOTAL ORGANIC CARBON	4/4	4310 - 42400	MTCSD01601	22753	22753	--	69200	0	NA	0	NA	0
FIELD (%)												
PERCENT CLAY	4/4	6 - 35.6	MTCSD01401	21.6	21.6	--	27.1	2	NA	0	NA	0
PERCENT GRAVEL	4/4	0 - 4.8	MTCSD01301	2.0	2.0	--	0.6	2	NA	0	NA	0
PERCENT SAND	4/4	18 - 81.9	MTCSD01501	40.0	40.0	--	79.4	1	NA	0	NA	0
PERCENT SILT	4/4	9.1 - 60.4	MTCSD01601	36.5	36.5	--	65.2	0	NA	0	NA	0
EXPLOSIVES (MG/KG)												
NITROCELLULOSE	4/4	4.2 - 122	MTCSD01601	53.8	53.8	--	56	2	NA	0	NA	0

TABLE 4-28

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 3 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION(1)	RANGE OF POSITIVE DETECTS(1)	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS(2)	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA(3)	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL(4)	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL

ASSOCIATED SAMPLES
MTCSD01301
MTCSD01401
MTCSD01501
MTCSD01601

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-9.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
5 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Shaded cells indicate an exceedance of the associated criteria.

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
RBC = Risk Based Concentration

TABLE 4-29

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 4 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCNETRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
VOLATILE ORGANICS (UG/KG)												
2-BUTANONE	2/13	200 - 390	S39SD0070001	295	52	10 - 27	ND	2	9330	0	47000000	0
ACETONE	5/13	19 - 2400	S39SD0070001	733	292	10 - 160	210	2	1000	2	7800000	0
CARBON DISULFIDE	7/13	3 - 23	S39SD0070001	11	9	10 - 13	71	0	1.9	7	7800000	0
CIS-1,2-DICHLOROETHENE	1/5	2	MTCSD02101	2	8	10 - 27	ND	1	1030	0	780000	0
DIETHYL ETHER	2/5	6 - 57	MTCSD02101	32	19	10 - 27	ND	2	NA	0	16000000	0
TOLUENE	1/13	4	MTCSD01901	4	8	10 - 31	ND	1	123	0	16000000	0
TRICHLOROETHENE	1/13	5	MTCSD02101	5	9	10 - 31	ND	1	450	0	1600	0
SEMIVOLATILE ORGANICS (UG/KG)												
2-METHYLNAPHTHALENE	2/13	48 - 85	MTCSD02101	67	298	390 - 1300	ND	2	70	1	1600000	0
ACENAPHTHENE	2/13	50 - 120	MTCSD02101	85	300	390 - 1300	ND	2	16	2	4700000	0
ACENAPHTHYLENE	1/13	83	MTCSD02101	83	311	390 - 1300	ND	1	44	1	4700000	0
ANTHRACENE	2/13	160 - 480	MTCSD02101	320	337	390 - 1300	ND	2	85.3	2	23000000	0
BAP EQUIVALENT	7/13	11 - 1476	MTCSD02101	391	391	--	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	4/13	95 - 1400	MTCSD02101	591	422	390 - 1300	ND	4	261	2	870	1
BENZO(A)PYRENE	3/13	150 - 1000	MTCSD02101	617	414	390 - 1300	ND	3	430	2	87	3
BENZO(B)FLUORANTHENE	7/13	110 - 1500	MTCSD02101	484	392	390 - 1300	ND	7	3200	0	870	2
BENZO(G,H,I)PERYLENE	3/13	71 - 330	MTCSD02101	224	323	390 - 1300	ND	3	670	0	2300000	0
BENZO(K)FLUORANTHENE	3/13	83 - 1500	MTCSD02101	644	420	390 - 1300	ND	3	240	2	8700	0
BIS(2-ETHYLHEXYL)PHTHALATE	4/13	48 - 410	S39SD0040001	158	166	79 - 1000	ND	4	1300	0	46000	0
CARBAZOLE	2/13	96 - 140	MTCSD02101	118	305	390 - 1300	ND	2	NA	0	32000	0
CHRYSENE	7/13	100 - 1400	MTCSD02101	420	357	390 - 1300	ND	7	384	2	87000	0
DI-N-BUTYL PHTHALATE	3/13	470 - 640	S39SD0080001	577	365	390 - 1300	ND	3	1400	0	7800000	0
DIBENZO(A,H)ANTHRACENE	2/13	83 - 130	MTCSD02101	107	304	390 - 1300	ND	2	63.4	2	87	1
DIBENZOFURAN	1/13	94	MTCSD02101	94	311	390 - 1300	ND	1	540	0	310000	0
FLUORANTHENE	7/13	97 - 2600	MTCSD02101	647	479	390 - 1300	ND	7	600	2	3100000	0
FLUORENE	2/13	64 - 200	MTCSD02101	132	308	390 - 1300	ND	2	19	2	3100000	0
HIGH MOLECULAR WEIGHT PAHS	7/13	437 - 12560	MTCSD02101	3262	3262	--	NA	0	1700	2	NA	0
INDENO(1,2,3-CD)PYRENE	3/13	77 - 400	MTCSD02101	256	331	390 - 1300	ND	3	600	0	870	0
LOW MOLECULAR WEIGHT PAHS	5/13	77 - 2539	MTCSD02101	772	772	--	NA	0	552	2	NA	0
N-NITROSODIPHENYLAMINE	6/13	140 - 4800	MTCSD02101	1748	954	390 - 1300	ND	6	28	6	130000	0
NAPHTHALENE	2/13	50 - 71	MTCSD02101	61	297	390 - 1300	ND	2	160	0	1600000	0
PHENANTHRENE	5/13	77 - 1500	MTCSD02101	489	381	390 - 1300	ND	5	240	2	2300000	0
PYRENE	7/13	110 - 2300	MTCSD02101	597	453	390 - 1300	ND	7	665	2	2300000	0
TOTAL PAHS	7/13	514 - 15099	MTCSD02101	3813	3813	--	NA	0	4022	2	NA	0
PESTICIDES/PCBS (UG/KG)												
4,4'-DDD	2/13	6 - 7.7	S39SD0070001	6.9	3.7	3.9 - 13	ND	2	16	0	2700	0
4,4'-DDE	2/13	4.1 - 6	S39SD0070001	5.1	3.4	3.9 - 13	ND	2	2.2	2	1900	0
ALPHA-BHC	1/13	0.7	S39SD0030001	0.70	1.7	1.9 - 6.7	ND	1	NA	0	100	0
INORGANICS (MG/KG)												
ALUMINUM	13/13	834 - 19600	S39SD0070001	5765	5765	--	11400	3	18000	1	78000	0
ANTIMONY	1/13	0.69	S39SD0040001	0.69	0.53	0.41 - 2.4	ND	1	150	0	31	0
ARSENIC	10/13	1.6 - 16.6	S39SD0070001	7.8	6.6	0.97 - 10.3	4.1	5	8.2	4	0.43	10
BARIUM	13/13	7.6 - 163	MTCSD01901	62.4	62.4	--	112	3	48	6	5500	0
BERYLLIUM	13/13	0.17 - 1.6	MTCSD01901	0.60	0.60	--	1.3	1	NA	0	160	0
CADMIUM	8/13	0.21 - 1.7	MTCSD01901	0.86	0.59	0.07 - 0.8	3.5	0	1.2	2	78	0
CALCIUM	12/13	123 - 4730	S39SD0080001	1479	1371	151	1490	5	NA	0	NA	0
CHROMIUM	13/13	5.4 - 32.3	S39SD0070001	16.2	16.2	--	25	3	81	0	230	0
COBALT	13/13	2 - 34.7	S39SD0020001	13.9	13.9	--	19.8	3	10	9	1600	0
COPPER	13/13	3.8 - 120	MTCSD02101	25.8	25.8	--	22.7	6	34	3	3100	0

TABLE 4-29

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 4 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCNETRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
CYANIDE	1/13	0.18	MTCSD02001	0.18	0.17	0.15 - 0.72	ND	1	0.667	0	1600	0
IRON	13/13	3840 - 43800	S39SD0070001	17928	17928	--	27900	2	20000	6	23000	4
LEAD	13/13	6.7 - 87.9	S39SD0030001	35.5	35.5	--	30.7	6	46.7	4	400	0
MAGNESIUM	12/13	148 - 2540	MTCSD01901	1371	1269	104	3590	0	NA	0	NA	0
MANGANESE	13/13	28.2 - 1470	MTCSD01901	354	354	--	876	2	260	6	1600	0
MERCURY	12/13	0.02 - 8.7	S39SD0070001	1.1	0.98	0.05	ND	12	0.15	6	23	0
NICKEL	13/13	3.1 - 39.8	S39SD0030001	17.8	17.8	--	22.5	4	20.9	5	1600	0
POTASSIUM	13/13	91.6 - 1360	MTCSD01901	521	521	--	1460	0	NA	0	NA	0
SILVER	10/13	0.27 - 308	S39SD0040001	41.7	32.1	0.1 - 0.2	0.76	9	1	9	390	0
THALLIUM	3/13	1.3 - 2.7	MTCSD01901	2.0	0.86	0.67 - 2.1	ND	3	NA	0	5.5	0
VANADIUM	13/13	6.2 - 53.4	MTCSD02101	23.0	23.0	--	32.9	4	57	0	550	0
ZINC	13/13	13.3 - 273	S39SD0070001	113	113	--	142	6	150	6	23000	0
AVS/SEM PARAMETERS (UMO/G)												
ACID VOLATILE SULFIDE	11/13	0.02 - 39.3	S39SD0080001	5.7	4.8	0.006 - 0.01	7.9	2	NA	0	NA	0
CADMIUM-SEM	2/13	0.004 - 0.006	S39SD0080001	0.005	0.003	0.001 - 0.02	ND	2	NA	0	NA	0
COPPER-SEM	12/13	0.02 - 1.6	MTCSD02101	0.38	0.35	0.03	2.0	0	NA	0	NA	0
LEAD-SEM	13/13	0.02 - 0.29	S39SD0070001	0.15	0.15	--	0.22	4	NA	0	NA	0
NICKEL-SEM	8/13	0.03 - 3.6	MTCSD02101	0.81	0.51	0.02 - 0.21	2.3	1	NA	0	NA	0
TOTAL SEM[5]-AVS	13/13	-44.7	MTCSD02101	-2.6	-2.6	--	10.0	0	NA	0	NA	0
ZINC-SEM	12/13	0.11 - 3.4	S39SD0070001	1.4	1.3	0.37	8.1	0	NA	0	NA	0
MISCELLANEOUS PARAMETERS												
PH (S.U.)	8/8	6.37 - 7.21	S39SD0050001	6.8	6.8	--	NA	0	NA	0	NA	0
TOTAL ORGANIC CARBON (MG/KG)	13/13	1070 - 45700	MTCSD01801	22945	22945	--	69200	0	NA	0	NA	0
FIELD (%)												
PERCENT CLAY	5/5	0.2 - 19.8	MTCSD01901	9.1	9.1	--	27.1	0	NA	0	NA	0
PERCENT GRAVEL	5/5	0 - 44.3	MTCSD01701	9.7	9.7	--	0.6	3	NA	0	NA	0
PERCENT SAND	5/5	8.4 - 92.6	MTCSD02001	58.2	58.2	--	79.4	2	NA	0	NA	0
PERCENT SILT	5/5	2.8 - 71.8	MTCSD01901	22.9	22.9	--	65.2	1	NA	0	NA	0
EXPLOSIVES (MG/KG)												
NITROCELLULOSE	11/13	2.6 - 4780	MTCSD02101	790	670	14.5 - 16.4	56	8	NA	0	NA	0

ASSOCIATED SAMPLES
MTCSD01701
MTCSD01801
MTCSD01901
MTCSD02001
MTCSD02101
S39SD0010001
S39SD0020001
S39SD0030001
S39SD0040001
S39SD0050001
S39SD0060001
S39SD0070001
S39SD0080001

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-9.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
5 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of the associated criteria.

TABLE 4-30

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 5 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF BACKGROUND MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
VOLATILE ORGANICS (UG/KG)												
ACETONE	5/5	18 - 150	MTCSD02301-D, MTCSD02401	94	94	--	210	0	1000	0	7800000	0
CARBON DISULFIDE	4/5	5 - 21	MTCSD02201	13	11	11 - 12	71	0	1.9	4	7800000	0
CHLOROFORM	1/5	12	MTCSD02301-D	12	11	11 - 34	ND	1	62.9	0	780000	0
METHYL TERT-BUTYL ETHER	1/5	3	MTCSD02201	3	9	11 - 34	ND	1	NA	0	160000	0
SEMIVOLATILE ORGANICS (UG/KG)												
BAP EQUIVALENT	3/5	117.18 - 140.14	MTCSD02201	131	131	--	NA	0	NA	0	NA	0
BENZO(A)ANTHRACENE	2/5	70 - 120	MTCSD02201	95	242	390 - 910	ND	2	261	0	870	0
BENZO(A)PYRENE	3/5	95 - 110	MTCSD02201, MTCSD02501	105	179	390 - 840	ND	3	430	0	87	3
BENZO(B)FLUORANTHENE	3/5	140 - 220	MTCSD02301-D	180	224	390 - 840	ND	3	3200	0	870	0
BENZO(G,H,I)PERYLENE	1/5	51	MTCSD02501	51	314	390 - 1000	ND	1	670	0	2300000	0
BENZO(K)FLUORANTHENE	1/5	50	MTCSD02501	50	314	390 - 1000	ND	1	240	0	8700	0
CHRYSENE	3/5	100 - 180	MTCSD02301-D	140	200	390 - 840	ND	3	384	0	87000	0
FLUORANTHENE	3/5	63 - 180	MTCSD02301-D	138	199	390 - 840	ND	3	600	0	3100000	0
HIGH MOLECULAR WEIGHT PAHS	3/5	759 - 960	MTCSD02201	858	858	--	NA	0	1700	0	NA	0
INDENO(1,2,3-CD)PYRENE	1/5	55	MTCSD02501	55	315	390 - 1000	ND	1	600	0	870	0
N-NITROSODIPHENYLAMINE	4/5	42 - 500	MTCSD02301-D	226	222	410 - 840	ND	4	28	4	130000	0
PYRENE	3/5	120 - 240	MTCSD02201	180	224	390 - 840	ND	3	665	0	2300000	0
TOTAL PAHS	3/5	759 - 960	MTCSD02201	858	858	--	NA	0	4022	0	NA	0
INORGANICS (MG/KG)												
ALUMINUM	5/5	545 - 9860	MTCSD02301	5610	5610	--	11400	0	18000	0	78000	0
ARSENIC	2/5	13.8 - 70.7	MTCSD02601	36.0	16.4	2.8 - 9.6	4.1	2	8.2	2	0.43	2
BARIUM	5/5	8.7 - 122	MTCSD02201	69.5	69.5	--	112	1	48	3	5500	0
BERYLLIUM	5/5	0.11 - 1.2	MTCSD02201	0.66	0.66	--	1.3	0	NA	0	160	0
CADMIUM	5/5	0.4 - 116	MTCSD02601	17.1	17.1	--	3.5	1	1.2	4	78	1
CALCIUM	5/5	131 - 2170	MTCSD02301-D	1132	1132	--	1490	2	NA	0	NA	0
CHROMIUM	5/5	1.8 - 23.1	MTCSD02201	14.5	14.5	--	25	0	81	0	230	0
COBALT	4/5	1.6 - 15.9	MTCSD02201	10.1	8.2	1.4	19.8	0	10	2	1600	0
COPPER	4/5	12.7 - 229	MTCSD02601	56.7	45.5	1.6	22.7	3	34	1	3100	0
IRON	5/5	1710 - 25200	MTCSD02301-D	15194	15194	--	27900	0	20000	2	23000	2
LEAD	5/5	16 - 3010	MTCSD02601	459	459	--	30.7	3	46.7	1	400	1
MAGNESIUM	4/5	217 - 1890	MTCSD02301-D	1283	1037	106	3590	0	NA	0	NA	0
MANGANESE	5/5	33.9 - 691	MTCSD02201	358	358	--	876	0	260	3	1600	0
MERCURY	3/4	0.12 - 0.34	MTCSD02201	0.21	0.16	0.059	ND	3	0.15	2	23	0
NICKEL	4/5	3.7 - 22	MTCSD02201	14.3	11.5	1.2	22.5	0	20.9	1	1600	0
POTASSIUM	5/5	74.7 - 889	MTCSD02201	503	503	8.9	1460	0	NA	0	NA	0
SILVER	4/5	0.12 - 5.9	MTCSD02301-D	1.7	1.4	0.15	0.76	2	1	2	390	0
SODIUM	1/5	16200 - 23000	MTCSD02601	19600	4032	119 - 375	3760	1	NA	0	NA	0
THALLIUM	1/5	1.1 - 2.4	MTCSD02601	1.8	0.95	0.98 - 1.9	ND	1	NA	0	5.5	0
VANADIUM	5/5	3.5 - 33.6	MTCSD02201	19.6	19.6	--	32.9	1	57	0	550	0
ZINC	5/5	35.3 - 71000	MTCSD02601	12463	12463	--	142	2	150	2	23000	1
AVS/SEM PARAMETERS (UMO/G)												
ACID VOLATILE SULFIDE	5/5	0.06 - 1.0	MTCSD02201	0.56	0.56	--	7.9	0	NA	0	NA	0
CADMIUM-SEM	1/5	0.65 - 0.68	MTCSD02601	0.67	0.14	0.003 - 0.01	ND	1	NA	0	NA	0
COPPER-SEM	4/5	0.24 - 7.7	MTCSD02601	2.2	1.7	0.03	2.0	1	NA	0	NA	0
LEAD-SEM	5/5	0.06 - 10.0	MTCSD02601-D	1.8	1.8	--	0.22	1	NA	0	NA	0
NICKEL-SEM	4/5	0.41 - 5.7	MTCSD02601	1.6	1.2	0.02 - 0.10	2.3	1	NA	0	NA	0
TOTAL SEM[5]-AVS	5/5	-963.43	MTCSD02601-D	171	171	--	10.0	1	NA	0	NA	0
ZINC-SEM	3/5	1.6 - 946	MTCSD02601-D	278	167	0.61 - 1.2	8.1	1	NA	0	NA	0

TABLE 4-30

SUMMARY OF DESCRIPTIVE STATISTICS-AREA 5 SEDIMENTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF BACKGROUND MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	MINIMUM ECOLOGICAL SEDIMENT CRITERIA[3]	NUMBER OF EXCEEDANCES OF COMBINED ECOLOGICAL SEDIMENT CRITERIA	REGION 3 RBC FOR RESIDENTIAL SOIL[4]	NUMBER OF EXCEEDANCES OF REGION 3 RBC FOR RESIDENTIAL SOIL
MISCELLANEOUS PARAMETERS (MG/KG)												
TOTAL ORGANIC CARBON	5/5	1800 - 46000	MTCSD02201	27238	27238	--	69200	0	NA	0	NA	0
FIELD (%)												
PERCENT CLAY	4/4	0.4 - 20.1	MTCSD02401	9.9	9.9	--	27.1	0	NA	0	NA	0
PERCENT GRAVEL	3/4	1.7 - 43.6	MTCSD02601	13.5	13.5	--	0.6	1	NA	0	NA	0
PERCENT SAND	4/4	29.2 - 81.4	MTCSD02501	54.0	54.0	--	79.4	1	NA	0	NA	0
PERCENT SILT	4/4	1.2 - 58	MTCSD02301-D	22.7	22.7	--	65.2	0	NA	0	NA	0
EXPLOSIVES (MG/KG)												
HMX	1/5	0.1	MTCSD02401	0.10	0.12	0.25	0.17	0	0.005	1	3900	0
NITROCELLULOSE	5/5	6.9 - 399	MTCSD02201	166	166	--	56	3	NA	0	NA	0

ASSOCIATED SAMPLES
MTCSD02201
MTCSD02301
MTCSD02301-AVG
MTCSD02301-D
MTCSD02401
MTCSD02501
MTCSD02601
MTCSD02601-AVG
MTCSD02601-D
MTCSD02601-A
MTCSD02601-A-AVG
MTCSD02601-A-D

Footnotes:
1 Duplicates are considered one samples for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Refer to Table 4-9.
4 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).
5 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Hg, Ni, Zn).

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
RBC = Risk Based Concentration

Shaded cells indicate an exceedance of one or both of the Combined Ecological Sediment Criteria or the Region 3 RBC for soil (residential).

TABLE 4-31

SUMMARY OF POSITIVE DETECTIONS IN FILET SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES FILET / WHOLE BODY SAMPLE ID SAMPLE DATE	REGION 3 RBC FOR FISH[2]	MAXIMUM BACKGROUND-FILET	MATTAWOMAN CREEK AREA 1 CATFISH FILET MTCCT00101 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 1 CATFISH FILET MTCCT00102 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 CATFISH FILET MTCCT00301 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 CATFISH FILET MTCCT00302 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 4 CATFISH FILET MTCCT00401 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 4 CATFISH FILET MTCCT00402 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 4 CATFISH FILET MTCCT00403 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 5 CATFISH FILET MTCCT005 9/6/2001	QUAL
EXPLOSIVES (MG/KG)																		
1,3-DINITROBENZENE	0.14	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.057	J
2-AMINO-4,6-DINITROTOLUENE	0.081	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.096	J	0.25	U	0.25	U
HMX	68	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.083	J
NITROCELLULOSE	NA	ND	1.9	B	1.3	B	1.8	B	1.2	B	3.5	B	5.7		1.3	B	2.7	B
NITROGUANIDINE	NA	ND	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
INORGANICS (MG/KG)																		
ALUMINUM	1400	20.1	6.8		22.4		2.3	B	3.3	B	4.1	B	3.7	B	3	B	8.5	
ARSENIC	0.0021	2.2	0.84	U	0.75	K	0.66	U	0.65		0.6	U	0.6	U	0.67		0.61	U
BARIUM	95	1.3	0.06	U	0.065	B	0.18	B	0.67		0.29	B	0.42	B	0.21	B	0.19	B
CADMIUM	1.4	0.024	0.034		0.031		0.021		0.019		0.017		0.017		0.033		0.033	K
CALCIUM	NA	21900	101		544		801		3220		220		1400		877		856	
CHROMIUM	4.1	0.59	0.29	B	0.23	B	0.2	B	0.26	B	0.19	B	0.18	B	0.26	B	0.32	B
COPPER	54	ND	0.78	B	0.65	B	0.42	B	0.33	B	0.66	B	0.53	B	0.53	B	3.6	
CYANIDE	27	ND	0.3	U	0.49		0.37	U	0.32	U	0.38	U	0.38	U	0.38	U	0.33	U
IRON	410	47.3	7.5	B	6	B	7.3	J	11.8	J	9.3	J	10	J	8.7	J	16.6	
LEAD	NA	ND	0.43	B	0.42	B	0.2		0.29		0.17	U	0.17	U	0.2		0.54	B
MAGNESIUM	NA	674	125		150		151		164		113		142		140		176	
MANGANESE	27	7.8	0.39	K	1.6	K	0.67	J	4	J	1.9	J	3.5	J	1.7	J	0.64	K
MERCURY	0.14	0.17	0.05	U	0.048	U	0.045	U	0.048	U	0.048	U	0.042	U	0.045	U	0.048	U
POTASSIUM	NA	3250	1740		1760		1990	J	1400	J	1670	J	1600	J	1930	J	2690	
SODIUM	NA	969	219		256		322		200		338		431		401		880	
ZINC	410	17.3	6.9	B	7.4		8.6	J	9.2	J	5.1	B	5.1	B	6.7	J	10.9	
MISCELLANEOUS PARAMETERS																		
LIPIDS (%)	NA	0.74	7.23		4.82		5.15		0.97		1.52		1.91		3.04		0.03	
PERCHLORATE (UG/KG)	NA	ND	5000	U	5000	U	5000	U	2500	U	2500	U	2500	U	5000	U	5000	U
SEMIVOLATILE ORGANICS (UG/KG)																		
4-METHYLPHENOL	6800	45000	620		2500	J	14000		64000		9800		200	J	16000		330	U
BENZALDEHYDE	140000	500	330	U	3300	U	330	U	9800	U	330	U	330	U	330	U	330	U
BIS(2-ETHYLHEXYL)PHTHALATE	230	800	720	J	1800	J	480		1200	J	1400		1300		2200		330	U
PHENOL	810000	46	54	J	3300	U	330	U	9800	U	330	U	330	U	330	U	150	J
PESTICIDES/PCBS (UG/KG)																		
4,4'-DDE	9.3	8.7	35		46		110		35		30		41		5		4.5	
AROCLOR-1260	1.6	73	160	J	280		380	J	240	J	180	J	230		39		33	U
DIELDRIN	0.2	ND	3.3	U	3.9	R	7.3	J	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
ENDOSULFAN I	8100	ND	1.7	U	2.1	J	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U
ENDRIN	410	ND	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	5		3.3	U	3.3	U
GAMMA-CHLORDANE	9	ND	3.2	J	7	J	8.5	J	1.7	R	1.7	U	2.5	R	1.7	U	1.7	U

TABLE 4-31

SUMMARY OF POSITIVE DETECTIONS IN FILET SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE	MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK		MATTAWOMAN CREEK	
AREA OF CONCERN	AREA 1		AREA 2		AREA 2		AREA 2		AREA 3		AREA 4		AREA 4		AREA 5	
SPECIES	LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS		LARGE MOUTH BASS	
FILET / WHOLE BODY	FILET		FILET		FILET		FILET		FILET		FILET		FILET		FILET	
SAMPLE ID	MTCLB001	QUAL	MTCLB00201	QUAL	MTCLB00202	QUAL	MTCLB00203	QUAL	MTCLB003	QUAL	MTCLB00401	QUAL	MTCLB00402	QUAL	MTCLB005	QUAL
SAMPLE DATE	9/8/2001		9/8/2001		9/8/2001		9/8/2001		9/8/2001		9/9/2001		9/9/2001		9/6/2001	
EXPLOSIVES (MG/KG)																
1,3-DINITROBENZENE	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
2-AMINO-4,6-DINITROTOLUENE	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
HMX	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U	0.25	U
NITROCELLULOSE	1.6	B	1.6	B	2	B	1.8	B	1.7	B	1.2	B	1.8	B	1.8	B
NITROGUANIDINE	0.25	U	0.25	U	0.25	U	0.25	U	0.12	J	0.19	J	0.25	U	0.25	U
INORGANICS (MG/KG)																
ALUMINUM	2.8		5		14		3.7		4.1	B	2.8	B	1.4	B	3.2	
ARSENIC	1.5	K	0.89	K	1.6	K	1.2	K	0.79	U	0.84	U	0.57	U	1.5	K
BARIUM	0.14	B	0.36		0.3		0.08	B	0.15	B	0.15	B	0.2	B	0.74	
CADMIUM	0.018	U	0.016	U	0.03		0.02	U	0.019	U	0.02	U	0.014	U	0.02	U
CALCIUM	3630		7900		6740		2320		207		1680		2770		16900	
CHROMIUM	0.24	B	0.23	B	6.2		0.26	B	0.28	B	1.4		0.17	B	0.92	K
COPPER	0.4	B	0.74	B	0.82	B	0.62	B	0.63	B	0.3	B	0.44	B	1.1	B
CYANIDE	0.3	U	5.5		0.33	U	0.42	U	0.37	U	0.35	U	0.38	U	0.43	U
IRON	3.9	B	3	B	48		4.1	B	7.5	B	32.5	J	3	B	6.9	B
LEAD	0.28	B	0.19	U	1.1		0.24	U	0.23	U	0.24	U	0.16	U	0.24	U
MAGNESIUM	229		402		330		233		220		212		232		611	
MANGANESE	0.81	K	0.93	K	1.7	K	0.56	K	0.34	B	0.78	J	0.52	J	2	K
MERCURY	0.042	U	0.052		0.048	U	0.045	U	0.042	U	0.042	U	0.042	U	0.098	
POTASSIUM	1870		3130		2290		2440		2810	J	2510	J	2240	J	3680	
SODIUM	342		554		431		367		395		413		391		698	
ZINC	7.2	B	11.9		7.8		6.2	B	6	B	6.3	B	6.1	J	11.5	
MISCELLANEOUS PARAMETERS																
LIPIDS (%)	0.91		1.16		0.6		1.19		0.89		1.17		0.75		0.12	
PERCHLORATE (UG/KG)	5000	U	10200		5000	U	5000	U	2500	U	2500	U	5000	U	5000	U
SEMIVOLATILE ORGANICS (UG/																
4-METHYLPHENOL	8300		330	U	330	U	80	J	330	U	550		23000		330	U
BENZALDEHYDE	330	U	75	J	77	J	43	J	43	J	330	U	330	U	91	J
BIS(2-ETHYLHEXYL)PHTHALATE	380	J	140	J	75	J	1200	J	640	J	1600	J	980	J	330	U
PHENOL	330	U	330	UJ	330	U	330	U	330	U	71	J	330	U	330	U
PESTICIDES/PCBS (UG/KG)																
4,4'-DDE	4.2		3.3	U	3.3	U	3.3	U	8.4	J	5.2		8.6	J	3.3	U
AROCLOR-1260	33	U	47	J	43	J	33	U	51	J	42	J	59		33	U
DIELDRIN	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
ENDOSULFAN I	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U
ENDRIN	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
GAMMA-CHLORDANE	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.
2 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration
PCB = Polychlorinated Biphenyl

Shaded cells indicate an exceedance of the Region 3 RBC for Fish.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
UJ = The analyte was analyzed for, but was not detected.
The associated detection limit is an estimate and may be inaccurate or imprecise.
K = The analyte is present. The reported value may be biased high.
The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
R= Analyte may or may not be present; however, the data are unusable.

TABLE 4-32

SUMMARY OF DESCRIPTIVE STATISTICS-FILET SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND FILET CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND FILET CONCENTRATION	REGION 3 RBC FOR FISH[3]	NUMBER OF EXEEDANCES OF REGION 3 RBC FOR FISH
EXPLOSIVES (MG/KG)										
1,3-DINITROBENZENE	1/16	0.057	MTCCT005	0.06	0.12	0.25	ND	1	0.14	0
2-AMINO-4,6-DINITROTOLUENE	1/16	0.096	MTCCT00402	0.10	0.12	0.25	ND	1	0.081	1
HMX	1/16	0.083	MTCCT005	0.08	0.12	0.25	ND	1	68	0
NITROCELLULOSE	1/16	5.7	MTCCT00402	5.7	1.2	1.2 - 3.5	ND	1	NA	0
NITROGUANIDINE	2/16	0.12 - 0.19	MTCLB00401	0.16	0.13	0.25	ND	2	NA	0
INORGANICS (MG/KG)										
ALUMINUM	8/16	2.8 - 22.4	MTCCT00102	8.3	4.9	1.4 - 4.1	20.1	1	1400	0
ARSENIC	8/16	0.65 - 1.6	MTCLB00202	1.1	0.72	0.57 - 0.84	2.2	0	0.0021	8
BARIUM	4/16	0.3 - 0.74	MTCLB005	0.52	0.20	0.06 - 0.42	1.3	0	95	0
CADMIUM	9/16	0.017 - 0.034	MTCCT00101	0.03	0.02	0.014 - 0.02	0.024	5	1.4	0
CALCIUM	16/16	101 - 16900	MTCLB005	3135	3135	--	21900	0	NA	0
CHROMIUM	3/16	0.92 - 6.2	MTCLB00202	2.84	0.63	0.17 - 0.32	0.59	3	4.1	1
COPPER	1/16	3.6	MTCCT005	3.6	0.50	0.3 - 1.1	ND	1	54	0
CYANIDE	2/16	0.49 - 5.5	MTCLB00201	3.0	0.53	0.3 - 0.43	ND	2	27	0
IRON	8/16	7.3 - 48	MTCLB00202	18.0	10.3	3 - 7.5	47.3	1	410	0
LEAD	4/16	0.2 - 1.1	MTCLB00202	0.45	0.22	0.16 - 0.54	ND	4	NA	0
MAGNESIUM	16/16	113 - 611	MTCLB005	227	227	--	674	0	NA	0
MANGANESE	15/16	0.39 - 4	MTCCT00302	1.4	1.37	0.34	7.8	0	27	0
MERCURY	2/16	0.052 - 0.098	MTCLB005	0.08	0.03	0.042 - 0.05	0.17	0	0.14	0
POTASSIUM	16/16	1400 - 3680	MTCLB005	2234	2234	--	3250	1	NA	0
SODIUM	16/16	200 - 880	MTCCT005	415	415	--	969	0	NA	0
ZINC	9/16	6.1 - 11.9	MTCLB00201	8.9	6.3	5.1 - 7.2	17.3	0	410	0
MISCELLANEOUS PARAMETERS										
LIPIDS (%)	16/16	0.03 - 7.23	MTCCT00101	2.0	2.0	--	0.74	13	NA	0
PERCHLORATE (UG/KG)	1/16	10200	MTCLB00201	10200	2591	2500 - 5000	ND	1	NA	0
SEMIVOLATILE ORGANICS (UG/KG)										
4-METHYLPHENOL	11/16	80 - 64000	MTCCT00302	12641	8742	330	45000	1	6800	6
BENZALDEHYDE	5/16	43 - 91	MTCLB005	65.8	523	330 - 9800	500	0	140000	0
BIS(2-ETHYLHEXYL)PHTHALATE	14/16	75 - 2200	MTCCT00403	1008	903	330	800	8	230	12
PHENOL	3/16	54 - 150	MTCCT005	91.7	540	330 - 9800	46	3	810000	0
PESTICIDES/PCBS (UG/KG)										
4,4'-DDE	12/16	4.2 - 110	MTCCT00301	28	21	3.3	8.7	6	9.3	6
AROCLOR-1260	12/16	39 - 380	MTCCT00301	146	114	33	73	6	1.6	12
DIELDRIN	1/15	7.3	MTCCT00301	7.3	2.0	3.3	ND	1	0.2	1
ENDOSULFAN I	1/16	2.1	MTCCT00102	2.1	0.93	1.7	ND	1	8100	0
ENDRIN	1/16	5	MTCCT00402	5.0	1.9	3.3	ND	1	410	0
GAMMA-CHLORDANE	3/14	3.2 - 8.5	MTCCT00301	6.2	2.0	1.7	ND	3	9	0

TABLE 4-32

SUMMARY OF DESCRIPTIVE STATISTICS-FILET SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

ASSOCIATED SAMPLES

MTCCT00101	MTCLB00202
MTCCT00102	MTCLB00203
MTCCT00301	MTCLB003
MTCCT00302	MTCLB00401
MTCCT00401	MTCLB00402
MTCCT00402	MTCLB005
MTCCT00403	
MTCCT005	
MTCLB001	
MTCLB00201	

Footnotes:

1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purpos identifying the range of concentrations detected.

2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the ave Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

3 U.S. EPA Region III Risk-Based Concentration Table (April, 2002).

Acronyms/Abbreviations:

NA = Not Available
ND = Not Detected
RBC = Risk Based Concentration
PCB = Polychlorinated Biphenyl

Shaded cells indicate an exceedance of the Region 3 RBC for Fish.

TABLE 4-33

SUMMARY OF POSITIVE DETECTIONS IN PUMPKINSEED AND SHINER SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES BODY SAMPLE ID SAMPLE DATE	MAXIMUM BACKGROUND-PUMPKINSEED, MUMMICHOG AND SHINER GROUP	MATTAWOMAN CREEK AREA 1 PUMPKINSEED WHOLE BODY MTCFS001 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 2 PUMPKINSEED WHOLE BODY MTCFS002 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 PUMPKINSEED WHOLE BODY MTCFS003 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 4 PUMPKINSEED WHOLE BODY MTCFS004 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 5 PUMPKINSEED WHOLE BODY MTCFS005 9/6/2001	QUAL	MATTAWOMAN CREEK AREA 2 GOLDEN SHINER WHOLE BODY MTCGS002 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 GOLDEN SHINER WHOLE BODY MTCGS003 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 1 SPOTTAIL SHINER WHOLE BODY MTCSS001 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 4 SPOTTAIL SHINER WHOLE BODY MTCSS004 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 5 SPOTTAIL SHINER WHOLE BODY MTCSS005 9/6/2001	QUAL
EXPLOSIVES (MG/KG)																					
NITROGLYCERIN	ND	0.1	J	0.5	U	0.5	U	0.1	J	0.5	U	0.18	J	1.3	U	0.5	U	0.5	U	0.22	J
NITROGUANIDINE	ND	0.25	U	1	U	0.25	U	0.25	U	0.25	U	0.25	U	3	U	0.25	U	0.25	U	0.068	J
INORGANICS (MG/KG)																					
ALUMINUM	15.9	6.6		3.6		16.4		2.7	B	5.4		8.7		7.3		18		6	B	20.6	
ARSENIC	1.7	1.5	K	1.6	K	2		1.2		1.7	K	0.59		0.7		1.7	K	0.7		1.9	K
BARIUM	6.2	0.54		0.95		1.3		0.82		1		1.5		1.6		2.3		2.6		4.8	
CADMIUM	ND	0.02	U	0.017	U	0.022		0.025		0.019	U	0.023		0.016	U	0.025		0.017		0.022	K
CALCIUM	13300	5020		10800		9580		6340		7800		2860		2990		3240		1800		6260	
CHROMIUM	1.2	0.31	B	0.26	B	0.31	B	0.74		0.28	B	6.6		0.28	B	0.29	B	0.26	B	0.58	K
CYANIDE	ND	0.3	U	0.42	U	0.37	U	0.32	U	0.38	U	0.31	U	0.45		0.4		0.35	U	0.34	U
IRON	40.5	9.6		10.2		17.6	J	12.5	J	13.5		166	J	17.9	J	38.7		13	J	48.6	
LEAD	ND	0.24	U	0.33	B	0.41		0.2		0.28	B	0.16	U	0.2	U	0.52	B	0.19	U	0.32	B
MAGNESIUM	358	180		293		274		200		211		176		181		145		100		224	
MANGANESE	21.5	4.1	K	7.8		8.2	J	4.8	J	7.3		6.3	J	5.6	J	7.8		2.3	J	6.1	
POTASSIUM	2050	1000		1130		1360	J	1200	J	1270		1210	J	1420	J	866		726	J	1620	
SODIUM	667	331		429		493		463		413		309		400		225		169		397	
VANADIUM	0.14	0.078	U	0.076		0.078		0.055	U	0.24		0.38		0.066	U	0.073	U	0.065	U	0.1	
ZINC	35.1	12.4		17.4		16	J	13.3	J	14.2		16.7	J	12.1	J	16.5		12.1	J	24.9	
MISCELLANEOUS PARAMETERS																					
LIPIDS (%)	1.4	1.23		0.95		1.17		1.3		1.06		0.57		2.38		0.64		0.54		0.56	
SEMIVOLATILE ORGANICS (UG/KG)																					
2-METHYLPHENOL	ND	330	U	330	U	330	U	6600	U	330	U	330	U	170	J	73	J	330	UJ	330	U
4-METHYLPHENOL	660	5400		35	J	11000		39000		31000		2800		150	J	330	U	12000		870	
BENZALDEHYDE	410	34	J	46	J	330	U	6600	U	53	J	330	U	330	U	330	U	330	UJ	330	U
BIS(2-ETHYLHEXYL)PHTHALATE	260	1900	J	330	UJ	780	J	1300	J	4900	UJ	330	UJ	120	J	330	UJ	880	J	150	J
PHENOL	98	330	U	330	U	140	J	6600	U	330	U	120	J	330	U	330	U	94	J	330	U
PESTICIDES/PCBS (UG/KG)																					
4,4'-DDD	ND	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U	6.5	U	3.3	U	3.3	U	3.9	J	3.3	U
4,4'-DDE	6.8	5.2	J	3.3	U	3.3	U	4.8		5.3		6.5	U	3.3	J	5.3	J	17		8.1	
AROCLOR-1260	59	33	U	36	J	33	U	50	J	34	J	65	U	33	U	46		130	J	58	

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

TABLE 4-33A

SUMMARY OF POSITIVE DETECTIONS IN PUMPKINSEED SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES BODY SAMPLE ID SAMPLE DATE	MAXIMUM BACKGROUND-PUMPKINSEED	MATTAWOMAN CREEK AREA 1 PUMPKINSEED WHOLE BODY MTCFS001 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 2 PUMPKINSEED WHOLE BODY MTCFS002 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 PUMPKINSEED WHOLE BODY MTCFS003 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 4 PUMPKINSEED WHOLE BODY MTCFS004 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 5 PUMPKINSEED WHOLE BODY MTCFS005 9/6/2001	QUAL
EXPLOSIVES (MG/KG)											
NITROGLYCERIN	ND	0.1	J	0.5	U	0.5	U	0.1	J	0.5	U
INORGANICS (MG/KG)											
ALUMINUM	7.2	6.6		3.6		16.4		2.7	B	5.4	
ARSENIC	1.7	1.5	K	1.6	K	2		1.2		1.7	K
BARIUM	1.6	0.54		0.95		1.3		0.82		1	
CADMIUM	ND	0.02	U	0.017	U	0.022		0.025		0.019	U
CALCIUM	13300	5020		10800		9580		6340		7800	
CHROMIUM	ND	0.31	B	0.26	B	0.31	B	0.74		0.28	B
IRON	40.5	9.6		10.2		17.6	J	12.5	J	13.5	
LEAD	ND	0.24	U	0.33	B	0.41		0.2		0.28	B
MAGNESIUM	358	180		293		274		200		211	
MANGANESE	11.7	4.1	K	7.8		8.2	J	4.8	J	7.3	
POTASSIUM	1600	1000		1130		1360	J	1200	J	1270	
SODIUM	667	331		429		493		463		413	
VANADIUM	0.14	0.078	U	0.076		0.078		0.055	U	0.24	
ZINC	17.4	12.4		17.4		16	J	13.3	J	14.2	
MISCELLANEOUS											
LIPIDS (%)	1.4	1.23		0.95		1.17		1.3		1.06	
SEMIVOLATILE ORGANICS (UG/KG)											
4-METHYLPHENOL	310	5400		35	J	11000		39000		31000	
BENZALDEHYDE	120	34	J	46	J	330	U	6600	U	53	J
BIS(2-ETHYLHEXYL)PHTHALATE	260	1900	J	330	UJ	780	J	1300	J	4900	UJ
PHENOL	65	330	U	330	U	140	J	6600	U	330	U
PESTICIDES/PCBS (UG/KG)											
4,4'-DDE	4.7	5.2	J	3.3	U	3.3	U	4.8		5.3	
AROCLOR-1260	36	33	U	36	J	33	U	50	J	34	J

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.

TABLE 4-33B

SUMMARY OF POSITIVE DETECTIONS IN SHINER SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES BODY SAMPLE ID SAMPLE DATE	MAXIMUM BACKGROUND-SHINER AND MUMMICHOG GROUP	MATTAWOMAN CREEK AREA 2 GOLDEN SHINER WHOLE BODY MTCGS002 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 3 GOLDEN SHINER WHOLE BODY MTCGS003 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 1 SPOTTAIL SHINER WHOLE BODY MTCSS001 9/8/2001	QUAL	MATTAWOMAN CREEK AREA 4 SPOTTAIL SHINER WHOLE BODY MTCSS004 9/9/2001	QUAL	MATTAWOMAN CREEK AREA 5 SPOTTAIL SHINER WHOLE BODY MTCSS005 9/6/2001	QUAL
EXPLOSIVES (MG/KG)											
NITROGLYCERIN	ND	0.18	J	1.3	U	0.5	U	0.5	U	0.22	J
NITROGUANIDINE	ND	0.25	U	3	U	0.25	U	0.25	U	0.068	J
INORGANICS (MG/KG)											
ALUMINUM	15.9	8.7		7.3		18		6	B	20.6	
ARSENIC	1.5	0.59		0.7		1.7	K	0.7		1.9	K
BARIUM	6.2	1.5		1.6		2.3		2.6		4.8	
CADMIUM	ND	0.023		0.016	U	0.025		0.017		0.022	K
CALCIUM	7990	2860		2990		3240		1800		6260	
CHROMIUM	1.2	6.6		0.28	B	0.29	B	0.26	B	0.58	K
CYANIDE	ND	0.31	U	0.45		0.4		0.35	U	0.34	U
IRON	35.2	166	J	17.9	J	38.7		13	J	48.6	
MAGNESIUM	308	176		181		145		100		224	
MANGANESE	21.5	6.3	J	5.6	J	7.8		2.3	J	6.1	
POTASSIUM	2050	1210	J	1420	J	866		726	J	1620	
SODIUM	655	309		400		225		169		397	
VANADIUM	0.1	0.38		0.066	U	0.073	U	0.065	U	0.1	
ZINC	35.1	16.7	J	12.1	J	16.5		12.1	J	24.9	
MISCELLANEOUS											
LIPIDS (%)	0.94	0.57		2.38		0.64		0.54		0.56	
SEMIVOLATILE ORGANICS (UG/KG)											
2-METHYLPHENOL	ND	330	U	170	J	73	J	330	UJ	330	U
4-METHYLPHENOL	660	2800		150	J	330	U	12000		870	
BIS(2-ETHYLHEXYL)PHTHALATE	ND	330	UJ	120	J	330	UJ	880	J	150	J
PHENOL	98	120	J	330	U	330	U	94	J	330	U
PESTICIDES/PCBS (UG/KG)											
4,4'-DDD	ND	6.5	U	3.3	U	3.3	U	3.9	J	3.3	U
4,4'-DDE	6.8	6.5	U	3.3	J	5.3	J	17		8.1	
AROCLOR-1260	59	65	U	33	U	46		130	J	58	

TABLE 4-33B

SUMMARY OF POSITIVE DETECTIONS IN SHINER SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.
UJ = The analyte was analyzed for, but was not detected. The associated detection limit is an estimate and may be inaccurate or imprecise.

TABLE 4-34

SUMMARY OF DESCRIPTIVE STATISTICS-SHINER AND PUMPKINSEED SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND CONCENTRATION-SHINER, MUMMICHOG, PUMPKINSEED GROUP	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND CONCENTRATION-SHINER, MUMMICHOG & PUMPKINSEED GROUP
EXPLOSIVES (MG/KG)								
NITROGLYCERIN	4/10	0.1 - 0.22	MTCSS005	0.15	0.25	0.5 - 1.3	ND	4
NITROGUANIDINE	1/10	0.068	MTCSS005	0.07	0.29	0.25 - 3	ND	1
INORGANICS (MG/KG)								
ALUMINUM	8/10	3.6 - 20.6	MTCSS005	10.8	9.1	2.7 - 6	15.9	3
ARSENIC	10/10	0.59 - 2	MTCFS003	1.4	1.4	--	1.7	2
BARIUM	10/10	0.54 - 4.8	MTCSS005	1.7	1.7	--	6.2	0
CADMIUM	6/10	0.017 - 0.025	MTCFS004, MTCSS001	0.02	0.02	0.016 - 0.02	ND	6
CALCIUM	10/10	1800 - 10800	MTCFS002	5669	5669	--	13300	0
CHROMIUM	3/10	0.58 - 6.6	MTCGS002	2.6	0.89	0.26 - 0.31	1.2	1
CYANIDE	2/10	0.4 - 0.45	MTCGS003	0.43	0.22	0.3 - 0.42	ND	2
IRON	10/10	9.6 - 166	MTCGS002	34.8	34.8	--	40.5	2
LEAD	2/10	0.2 - 0.41	MTCFS003	0.31	0.17	0.16 - 0.52	ND	2
MAGNESIUM	10/10	100 - 293	MTCFS002	198	198	--	358	0
MANGANESE	10/10	2.3 - 8.2	MTCFS003	6.0	6.0	--	21.5	0
POTASSIUM	10/10	726 - 1620	MTCSS005	1180	1180	--	2050	0
SODIUM	10/10	169 - 493	MTCFS003	363	363	--	667	0
VANADIUM	5/10	0.076 - 0.38	MTCGS002	0.17	0.10	0.055 - 0.078	0.14	2
ZINC	10/10	12.1 - 24.9	MTCSS005	15.6	15.6	--	35.1	0
MISCELLANEOUS PARAMETERS								
LIPIDS (%)	10/10	0.54 - 2.38	MTCGS003	1.0	1.0	--	1.4	1
SEMIVOLATILE ORGANICS (UG/KG)								
2-METHYLPHENOL	2/10	73 - 170	MTCGS003	122	470	330 - 6600	ND	2
4-METHYLPHENOL	9/10	35 - 39000	MTCFS004	11362	10242	330	660	7
BENZALDEHYDE	3/10	34 - 53	MTCFS005	44	442	330 - 6600	410	0
BIS(2-ETHYLHEXYL)PHTHALATE	6/10	120 - 1900	MTCFS001	855	808	330 - 4900	260	4
PHENOL	3/10	94 - 140	MTCFS003	118	464	330 - 6600	98	2
PESTICIDES/PCBS (UG/KG)								
4,4'-DDD	1/10	3.9	MTCSS004	3.9	2.0	3.3 - 6.5	ND	1
4,4'-DDE	7/10	3.3 - 17	MTCSS004	7	5.6	3.3 - 6.5	6.8	2
AROCLOR-1260	6/10	34 - 130	MTCSS004	59	44	33 - 65	59	1

ASSOCIATED SAMPLES

MTCFS001	MTCGS002
MTCFS002	MTCGS003
MTCFS003	MTCSS001
MTCFS004	MTCSS004
MTCFS005	MTCSS005

Footnotes:

1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.

2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Acronyms/Abbreviations:

ND = Not Detected

PCB = Polychlorinated Biphenyl

TABLE 4-34A

SUMMARY OF DESCRIPTIVE STATISTICS-PUMPKINSEED SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND PUMPKINSEED CONCENTRATIONS	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND PUMPKINSEED CONCENTRATION
EXPLOSIVES (MG/KG)								
NITROGLYCERIN	2/5	0.1	MTCFS001, MTCFS004	0.10	0.19	0.5	ND	2
INORGANICS (MG/KG)								
ALUMINUM	4/5	3.6 - 16.4	MTCFS003	8.0	6.7	2.7	7.2	1
ARSENIC	5/5	1.2 - 2	MTCFS003	1.6	1.6	--	1.7	1
BARIUM	5/5	0.54 - 1.3	MTCFS003	0.92	0.92	--	1.6	0
CADMIUM	2/5	0.022 - 0.025	MTCFS004	0.02	0.02	0.017 - 0.02	ND	2
CALCIUM	5/5	5020 - 10800	MTCFS002	7908	7908	--	13300	0
CHROMIUM	1/5	0.74	MTCFS004	0.74	0.26	0.26 - 0.31	ND	1
IRON	5/5	9.6 - 17.6	MTCFS003	12.7	12.7	--	40.5	0
LEAD	2/5	0.2 - 0.41	MTCFS003	0.31	0.21	0.24 - 0.33	ND	2
MAGNESIUM	5/5	180 - 293	MTCFS002	232	232	--	358	0
MANGANESE	5/5	4.1 - 8.2	MTCFS003	6.4	6.4	--	11.7	0
POTASSIUM	5/5	1000 - 1360	MTCFS003	1192	1192	--	1600	0
SODIUM	5/5	331 - 493	MTCFS003	426	426	--	667	0
VANADIUM	3/5	0.076 - 0.24	MTCFS005	0.13	0.09	0.055 - 0.078	0.14	1
ZINC	5/5	12.4 - 17.4	MTCFS002	14.7	14.7	--	17.4	0
MISCELLANEOUS PARAMETERS								
LIPIDS (%)	5/5	0.95 - 1.3	MTCFS004	1.1	1.1	--	1.4	0
SEMIVOLATILE ORGANICS (UG/KG)								
4-METHYLPHENOL	5/5	35 - 39000	MTCFS004	17287	17287	--	310	4
BENZALDEHYDE	3/5	34 - 53	MTCFS005	44	720	330 - 6600	120	0
BIS(2-ETHYLHEXYL)PHTHALATE	3/5	780 - 1900	MTCFS001	1327	1319	330 - 4900	260	3
PHENOL	1/5	140	MTCFS003	140	787	330 - 6600	65	1
PESTICIDES/PCBS (UG/KG)								
4,4'-DDE	3/5	4.8 - 5.3	MTCFS005	5.1	3.7	3.3	4.7	3
AROCLOR-1260	3/5	34 - 50	MTCFS004	40	31	33	36	1

ASSOCIATED SAMPLES
MTCFS001
MTCFS002
MTCFS003
MTCFS004
MTCFS005

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

TABLE 4-34B

SUMMARY OF DESCRIPTIVE STATISTICS-SHINER SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND SHINER & MUMMICHOG GROUP CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SHINER & MUMMICHOG GROUP CONCENTRATION
EXPLOSIVES (MG/KG)								
NITROGLYCERIN	2/5	0.18 - 0.22	MTCSS005	0.2	0.31	0.5 - 1.3	ND	2
NITROGUANIDINE	1/5	0.068	MTCSS005	0.07	0.39	0.25 - 3	ND	1
INORGANICS (MG/KG)								
ALUMINUM	4/5	7.3 - 20.6	MTCSS005	13.7	11.5	6	15.9	2
ARSENIC	5/5	0.59 - 1.9	MTCSS005	1.1	1.1	--	1.5	2
BARIUM	5/5	1.5 - 4.8	MTCSS005	2.6	2.6	--	6.2	0
CADMIUM	4/5	0.017 - 0.025	MTCSS001	0.02	0.02	0.016	ND	4
CALCIUM	5/5	1800 - 6260	MTCSS005	3430	3430	--	7990	0
CHROMIUM	2/5	0.58 - 6.6	MTCGS002	3.6	1.5	0.26 - 0.29	1.2	1
CYANIDE	2/5	0.4 - 0.45	MTCGS003	0.43	0.27	0.31 - 0.35	ND	2
IRON	5/5	13 - 166	MTCGS002	56.8	56.8	--	35.2	3
MAGNESIUM	5/5	100 - 224	MTCSS005	165	165	--	308	0
MANGANESE	5/5	2.3 - 7.8	MTCSS001	5.6	5.6	--	21.5	0
POTASSIUM	5/5	726 - 1620	MTCSS005	1168	1168	--	2050	0
SODIUM	5/5	169 - 400	MTCGS003	300	300	--	655	0
VANADIUM	2/5	0.1 - 0.38	MTCGS002	0.24	0.12	0.065 - 0.073	0.1	1
ZINC	5/5	12.1 - 24.9	MTCSS005	16.5	16.5	--	35.1	0
MISCELLANEOUS PARAMETERS								
LIPIDS (%)	5/5	0.54 - 2.38	MTCGS003	0.94	0.94	--	0.94	1
SEMIVOLATILE ORGANICS (UG/KG)								
2-METHYLPHENOL	2/5	73 - 170	MTCGS003	122	148	330	ND	2
4-METHYLPHENOL	4/5	150 - 12000	MTCSS004	3955	3197	330	660	3
BIS(2-ETHYLHEXYL)PHTHALATE	3/5	120 - 880	MTCSS004	383	296	330	ND	3
PHENOL	2/5	94 - 120	MTCGS002	107	142	330	98	1
PESTICIDES/PCBS (UG/KG)								
4,4'-DDD	1/5	3.9	MTCSS004	3.9	2.4	3.3 - 6.5	ND	1
4,4'-DDE	4/5	3.3 - 17	MTCSS004	8.4	7.4	6.5	6.8	2
AROCLOR-1260	3/5	46 - 130	MTCSS004	78	57	33 - 65	59	1

ASSOCIATED SAMPLES
MTCGS002
MTCGS003
MTCSS001
MTCSS004
MTCSS005

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

TABLE 4-35

SUMMARY OF POSITIVE DETECTIONS IN HYDRILLA SAMPLES[1]
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

SITE AREA OF CONCERN SPECIES SAMPLE ID SAMPLE DATE	MAXIMUM BACKGROUND-HYDRILLA	MATTAWOMAN CREEK AREA 1 HYDRILLA MTCVG001 9/7/2001	QUAL	MATTAWOMAN CREEK AREA 2 HYDRILLA MTCVG002 9/7/2001	QUAL	MATTAWOMAN CREEK AREA 3 HYDRILLA MTCVG003 9/7/2001	QUAL	MATTAWOMAN CREEK AREA 4 HYDRILLA MTCVG004 9/7/2001	QUAL	MATTAWOMAN CREEK AREA 5 HYDRILLA MTCVG005 9/6/2001	QUAL
INORGANICS (MG/KG)											
ALUMINUM	286	65.2		45.5		275		184		110	
BARIUM	35.1	9.5		9.7		17.2		18.4		15.8	
BERYLLIUM	0.044	0.019	U	0.019	U	0.032		0.031		0.019	
CADMIUM	0.39	0.11	B	0.082	B	0.13	K	0.14	B	0.097	B
CALCIUM	616	703		746		720		859		960	
CHROMIUM	0.98	0.5	B	0.41	B	0.9	K	0.74	B	0.56	B
IRON	2260	171		122		684		464		278	
MAGNESIUM	427	339		356		394		389		334	
MANGANESE	1970	230		178		327		354		324	J
NICKEL	2.1	1.2	B	1.2	B	1.4	K	1.7	K	1.6	K
POTASSIUM	2560	3580		2690		2790		2920		3360	
SODIUM	1420	499		393	B	311	B	403	B	304	J
VANADIUM	1.2	0.39	K	0.29	K	0.99	K	0.69	K	0.4	K
ZINC	18.3	8.9	B	6.2	B	10.3	B	11.9	B	21.6	J

Footnotes:
1 Analytical results presented for all analytes detected at least once in the data set.

Data Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above either the sample quantitation limit or the sample detection limit.
J = The associated value is an estimated concentration.
K = The analyte is present. The reported value may be biased high. The actual value is expected to be lower than reported.
B = Positive result is considered to be an artifact of blank contamination and should not be considered present.

TABLE 4-36

SUMMARY OF DESCRIPTIVE STATISTICS-HYDRILLA SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	RANGE OF POSITIVE DETECTS[1]	LOCATION OF MAXIMIM POSITIVE DETECT	AVERAGE OF POSITIVE DETECTIONS	AVERAGE OF ALL ANALTICAL RESULTS[2]	RANGE OF NONDETECTIONS	MAXIMUM BACKGROUND HYDRILLA CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND HYDRILLA CONCENTRATION
INORGANICS (MG/KG)								
ALUMINUM	5/5	45.5 - 275	MTCVG003	136	136	--	286	0
BARIUM	5/5	9.5 - 18.4	MTCVG004	14.1	14.1	--	35.1	0
BERYLLIUM	3/5	0.019 - 0.032	MTCVG003	0.03	0.02	0.019	0.044	0
CADMIUM	1/5	0.13	MTCVG003	0.13	0.07	0.082 - 0.14	0.39	0
CALCIUM	5/5	703 - 960	MTCVG005	798	798	--	616	5
CHROMIUM	1/5	0.9	MTCVG003	0.90	0.40	0.41 - 0.74	0.98	0
IRON	5/5	122 - 684	MTCVG003	344	344	--	2260	0
MAGNESIUM	5/5	334 - 394	MTCVG003	362	362	--	427	0
MANGANESE	5/5	178 - 354	MTCVG004	283	283	--	1970	0
NICKEL	3/5	1.4 - 1.7	MTCVG004	1.6	1.2	1.2	2.1	0
POTASSIUM	5/5	2690 - 3580	MTCVG001	3068	3068	--	2560	5
SODIUM	2/5	304 - 499	MTCVG001	402	271	311 - 403	1420	0
VANADIUM	5/5	0.29 - 0.99	MTCVG003	0.55	0.55	--	1.2	0
ZINC	1/5	21.6	MTCVG005	21.6	8.1	6.2 - 11.9	18.3	1

ASSOCIATED SAMPLES
MTCVG001
MTCVG002
MTCVG003
MTCVG004
MTCVG005

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.

IS11SW01
Volatile Organics (ug/L)
METHYL TERT-BUTYL ETHER 1 J C
Semivolatile Organics (ug/L)
BIS(2-ETHYLHEXYL)PHTHALATE 1 J C
Inorganics (ug/L)
ALUMINUM 457 A
BARIUM 29 J
IRON 772 A,C
LEAD 38.4 A,B,C
MANGANESE 127 A
VANADIUM 2 J C
Filtered Inorganics (ug/L)
BARIUM 23.6 J C
LEAD 1.3 C
MANGANESE 4.5 J
Miscellaneous Parameters (various units)
DIESEL RANGE ORGANICS 160 (UG/L) C
Energetics (ug/L)
1,3-DINITROBENZENE 0.075 J C

IS17SW06
Inorganics (ug/L)
BARIUM 24.4 J
COPPER 5.4 J A,C
IRON 227
LEAD 7.3 A,C
MANGANESE 95.9 A
NICKEL 2.8 J C
ZINC 32.7 A,C
Filtered Inorganics (ug/L)
BARIUM 21 J C
IRON 37.5 J C
NICKEL 3.3 J C

IS17SW05
Inorganics (ug/L)
BARIUM 25.2 J
COPPER 5 J A,C
IRON 362 A
LEAD 1.9 J C
MANGANESE 105 A
NICKEL 2.8 J C
SELENIUM 5.8 A,C
VANADIUM 1.5 J C
ZINC 26 A,C
Filtered Inorganics (ug/L)
BARIUM 20.7 J C
COPPER 2.2 J C
NICKEL 3.7 J C

IS17SW03
Inorganics (ug/L)
ALUMINUM 553 J A
BARIUM 25.8 J
COPPER 2.4 J C
CYANIDE 1.1 L A
IRON 981 A,C
LEAD 1.3 K C
MANGANESE 106 A
NICKEL 2.7 J C
VANADIUM 2.1 J C
Filtered Inorganics (ug/L)
BARIUM 17.8 J C
IRON 28.2 J C

IS17SW02
Inorganics (ug/L)
ALUMINUM 664 A,C
BARIUM 24.7 J
COPPER 3.9 J A,C
CYANIDE 10 L A
IRON 725 A,C
MANGANESE 87.4 A
VANADIUM 2.1 J C
Filtered Inorganics (ug/L)
BARIUM 17 J C
Energetics (ug/L)
4-NITROTOLUENE 0.11 J C

IS17SW04
Inorganics (ug/L)
ALUMINUM 258 A
BARIUM 24 J
COPPER 4.5 J A,C
IRON 576 A
MANGANESE 105 A
NICKEL 3.5 J C
VANADIUM 1.7 J C
ZINC 24.2 A,C
Filtered Inorganics (ug/L)
BARIUM 20.4 J C
COPPER 2.8 J C
IRON 59.2 J C
NICKEL 3.1 J C
SELENIUM 4.9 J C
ZINC 29.9 A,C

IS11SW02
Inorganics (ug/L)
ALUMINUM 239 A
BARIUM 24 J
IRON 475 A
LEAD 1.6 J C
MANGANESE 98.3 A
VANADIUM 1.5 J C
Filtered Inorganics (ug/L)
BARIUM 21.2 J C
MANGANESE 2.2 J
Miscellaneous Parameters (various units)
AMMONIUM PERCHLORATE 1.6 J (UG/L) C
DIESEL RANGE ORGANICS 160 (UG/L) C
PERCHLORATE 1.36 J (UG/L) C

IS11SW03
Inorganics (ug/L)
ALUMINUM 276 A
BARIUM 24.7 J
COPPER 4.2 J A,C
IRON 564 A
LEAD 1.3 J C
MANGANESE 103 A
VANADIUM 1.5 J C
Filtered Inorganics (ug/L)
BARIUM 22 J C
COPPER 2.4 J C
Miscellaneous Parameters (various units)
AMMONIUM PERCHLORATE 2.9 J (UG/L) C
DIESEL RANGE ORGANICS 100 (UG/L) C
PERCHLORATE 2.46 J (UG/L) C

IS11SW04
Inorganics (ug/L)
ALUMINUM 366 A
BARIUM 26 J
COPPER 5.2 J A,C
IRON 726 A,C
LEAD 6.1 A,C
MANGANESE 111 A
Filtered Inorganics (ug/L)
BARIUM 22.9 J C
Miscellaneous Parameters (various units)
AMMONIUM PERCHLORATE 3.6 J (UG/L) C
DIESEL RANGE ORGANICS 120 (UG/L) C
PERCHLORATE 3.05 J (UG/L) C

MTC004
Inorganics (ug/L)
ALUMINUM 231 A
BARIUM 31.9
CHROMIUM 3.4 K A,C
IRON 263
MANGANESE 47.9 A
VANADIUM 1.4 K C
Filtered Inorganics (ug/L)
ARSENIC 4.5 K B,C
BARIUM 34.7 C
CADMIUM 0.16 K C
VANADIUM 0.98 K C

MTC003
Volatile Organics (ug/L)
BENZENE 0.7 J B,C
BROMOFORM 0.5 J C
ETHYLBENZENE 0.6 J C
TOLUENE 3 C
TOTAL XYLENES 4 C
Inorganics (ug/L)
ALUMINUM 347 A
ARSENIC 6.5 K B,C
BARIUM 33.6
IRON 457 A
MANGANESE 68.9 A
VANADIUM 1.7 K C
Filtered Inorganics (ug/L)
BARIUM 32.9 C
CADMIUM 0.3 K A,C
IRON 133 C
VANADIUM 1.3 K C

MTC002
Inorganics (ug/L)
ALUMINUM 140 A
BARIUM 26.2
IRON 192
MANGANESE 38.8 A
VANADIUM 1.2 K C
Filtered Inorganics (ug/L)
BARIUM 25.9 C
CADMIUM 0.17 K C
VANADIUM 1 K C

MTC002 (DUP)
Inorganics (ug/L)
ALUMINUM 124 A
BARIUM 36.3
IRON 211
MANGANESE 40.7 A
VANADIUM 1.4 K C
Filtered Inorganics (ug/L)
BARIUM 24.4 C
CHROMIUM 9.7 K A,C
IRON 136 C
NICKEL 16.2 K A,C
VANADIUM 0.81 K C

MTC001
Inorganics (ug/L)
BARIUM 29.7
IRON 130
MANGANESE 28.3 K A
VANADIUM 1.3 K C
Filtered Inorganics (ug/L)
BARIUM 39.3 C
CADMIUM 0.22 K C
VANADIUM 1.2 K C

MTC005
Semivolatile Organics (ug/L)
BIS(2-ETHYLHEXYL)PHTHALATE 1 J C
Inorganics (ug/L)
ALUMINUM 351 A
BARIUM 28.3
CYANIDE 10 A
IRON 669 A,C
MANGANESE 147 A
VANADIUM 2.6 K C
Filtered Inorganics (ug/L)
VANADIUM 1.5 K C

IS17SW01
Inorganics (ug/L)
BARIUM 19 J
CYANIDE 6.2 L A
Filtered Inorganics (ug/L)
BARIUM 21.8 J C
BERYLLIUM 0.31 J C
COPPER 4.8 J A,C
IRON 456 A,C
MANGANESE 86.7 A
NICKEL 17.9 J A,C

IS17SW01 (DUP)
BARIUM 23.4 J
CYANIDE 2.2 L A
IRON 453 A
MANGANESE 93.9 A
NICKEL 2.5 K C
BARIUM 18.4 J C
MANGANESE 1.7 J

MTC029
Inorganics (ug/L)
BARIUM 21.5
IRON 193
MANGANESE 27.5 K A
VANADIUM 1.4 K C
Filtered Inorganics (ug/L)
BARIUM 37.5 C
VANADIUM 0.94 K C

MTC030
Inorganics (ug/L)
ARSENIC 4.4 K B,C
BARIUM 23.1
CYANIDE 4 A
IRON 102
MANGANESE 9.3 K
VANADIUM 0.73 K C
Filtered Inorganics (ug/L)
BARIUM 27.5 C
VANADIUM 0.74 K C

LEGEND

- CH2M Hill Sample Location
- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Surface Water Criteria.
B = Value exceeds the EPA Region 3 RBC for Tap Water.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SURFACE WATER SAMPLES
AREA 1
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 1	0

IS17SW01
Inorganics (ug/L)

BARIUM	19 J	
CALCIUM	10600	
CYANIDE	6.2 L	A
MAGNESIUM	5690	
POTASSIUM	2770 J	
SODIUM	13400	
Filtered Inorganics (ug/L)		
BARIUM	21.8 J	C
BERYLLIUM	0.31 J	C
CALCIUM	9120	
COPPER	4.8 J	A,C
IRON	456	A,C
MAGNESIUM	4840 J	
MANGANESE	86.7	A
NICKEL	17.9 J	A,C
POTASSIUM	2400 J	
SODIUM	11300	
Miscellaneous Parameters (various units)		
HARDNESS	42	(MG/L)

IS17SW01 (DUP)

BARIUM	23.4 J	
CALCIUM	10200	
CYANIDE	2.2 L	A
IRON	453	A
MAGNESIUM	5500	
MANGANESE	93.9	A
NICKEL	2.5 K	C
POTASSIUM	2790 J	
SODIUM	12200	
BARIUM	18.4 J	C
CALCIUM	10400	
MAGNESIUM	5660	
MANGANESE	1.7 J	
POTASSIUM	2800 J	
SODIUM	12800	
HARDNESS	48	(MG/L)

IS17SW02
Inorganics (ug/L)

ALUMINUM	664	A,C
BARIUM	24.7 J	
CALCIUM	10000	
COPPER	3.9 J	A,C
CYANIDE	10 L	A
IRON	725	A,C
MAGNESIUM	5300	
MANGANESE	87.4	A
POTASSIUM	2670 J	
SODIUM	12200	
VANADIUM	2.1 J	C
Filtered Inorganics (ug/L)		
BARIUM	17 J	C
CALCIUM	10100	
MAGNESIUM	5320	
POTASSIUM	2550 J	
SODIUM	12300	
Miscellaneous Parameters (various units)		
HARDNESS	44	(MG/L)
Energetics (ug/L)		
4-NITROTOLUENE	0.11 J	C

IS17SW03
Inorganics (ug/L)

ALUMINUM	553 J	A
BARIUM	25.8 J	
CALCIUM	10100	
COPPER	2.4 J	C
CYANIDE	1.1 L	A
IRON	981	A,C
LEAD	1.3 K	C
MAGNESIUM	5310	
MANGANESE	106	A
NICKEL	2.7 J	C
POTASSIUM	2700 J	
SODIUM	12100	
VANADIUM	2.1 J	C
Filtered Inorganics (ug/L)		
BARIUM	17.8 J	C
CALCIUM	10200	
IRON	28.2 J	C
MAGNESIUM	5470	
POTASSIUM	2710 J	
SODIUM	12900	
Miscellaneous Parameters (various units)		
HARDNESS	46	(MG/L)

IS17SW04
Inorganics (ug/L)

ALUMINUM	258	A
BARIUM	24 J	
CALCIUM	9950	
COPPER	4.5 J	A,C
IRON	576	A
MAGNESIUM	5140	
MANGANESE	105	A
NICKEL	3.5 J	C
POTASSIUM	2650 J	
SODIUM	15000	
VANADIUM	1.7 J	C
ZINC	24.2	A,C
Filtered Inorganics (ug/L)		
BARIUM	20.4 J	C
CALCIUM	10000	
COPPER	2.8 J	C
IRON	59.2 J	C
MAGNESIUM	5230	
NICKEL	3.1 J	C
POTASSIUM	2640 J	
SELENIUM	4.9 J	C
SODIUM	14900	
ZINC	29.9	A,C
Miscellaneous Parameters (various units)		
HARDNESS	40	(MG/L)

IS17SW05
Inorganics (ug/L)

BARIUM	25.2 J	
CALCIUM	10800	
COPPER	5 J	A,C
IRON	362	A
LEAD	1.9 J	C
MAGNESIUM	5600	
MANGANESE	105	A
NICKEL	2.8 J	C
POTASSIUM	2920 J	
SELENIUM	5.8	A,C
SODIUM	15800	
VANADIUM	1.5 J	C
ZINC	26	A,C
Filtered Inorganics (ug/L)		
BARIUM	20.7 J	C
CALCIUM	10700	
COPPER	2.2 J	C
MAGNESIUM	5630	
NICKEL	3.7 J	C
POTASSIUM	2840 J	
SODIUM	13700	
Miscellaneous Parameters (various units)		
HARDNESS	36	(MG/L)

IS17SW06
Inorganics (ug/L)

BARIUM	24.4 J	
CALCIUM	11800	
COPPER	5.4 J	A,C
IRON	227	
LEAD	7.3	A,C
MAGNESIUM	5900	
MANGANESE	95.9	A
NICKEL	2.8 J	C
POTASSIUM	3030 J	
SODIUM	15900	
ZINC	32.7	A,C
Filtered Inorganics (ug/L)		
BARIUM	21 J	C
CALCIUM	12200	
IRON	37.5 J	C
MAGNESIUM	6180	
NICKEL	3.3 J	C
POTASSIUM	3090 J	
SODIUM	14200	
Miscellaneous Parameters (various units)		
HARDNESS	42	(MG/L)

IS11SW01
Volatile Organics (ug/L)

METHYL TERT-BUTYL ETHER	1 J	C
Semivolatile Organics (ug/L)		
BIS(2-ETHYLHEXYL)PHTHALATE	1 J	C
Inorganics (ug/L)		
ALUMINUM	457	A
BARIUM	29 J	
CALCIUM	11500	
IRON	772	A,C
LEAD	38.4	A,B,C
MAGNESIUM	5920	
MANGANESE	127	A
POTASSIUM	2950 J	
SODIUM	13300	
VANADIUM	2 J	C
Filtered Inorganics (ug/L)		
BARIUM	23.6 J	C
CALCIUM	12000	
LEAD	1.3	C
MANGANESE	4.5 J	
POTASSIUM	2940 J	
SODIUM	13900	
Miscellaneous Parameters (various units)		
DIESEL RANGE ORGANICS	160	(UG/L) C
Energetics (ug/L)		
1,3-DINITROBENZENE	0.075 J	C

IS11SW02
Inorganics (ug/L)

ALUMINUM	239	A
BARIUM	24 J	
CALCIUM	10400	
IRON	475	A
LEAD	1.6 J	C
MAGNESIUM	5380	
MANGANESE	98.3	A
POTASSIUM	2670 J	
SODIUM	12200	
VANADIUM	1.5 J	C
Filtered Inorganics (ug/L)		
BARIUM	21.2 J	C
CALCIUM	11600	
MANGANESE	2.2 J	
POTASSIUM	2910 J	
SODIUM	14000	
Miscellaneous Parameters (various units)		
AMMONIUM PERCHLORATE	1.6 J	(UG/L) C
DIESEL RANGE ORGANICS	140	(UG/L) C
PERCHLORATE	1.36 J	(UG/L) C

IS11SW03
Inorganics (ug/L)

ALUMINUM	276	A
BARIUM	24.7 J	
CALCIUM	10700	
COPPER	4.2 J	A,C
IRON	564	A
LEAD	1.3 J	C
MAGNESIUM	5360	
MANGANESE	103	A
POTASSIUM	2630 J	
SODIUM	12000	
VANADIUM	1.5 J	C
Filtered Inorganics (ug/L)		
BARIUM	22 J	C
CALCIUM	11900	
COPPER	2.4 J	C
MAGNESIUM	5980	
POTASSIUM	2870 J	
SODIUM	13900	
Miscellaneous Parameters (various units)		
AMMONIUM PERCHLORATE	2.9 J	(UG/L) C
DIESEL RANGE ORGANICS	100	(UG/L) C
PERCHLORATE	2.46 J	(UG/L) C

IS11SW04
Inorganics (ug/L)

BARIUM	366	A
CALCIUM	26 J	
CALCIUM	10100	
COPPER	5.2 J	A,C
IRON	726	A,C
LEAD	6.1	A,C
MAGNESIUM	5190	
MANGANESE	111	A
POTASSIUM	2650 J	
SODIUM	11900	
Filtered Inorganics (ug/L)		
BARIUM	22.9 J	C
CALCIUM	11400	
MAGNESIUM	5910	
POTASSIUM	2910 J	
SODIUM	14300	
Miscellaneous Parameters (various units)		
AMMONIUM PERCHLORATE	3.6 J	(UG/L) C
DIESEL RANGE ORGANICS	120	(UG/L) C
PERCHLORATE	3.05 J	(UG/L) C

LEGEND

- CH2M Hill Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Surface Water Criteria.
B = Value exceeds the EPA Region 3 RBC for Tap Water.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SURFACE WATER SAMPLES
AREA 1 - CH2M HILL LOCATIONS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 2	0

500 0 500 Feet

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREATAGS.APR SW TAGS AREA2_3 3/21/03 KMP

LEGEND

- ● TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Surface Water Criteria.
B = Value exceeds the EPA Region 3 RBC for Tap Water.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY

11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SURFACE WATER SAMPLES
AREAS 2 AND 3
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 3	0

S39SD07/SW05
Inorganics (ug/L)

ALUMINUM	292 K	A
BARIUM	76.8	C
IRON	976 K	A,C
MANGANESE	143	A
NICKEL	3.0	C
VANADIUM	1.3	C
ZINC	30.4	A,C

S39SD04/SW04
Semivolatile Organics (ug/L)

BIS(2-ETHYLHEXYL)PHTHALATE	1 J	C

Inorganics (ug/L)

BARIUM	74.2	C
IRON	382 K	A
MANGANESE	83.4	A
NICKEL	1.9	C

S39SD05/SW03
Inorganics (ug/L)

BARIUM	72.8	C
IRON	326 K	A
MANGANESE	78.0	A
NICKEL	2.5	C

MTC018
Volatile Organics (ug/L)

TOLUENE	0.6 J	C

Inorganics (ug/L)

BARIUM	28.7	C
IRON	206	
MANGANESE	46.1	A
VANADIUM	0.88	C

Filtered Inorganics (ug/L)

BARIUM	27.2	C
MANGANESE	14 K	A
VANADIUM	0.7	C

S39SD03/SW02
Semivolatile Organics (ug/L)

BIS(2-ETHYLHEXYL)PHTHALATE	1 J	C

Inorganics (ug/L)

ALUMINUM	410	A
BARIUM	64.7	C
IRON	1060 K	A,C
LEAD	5.2 L	A,C
MANGANESE	153	A
NICKEL	2.4	C
SILVER	1.1	A,C
ZINC	31.5	A,C

S39SD03/SW02 (DUP)
Inorganics (ug/L)

ALUMINUM	918	A,C
BARIUM	64.8	C
COBALT	6.3	C
IRON	1620 K	A,C
LEAD	5.0 L	A,C
MANGANESE	202	A
NICKEL	4.0	C
SILVER	6.0	A,C
VANADIUM	2.5	C
ZINC	42.5	A,C

S39SD/SW01
Inorganics (ug/L)

BARIUM	72.3	C
IRON	300 K	A
MANGANESE	75.8	A
NICKEL	3.1	C

MTC017
Inorganics (ug/L)

BARIUM	31.4	
IRON	218	
MANGANESE	44.5	A
VANADIUM	1.2	C

Filtered Inorganics (ug/L)

BARIUM	26	C
CADMIUM	1.4 K	A,C
MANGANESE	22.3 K	A
VANADIUM	0.55	C

MTC024
Semivolatile Organics (ug/L)

BIS(2-ETHYLHEXYL)PHTHALATE	1 L	C

Inorganics (ug/L)

BARIUM	28.6	
IRON	322	A
MANGANESE	46.6	A
VANADIUM	1.1	C

Filtered Inorganics (ug/L)

BARIUM	28.8	C
CADMIUM	5.9 K	A,C
IRON	77.7	C
LEAD	66.9	A,B,C
MANGANESE	3.7 K	A
VANADIUM	0.54	C

MTC025
Inorganics (ug/L)

ALUMINUM	312	A
BARIUM	31.9	
IRON	632	A,C
MANGANESE	63.6	A
VANADIUM	1.7	C

Filtered Inorganics (ug/L)

BARIUM	26.1	C
CADMIUM	6.5 K	A,C
MANGANESE	22.5 K	A

MTC026
Volatile Organics (ug/L)

TOLUENE	2	C
TOTAL XYLENES	2	C

Semivolatile Organics (ug/L)

BIS(2-ETHYLHEXYL)PHTHALATE	1 J	C

Inorganics (ug/L)

ALUMINUM	227	A
BARIUM	30.5	
CHROMIUM	0.93 K	
IRON	324	A
MANGANESE	46.4	A

Filtered Inorganics (ug/L)

MTC026 (DUP)
Inorganics (ug/L)

BARIUM	28.6	
CHROMIUM	0.57 K	
IRON	197	
MANGANESE	39.1	A

MTC023
Inorganics (ug/L)

ALUMINUM	158	A
BARIUM	25.8	
IRON	384	A
MANGANESE	47.2	A
VANADIUM	1.4	C

Filtered Inorganics (ug/L)

BARIUM	20.8	C
CADMIUM	0.26 K	C
VANADIUM	0.48	C

MTC023 (DUP)
Semivolatile Organics (ug/L)

BIS(2-ETHYLHEXYL)PHTHALATE	1 J	C

Inorganics (ug/L)

ALUMINUM	298	A
BARIUM	25.8	
CADMIUM	0.21 K	C
IRON	460	A
MANGANESE	41.4	A
VANADIUM	1	C

Filtered Inorganics (ug/L)

BARIUM	22.4	C
CADMIUM	0.14 K	C
MANGANESE	33.6	A
VANADIUM	0.57	C

MTC022
Inorganics (ug/L)

ALUMINUM	161	A
BARIUM	28.9	
IRON	401	A
MANGANESE	50.3	A
VANADIUM	1.3	C

Filtered Inorganics (ug/L)

BARIUM	24.7	C
CADMIUM	0.66 K	A,C
VANADIUM	0.61	C

MTC021
Volatile Organics (ug/L)

CIS-1,2-DICHLOROETHENE	4	C
DIETHYL ETHER	6 J	C
TRICHLOROETHENE	6	B,C

Inorganics (ug/L)

ALUMINUM	200	A
ARSENIC	8.3 K	B,C
BARIUM	42.7	
COPPER	28.1 K	A,C
IRON	522	A
LEAD	1.3 K	C
MANGANESE	35.7	A
VANADIUM	7.4	C

Filtered Inorganics (ug/L)

ARSENIC	4.9	B,C
BARIUM	55.8 K	C
CADMIUM	2.5 K	A,C
COPPER	69.1	A,C
IRON	227	C
LEAD	32	A,B,C
MANGANESE	26.4 K	A
VANADIUM	3.4	C

MTC020
Inorganics (ug/L)

ALUMINUM	215	A
ARSENIC	4.2 K	B,C
BARIUM	29.9	
IRON	339	A
MANGANESE	53.5	A
VANADIUM	1.5	C

Filtered Inorganics (ug/L)

BARIUM	30.5	C
CADMIUM	1 K	A,C
LEAD	2.5 K	C
MANGANESE	6.4 K	
VANADIUM	0.93	C

S39SD08/SW06
Volatile Organics (ug/L)

TRICHLOROETHENE	1	B,C

Inorganics (ug/L)

BARIUM	63.9	C
IRON	410 K	A
MANGANESE	67.2	A
NICKEL	2.9	C
ZINC	16.0	C

MTC019
Inorganics (ug/L)

ALUMINUM	204	A
BARIUM	29	
IRON	296	
MANGANESE	45.7	A
VANADIUM	1.1	C

Filtered Inorganics (ug/L)

BARIUM	62.3	C
CADMIUM	0.48 K	A,C
MANGANESE	3.6 K	
VANADIUM	0.66	C

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Surface Water Criteria.
B = Value exceeds the EPA Region 3 RBC for Tap Water.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03

COST/SCHEDULE-AREA

SCALE
AS NOTED

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SURFACE WATER SAMPLES
AREAS 4 AND 5
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 4	0

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Surface Water Criteria.
B = Value exceeds the EPA Region 3 RBC for Tap Water.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
28 - Original Burning Ground
39 - Organics Plant
41 - Scrap Yard
57 - TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SURFACE WATER SAMPLES
AREA 4 - HISTORIC TtNUS LOCATIONS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 5	0

IS178D05		
Inorganics (mg/kg)		
ALUMINUM	13100	C
ANTIMONY	3.5 J	C
ARSENIC	17.8	A,B,C
BARIUM	95	A
BERYLLIUM	0.39 J	
CADMIUM	4.2	A,C
CHROMIUM	38.8	C
COBALT	12 J	A
COPPER	335	A,C
IRON	34100	A,B,C
LEAD	707 J	A,B,C
MANGANESE	305	A
MERCURY	0.34	A,C
NICKEL	39.4	A,C
SILVER	8.3	A,C
VANADIUM	28.1	
ZINC	712 J	A,C
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	39200	
Energetics (mg/kg)		
2,4,6-TRINITROTOLUENE	0.066 J	C
2-AMINO-4,6-DINITROTOLUENE	0.22 J	C

IS178D04		
Inorganics (mg/kg)		
ALUMINUM	1560	
ANTIMONY	1.3 J	C
ARSENIC	7.1	B,C
BARIUM	11 J	
BERYLLIUM	0.061 J	
CADMIUM	0.71 J	
CHROMIUM	27.5	C
COBALT	2.9 J	
COPPER	80.4	A,C
IRON	26900	A,B
LEAD	138 J	A,C
MANGANESE	172	
NICKEL	9.5 J	
VANADIUM	11.3 J	
ZINC	156 J	A,C

MTC005		
Volatile Organics (ug/kg)		
ACETONE	130 J	
Inorganics (mg/kg)		
ALUMINUM	4070	
ARSENIC	2.7 K	B
BARIUM	42.6	
BERYLLIUM	0.37	
CADMIUM	0.66 K	
CHROMIUM	7.9	
COBALT	2.2	
IRON	6000	
LEAD	6.1	
MANGANESE	109	
NICKEL	4.9	
VANADIUM	11.2	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.07199	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	69900	C

IS118D01		
Volatile Organics (ug/kg)		
2-BUTANONE	14 J	C
CHLOROMETHANE	14 J	C
Inorganics (mg/kg)		
ALUMINUM	8230	
ANTIMONY	22.8 L	C
ARSENIC	6.7 J	B,C
BARIUM	169	A,C
CADMIUM	1.2 L	
CHROMIUM	14.2 L	
COPPER	757 L	A,C
IRON	23100 J	A,B
LEAD	76400 J	A,B,C
MANGANESE	330 J	A
MERCURY	0.2	A,C
NICKEL	14.6 L	
SILVER	8.7	A,C
THALLIUM	4.2	C
VANADIUM	22.1	
ZINC	1310 J	A,C
Energetics (mg/kg)		
3-NITROTOLUENE	0.18 J	C

IS178D01		
Inorganics (mg/kg)		
ALUMINUM	837	
ARSENIC	2.1 J	B
BARIUM	7.6 J	
BERYLLIUM	0.2 J	
CADMIUM	0.13 J	
CHROMIUM	7	
COBALT	2.5 J	
COPPER	3 J	
IRON	7270	
LEAD	4.4 J	
MANGANESE	85.3	
VANADIUM	7.7 J	
ZINC	8.8 J	

MTC004		
Semivolatile Organics (ug/kg)		
ANTHRACENE	76 J	C
BAP EQUIVALENT	271.33	C
BENZO(A)ANTHRACENE	210 J	C
BENZO(A)PYRENE	210 J	B,C
BENZO(B)FLUORANTHENE	260 J	C
BENZO(G,H,I)PERYLENE	120 J	C
BENZO(K)FLUORANTHENE	110 J	C
CHRYSENE	230 J	C
DI-N-BUTYL PHTHALATE	630	C
DIETHYL PHTHALATE	99 J	C
FLUORANTHENE	410 J	C
HIGH MOLECULAR WEIGHT PAHS	2030	A,C
INDENO(1,2,3-CD)PYRENE	130 J	C
LOW MOLECULAR WEIGHT PAHS	366	C
PHENANTHRENE	290 J	A,C
PYRENE	350 J	C
TOTAL PAHS	2396	C
Pesticides/PCB's (ug/kg)		
AROCLOR-1248	170	A,C
Inorganics (mg/kg)		
ALUMINUM	3660	
ARSENIC	20	A,B,C
BARIUM	102	A
BERYLLIUM	0.98	
CADMIUM	0.77 K	
CHROMIUM	13.8	
COBALT	12.6 K	A
COPPER	18.4 L	
IRON	37100	A,B,C
LEAD	53.4	A,C
MANGANESE	1120	A,C
MERCURY	0.13	C
NICKEL	13.5 K	
SILVER	3.2 J	A,C
THALLIUM	2.9 L	C
VANADIUM	23.1	
ZINC	37.1 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	9.8476	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	15300	
Energetics (mg/kg)		
NITROCELLULOSE	3.6 J	
Field (%)		
PERCENT CLAY	4	
PERCENT GRAVEL	2.4	C
PERCENT SAND	79.4	
PERCENT SILT	14.2	

IS118D04		
Semivolatile Organics (ug/kg)		
BIS(2-ETHYLHEXYL)PHTHALATE	67 J	C
Inorganics (mg/kg)		
ALUMINUM	1900	
ANTIMONY	34.4 L	B,C
ARSENIC	18.9 J	A,B,C
BARIUM	112	A
CADMIUM	4.9 L	A,C
CHROMIUM	69.7 L	C
COBALT	14	A
COPPER	650 L	A,C
CYANIDE	0.12 J	C
IRON	129000 J	A,B,C
LEAD	1000 J	A,B,C
MANGANESE	940 J	A,C
MERCURY	0.11 J	C
NICKEL	46.4 L	A,C
SILVER	7.5	A,C
VANADIUM	14.1 J	
ZINC	1910 J	A,C
Miscellaneous Parameters (mg/kg)		
DIESEL RANGE ORGANICS	15	C
Energetics (mg/kg)		
4-NITROTOLUENE	0.14 J	C

MTC003		
Volatile Organics (ug/kg)		
ACETONE	11 J	
CARBON DISULFIDE	2 J	A
TOLUENE	0.8 J	C
Inorganics (mg/kg)		
ALUMINUM	2510	
ARSENIC	1.1 K	B
BARIUM	32	
BERYLLIUM	0.28	
CADMIUM	1 K	
CHROMIUM	7.2	
COBALT	6	
COPPER	8.6	
IRON	8000	
LEAD	15.8	
MANGANESE	157	
NICKEL	6.9 K	
SILVER	0.34 L	
VANADIUM	9.1	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.4261	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	5170	
Field (%)		
PERCENT CLAY	5.6	
PERCENT GRAVEL	12	C
PERCENT SAND	67.1	
PERCENT SILT	15.3	

MTC002		
Volatile Organics (ug/kg)		
ACETONE	47 J	
CARBON DISULFIDE	13 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	12.098	C
BENZO(B)FLUORANTHENE	120 J	C
CHRYSENE	98 J	C
FLUORANTHENE	160 J	C
HIGH MOLECULAR WEIGHT PAHS	518	C
LOW MOLECULAR WEIGHT PAHS	98	C
PHENANTHRENE	98 J	C
PYRENE	140 J	C
TOTAL PAHS	616	C
Inorganics (mg/kg)		
ALUMINUM	9710	
ARSENIC	6.6 K	B,C
BARIUM	112	A
BERYLLIUM	0.97	
CADMIUM	0.62 K	
CHROMIUM	24.1	
COBALT	17.5	A
COPPER	29.8	C
CYANIDE	4.7 J	A,C
IRON	24400	A,B
LEAD	43.4	C
MANGANESE	635	A
MERCURY	0.16	A,C
NICKEL	23.6 K	A,C
SILVER	1.4 L	A,C
VANADIUM	32.3	
ZINC	74.3 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.01627	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	20800	
Energetics (mg/kg)		
NITROCELLULOSE	2.7 J	
Field (%)		
PERCENT CLAY	11.3	
PERCENT GRAVEL	0	
PERCENT SAND	34.2	
PERCENT SILT	54.5	
MTC002 (DUP)		
Volatile Organics (ug/kg)		
ACETONE	66 J	
CARBON DISULFIDE	15	A
Inorganics (mg/kg)		
ALUMINUM	8630	
ARSENIC	4.2 K	B,C
BARIUM	101	A
BERYLLIUM	0.86	
CADMIUM	0.64 K	
CHROMIUM	21.4	
COBALT	15.2	A
COPPER	25.7	C
IRON	21600	A
LEAD	38.3	C
MANGANESE	575	A
NICKEL	20.5 K	
SILVER	1.2 L	A,C
VANADIUM	29.1	
ZINC	72.2 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.4539	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	21400	
Energetics (mg/kg)		
NITROCELLULOSE	2.5 J	
Field (%)		
PERCENT CLAY	19.8	
PERCENT GRAVEL	0	
PERCENT SAND	50	
PERCENT SILT	30.2	

MTC001		
Volatile Organics (ug/kg)		
ACETONE	51 J	
CARBON DISULFIDE	20	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	9.7	C
BENZO(B)FLUORANTHENE	97 J	C
FLUORANTHENE	110 J	C
HIGH MOLECULAR WEIGHT PAHS	307	C
PYRENE	100 J	C
TOTAL PAHS	307	C
Inorganics (mg/kg)		
ALUMINUM	12100	C
ARSENIC	7.1 K	B,C
BARIUM	124	A,C
BERYLLIUM	1.2	
CADMIUM	0.79 K	
CHROMIUM	28.2	C
COBALT	20	A,C
COPPER	37.4	A,C
IRON	30100	A,B,C
LEAD	60.5	A,C
MANGANESE	799	A
MERCURY	0.2	A,C
NICKEL	28.4 K	A,C
SILVER	1.3 L	A,C
VANADIUM	39	C
ZINC	89.7 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.15107	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	23400	
Field (%)		
PERCENT CLAY	16.5	
PERCENT GRAVEL	0	
PERCENT SAND	50.9	
PERCENT SILT	32.6	

MTC029		
Volatile Organics (ug/kg)		
ACETONE	7 J	
Inorganics (mg/kg)		
ALUMINUM	245	
BARIUM	5.5	
BERYLLIUM	0.13	
CADMIUM	0.59 K	
CHROMIUM	2.5 K	
COBALT	1.5	
IRON	6100	
LEAD	1.7	
MANGANESE	71.3	
NICKEL	1.3 K	
VANADIUM	6.4	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	550	

MTC030		
Volatile Organics (ug/kg)		
ACETONE	66 J	
CARBON DISULFIDE	16	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	7.5	C
BENZO(B)FLUORANTHENE	75 J	C
FLUORANTHENE	81 J	C
HIGH MOLECULAR WEIGHT PAHS	254	C
PYRENE	98 J	C
TOTAL PAHS	254	C
Inorganics (mg/kg)		
ALUMINUM	5300	
ARSENIC	3.1 K	B
BARIUM	59.2	A
BERYLLIUM	0.59	
CADMIUM	1.9 K	A
CHROMIUM	13.4	
COBALT	10.2	A
COPPER	11.5	
IRON	15800	
LEAD	19	
MANGANESE	393	A
NICKEL	11.2 K	
SILVER	0.4 L	
VANADIUM	18.7	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.10988	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	16000	
Energetics (mg/kg)		
NITROCELLULOSE	2 J	

IS118D03		
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	5.146	C
BENZO(B)FLUORANTHENE	51 J	C
BIS(2-ETHYLHEXYL)PHTHALATE	150 J	C
CHRYSENE	46 J	C
FLUORANTHENE	56 J	C
HIGH MOLECULAR WEIGHT PAHS	201	C
PYRENE	48 J	C
TOTAL PAHS	201	C
Inorganics (mg/kg)		
ALUMINUM	3740	
ANTIMONY	33.6 L	B,C
ARSENIC	24.5 J	A,B,C
BARIUM	50.4 J	A
CADMIUM	6.5 L	A,C
CHROMIUM	28.8 L	C
COBALT	7.4 J	
COPPER	343 L	A,C
IRON	134000 J	A,B,C
LEAD	375 J	A,C
MANGANESE	432 J	A
MERCURY	0.53	A,C
NICKEL	29.5 L	A,C
SELENIUM	1.7 L	A,C
SILVER	10.9	A,C
THALLIUM	1.5 J	C
VANADIUM	12.9	
ZINC	898 J	A,C
Miscellaneous Parameters (mg/kg)		
DIESEL RANGE ORGANICS	26	C

IS178D03		
Inorganics (mg/kg)		
ALUMINUM	5360	
ARSENIC	3.5	B
BARIUM	61.1	A
CHROMIUM	10	
COBALT	7.4 J	
COPPER	11.7	
IRON	10600	
LEAD	21.6 J	
MANGANESE	311	A
MERCURY	0.097 J	C
NICKEL	6 J	
VANADIUM	17.5	
ZINC	25.6 J	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	13000	
Energetics (mg/kg)		
2,4-DINITROTOLUENE	0.1 J	C

IS178D02		
Inorganics (mg/kg)		
ALUMINUM	5440	
ARSENIC	3.4	B
BARIUM	56.1	A
CHROMIUM	10.6	
COBALT	3.9 J	
COPPER	6.5	
IRON	11100	
LEAD	10.9 J	
MANGANESE	73.6	
MERCURY	0.062 J	C
NICKEL	5.6 J	
VANADIUM	17	
ZINC	23.5 J	
Energetics (mg/kg)		
1,3,5-TRINITROBENZENE	0.094 J	C
1,3-DINITROBENZENE	0.069 J	C
2,4,6-TRINITROTOLUENE	0.1 J	C
3-NITROTOLUENE	0.22 J	C

IS178D06		
Inorganics (mg/kg)		
ALUMINUM	11900	C
ANTIMONY	3.2 J	C
ARSENIC	32.7	A,B,C
BARIUM	85.8	A
BERYLLIUM	0.39 J	
CADMIUM	18.7	A,C
CHROMIUM	43.4	C
COBALT	12.2 J	A
COPPER	483	A,C
IRON	118000	A,B,C
LEAD	1140 J	A,B,C
MANGANESE	763	A
MERCURY	0.26	A,C
NICKEL	35.7	A,C
SILVER	4.5	A,C
VANADIUM	33.6	C
ZINC	939 J	A,C
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	52100	

IS115D02		
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	208.27	C
BENZO(A)ANTHRACENE	250 J	C
BENZO(A)PYRENE	77 J	C
BENZO(B)FLUORANTHENE	400 J	C
BENZO(K)FLUORANTHENE	170 J	C
CHRYSENE	370 J	C
DIBENZO(A,H)ANTHRACENE	55 J	C
FLUORANTHENE	300 J	C
HIGH MOLECULAR WEIGHT PAHS	1954	A,C
INDENO(1,2,3-CD)PYRENE	92 J	C
LOW MOLECULAR WEIGHT PAHS	79	C
PHENANTHRENE	79 J	C
PYRENE	240 J	C
TOTAL PAHS	2033	C
Inorganics (mg/kg)		
ALUMINUM	2450	
ANTIMONY	63.9 L	B,C
ARSENIC	15.2 J	A,B,C
BARIUM	86.4	A
CADMIUM	4.5 L	A,C
CHROMIUM	57.2 L	C
COBALT	6.3 J	
COPPER	149 L	A,C
IRON	8360 J	
LEAD	1160 J	A,B,C
MANGANESE	637 J	A
MERCURY	0.081 J	C
NICKEL	45.1 L	A,C
VANADIUM	16.1	
ZINC	847 J	A,C
Miscellaneous Parameters (mg/kg)		
DIESEL RANGE ORGANICS	13	C

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREA1TAGS.APR SD TAGS AREA1 3/21/03 KMP

LEGEND

- CH2M Hill Sample Location
- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
B = Value exceeds the EPA Region 3 RBC for Residential Soil.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREA 1
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 6	0

IS17SD01
Inorganics (mg/kg)

ALUMINUM	837	
ARSENIC	2.1 J	B
BARIUM	7.6 J	
BERYLLIUM	0.2 J	
CADMIUM	0.13 J	
CHROMIUM	7	
COBALT	2.5 J	
COPPER	3 J	
IRON	7270	
LEAD	4.4 J	
MAGNESIUM	108 J	
MANGANESE	85.3	
POTASSIUM	91.7 J	
VANADIUM	7.7 J	
ZINC	8.8 J	
Miscellaneous Parameters		
PERCENT MOISTURE	24.1	
PERCENT SOLIDS	79.7	
PH	7.1	

IS17SD02
Inorganics (mg/kg)

ALUMINUM	5440	
ARSENIC	3.4	B
BARIUM	56.1	A
CALCIUM	349 J	
CHROMIUM	10.6	
COBALT	3.9 J	
COPPER	6.5	
IRON	11100	
LEAD	10.9 J	
MAGNESIUM	563 J	
MANGANESE	73.6	
MERCURY	0.062 J	C
NICKEL	5.6 J	
POTASSIUM	340 J	
VANADIUM	13	
ZINC	23.5 J	
Miscellaneous Parameters		
PERCENT MOISTURE	19	
PERCENT SOLIDS	75.3	
PH	5.4	
Energetics (mg/kg)		
1,3,5-TRINITROBENZENE	0.094 J	A,C
1,3-DINITROBENZENE	0.069 J	A,C
2,4,6-TRINITROTOLUENE	0.1 J	A,C
3-NITROTOLUENE	0.22 J	C

IS17SD03
Inorganics (mg/kg)

ALUMINUM	5360	
ARSENIC	3.5	B
BARIUM	61.1	A
CALCIUM	441 J	
CHROMIUM	10	
COBALT	7.4 J	
COPPER	11.7	
IRON	10600	
LEAD	21.6 J	
MAGNESIUM	516 J	
MANGANESE	311	A
MERCURY	0.097 J	C
NICKEL	6 J	
POTASSIUM	356 J	
VANADIUM	17.5	
ZINC	25.6 J	
Miscellaneous Parameters		
PERCENT MOISTURE	24.8	
PERCENT SOLIDS	65.3	
PH	5.8	
TOTAL ORGANIC CARBON	13000	
Energetics (mg/kg)		
2,4-DINITROTOLUENE	0.1 J	C

IS17SD04
Inorganics (mg/kg)

ALUMINUM	1560	
ANTIMONY	1.3 J	C
ARSENIC	7.1	B,C
BARIUM	11 J	
BERYLLIUM	0.061 J	
CADMIUM	0.71 J	
CALCIUM	362 J	
CHROMIUM	27.5	C
COBALT	2.9 J	
COPPER	80.4	A,C
IRON	26900	A,B
LEAD	138 J	A,C
MAGNESIUM	181 J	
MANGANESE	172	
NICKEL	9.5 J	
POTASSIUM	94.8 J	
SODIUM	372 J	
VANADIUM	11.3 J	
ZINC	156 J	A,C
Miscellaneous Parameters		
PERCENT MOISTURE	22.6	
PERCENT SOLIDS	81	
PH	6.8	

IS17SD05
Inorganics (mg/kg)

ALUMINUM	13100	C
ANTIMONY	3.5 J	C
ARSENIC	17.8	A,B,C
BARIUM	95	A
BERYLLIUM	0.39 J	
CADMIUM	4.2	A,C
CALCIUM	1750 J	C
CHROMIUM	38.8	C
COBALT	12 J	A
COPPER	335	A,C
IRON	34100	A,B,C
LEAD	707 J	A,B,C
MAGNESIUM	1550	
MANGANESE	905	A
MERCURY	0.34	A,C
NICKEL	39.4	A,C
POTASSIUM	796 J	
SILVER	8.3	A,C
SODIUM	521 J	
VANADIUM	28.1	
ZINC	712 J	A,C
Miscellaneous Parameters		
PERCENT MOISTURE	21.4	
PERCENT SOLIDS	79.5	
PH	7.1	
TOTAL ORGANIC CARBON	39200 (mg/kg)	
Energetics (mg/kg)		
2,4,6-TRINITROTOLUENE	0.066 J	C
2-AMINO-4,6-DINITROTOLUENE	0.22 J	C

IS17SD06
Inorganics (mg/kg)

ALUMINUM	11900	C
ANTIMONY	3.2 J	C
ARSENIC	32.7	A,B,C
BARIUM	85.8	A
BERYLLIUM	0.39 J	
CADMIUM	18.7	A,C
CALCIUM	3350 J	C
CHROMIUM	43.4	C
COBALT	12.2 J	A
COPPER	483	A,C
IRON	118000	A,B,C
LEAD	1140 J	A,B,C
MAGNESIUM	1510 J	
MANGANESE	763	A
MERCURY	0.26	A,C
NICKEL	35.7	A,C
POTASSIUM	581 J	
SILVER	4.5	A,C
SODIUM	604 J	
VANADIUM	33.6	C
ZINC	939 J	A,C
Miscellaneous Parameters		
PERCENT MOISTURE	39.6	
PERCENT SOLIDS	60.2	
PH	7.5	
TOTAL ORGANIC CARBON	52100	

IS11SD01
Volatile Organics (ug/kg)

2-BUTANONE	14 J	C
CHLOROMETHANE	14 J	C
Inorganics (mg/kg)		
ALUMINUM	8230	
ANTIMONY	22.8 L	C
ARSENIC	6.9 J	B,C
BARIUM	169	A,C
CADMIUM	1.2 L	
CALCIUM	3610 J	C
CHROMIUM	14.2 L	
COPPER	757 L	A,C
IRON	23100 J	A,B
LEAD	76400 J	A,B,C
MAGNESIUM	2660 J	
MANGANESE	330 J	A
MERCURY	0.2	A,C
NICKEL	14.6 L	
POTASSIUM	454 J	
SILVER	8.7	A,C
THALLIUM	4.2	C
VANADIUM	22.1	
ZINC	1310 J	A,C
Miscellaneous Parameters		
PERCENT MOISTURE	26.6	
Energetics (mg/kg)		
3-NITROTOLUENE	0.18 J	C

IS11SD02
Semivolatile Organics (ug/kg)

BAP EQUIVALENT	208.27	C
BENZO(A)ANTHRACENE	250 J	C
BENZO(A)PYRENE	77 J	C
BENZO(B)FLUORANTHENE	400 J	C
BENZO(K)FLUORANTHENE	170 J	C
CHRYSENE	370 J	C
DIBENZO(A,H)ANTHRACENE	55 J	C
FLUORANTHENE	300 J	C
HIGH MOLECULAR WEIGHT PAHS	1954	A,C
INDENO(1,2,3-CD)PYRENE	92 J	C
LOW MOLECULAR WEIGHT PAHS	79	C
PHENANTHRENE	79 J	C
PYRENE	240 J	C
TOTAL PAHS	2033	C
Inorganics (mg/kg)		
ALUMINUM	2450	
ANTIMONY	63.9 L	B,C
ARSENIC	15.2 J	A,B,C
BARIUM	86.4	A
CADMIUM	4.5 L	A,C
CALCIUM	22100 J	C
CHROMIUM	57.2 L	C
COBALT	6.3 J	
COPPER	149 L	A,C
IRON	8360 J	
LEAD	1160 J	A,B,C
MAGNESIUM	3190 J	
MANGANESE	637 J	A
MERCURY	0.081 J	C
NICKEL	45.1 L	A,C
POTASSIUM	182 J	
VANADIUM	16.1	
ZINC	847 J	A,C
Miscellaneous Parameters		
DIESEL RANGE ORGANICS	13 (mg/kg)	
PERCENT MOISTURE	24.3	

IS11SD03
Semivolatile Organics (ug/kg)

BAP EQUIVALENT	3.146	C
BENZO(B)FLUORANTHENE	51 J	C
BIS(2-ETHYLHEXYL)PHTHALATE	150 J	C
CHRYSENE	46 J	C
FLUORANTHENE	56 J	C
HIGH MOLECULAR WEIGHT PAHS	201	C
PYRENE	48 J	C
TOTAL PAHS	201	C
Inorganics (mg/kg)		
ALUMINUM	3740	
ANTIMONY	33.6 L	B,C
ARSENIC	24.5 J	A,B,C
BARIUM	50.4 J	A
CADMIUM	6.5 L	A,C
CALCIUM	632 J	
CHROMIUM	28.8 L	C
COBALT	7.4 J	
COPPER	343 L	A,C
IRON	134000 J	A,B,C
LEAD	375 J	A,C
MAGNESIUM	717 J	
MANGANESE	432 J	A
MERCURY	0.53	A,C
NICKEL	29.5 L	A,C
POTASSIUM	164 J	
SELENIUM	1.7 L	A,C
SILVER	10.9	A,C
THALLIUM	1.5 J	C
VANADIUM	12.9	
ZINC	898 J	A,C
Miscellaneous Parameters		
DIESEL RANGE ORGANICS	26 (mg/kg)	
PERCENT MOISTURE	22.1	

IS11SD04
Semivolatile Organics (ug/kg)

BIS(2-ETHYLHEXYL)PHTHALATE	67 J	C
Inorganics (mg/kg)		
ALUMINUM	1900	
ANTIMONY	34.4 L	B,C
ARSENIC	18.9 J	A,B,C
BARIUM	112	A
CADMIUM	4.9 L	A,C
CALCIUM	1070 J	
CHROMIUM	69.7 L	C
COBALT	14	A
COPPER	650 L	A,C
CYANIDE	0.12 J	C
IRON	129000 J	A,B,C
LEAD	1000 J	A,B,C
MAGNESIUM	688 J	
MANGANESE	940 J	A,C
MERCURY	0.11 J	C
NICKEL	46.4 L	A,C
POTASSIUM	131 J	
SILVER	7.5	A,C
VANADIUM	14.1 J	
ZINC	1910 J	A,C
Miscellaneous Parameters		
DIESEL RANGE ORGANICS	15	
PERCENT MOISTURE	21.2	
Energetics (mg/kg)		
4-NITROTOLUENE	0.14 J	C

200 0 200 Feet

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MATTAWOMANCREEKAREA1AGS.APR CH2MHILL_1_SD 3/21/03 KMP

LEGEND

- CH2M Hill Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
B = Value exceeds the EPA Region 3 RBC for Residential Soil.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

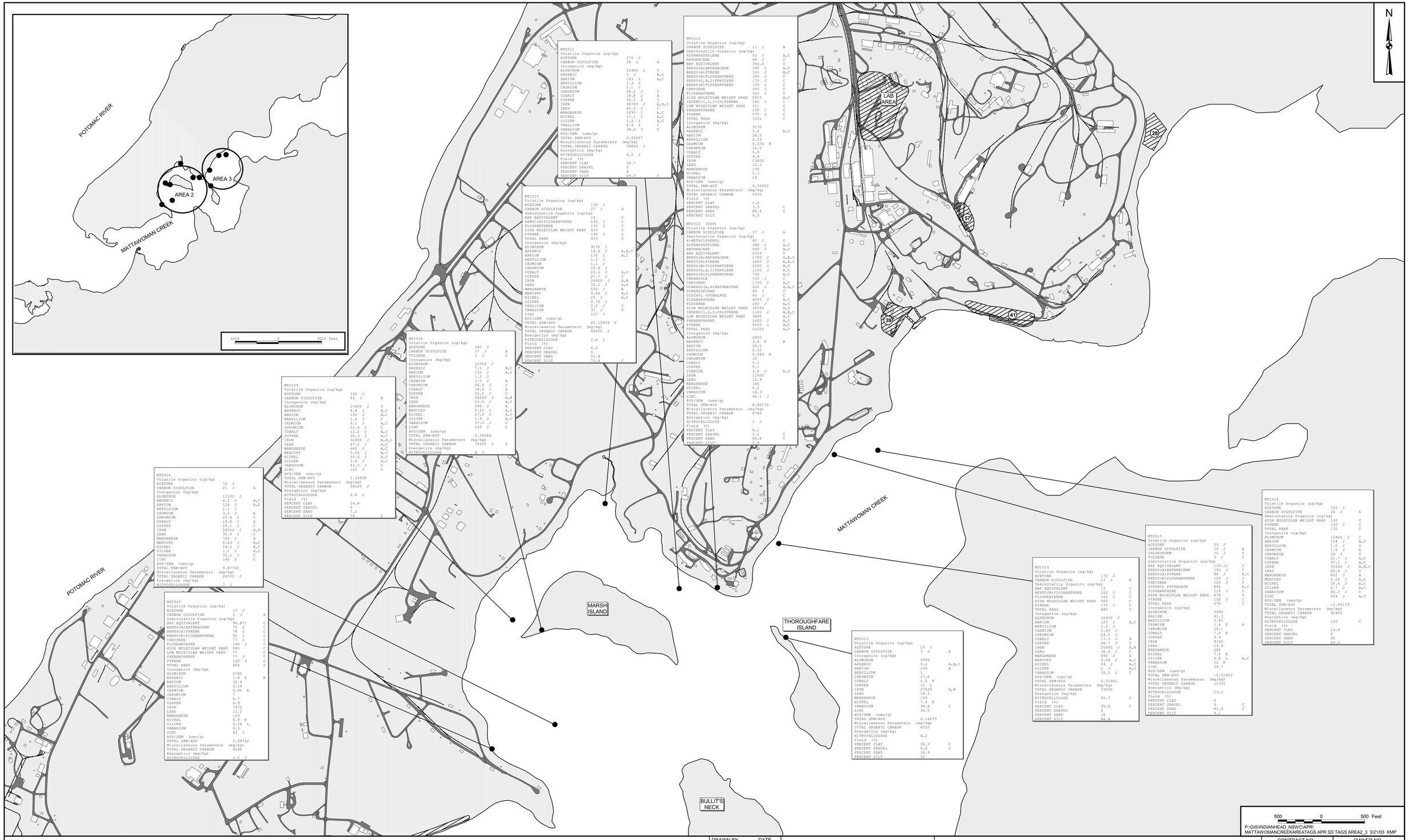
SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline

DRAWN BY K. PEILA	DATE 1/27/03
CHECKED BY G. LATULIPPE	DATE 1/27/03
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREA 1 - CH2M HILL LOCATIONS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO. 4019	OWNER NO. 0820
APPROVED BY G. LATULIPPE	DATE 1/27/03
APPROVED BY	DATE
DRAWING NO. FIGURE 4 - 7	REV. 0



MTC011		
Volatile Organics (ug/kg)		
ACETONE	170 J	
CARBON DISULFIDE	28 J	A
Inorganics (mg/kg)		
ALUMINUM	12400 J	C
ARSENIC	5 J	B,C
BARIUM	143 J	A,C
BERYLLIUM	1.3 J	
CADMIUM	1.1 J	
CHROMIUM	28.2 J	C
COBALT	18.8 J	A
COPPER	30.2 J	C
IRON	30700 J	A,B,C
LEAD	43.5 J	C
MANGANESE	1030 J	A,C
NICKEL	27.1 J	A,C
SILVER	1.3 J	A,C
THALLIUM	2.9 J	C
VANADIUM	38.6 J	C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	3.09267	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	34600 J	
Energetics (mg/kg)		
NITROCELLULOSE	9.2 J	
Field (%)		
PERCENT CLAY	26.7	
PERCENT GRAVEL	0	
PERCENT SAND	4	
PERCENT SILT	69.3	C

MTC010		
Volatile Organics (ug/kg)		
ACETONE	110 J	
CARBON DISULFIDE	27 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	14	C
BENZO(B)FLUORANTHENE	140 J	C
FLUORANTHENE	130 J	C
HIGH MOLECULAR WEIGHT PAHS	410	C
PYRENE	140 J	C
TOTAL PAHS	410	C
Inorganics (mg/kg)		
ALUMINUM	9130 J	
ARSENIC	14.6 J	A,B,C
BARIUM	130 J	A,C
BERYLLIUM	1.1 J	
CADMIUM	1.1 J	
CHROMIUM	22.4 J	
COBALT	22.6 J	A,C
COPPER	27.7 J	C
IRON	24600 J	A,B
LEAD	54.2 J	A,C
MANGANESE	530 J	A
MERCURY	0.54 J	A,C
NICKEL	25 J	A,C
SILVER	0.76 J	
THALLIUM	2.2 J	C
VANADIUM	37 J	C
ZINC	107 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	20.12979	C
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	40800 J	
Energetics (mg/kg)		
NITROCELLULOSE	2.4 J	
Field (%)		
PERCENT CLAY	6.2	
PERCENT GRAVEL	0	
PERCENT SAND	21.4	
PERCENT SILT	72.4	C

MTC008		
Volatile Organics (ug/kg)		
ACETONE	140 J	
CARBON DISULFIDE	37 J	A
TOLUENE	3 J	C
Inorganics (mg/kg)		
ALUMINUM	10700 J	
ARSENIC	7.5 J	B,C
BARIUM	130 J	A,C
BERYLLIUM	1.2 J	
CADMIUM	3.5 J	A
CHROMIUM	26.9 J	C
COBALT	18.4 J	A
COPPER	33.3 J	C
IRON	26200 J	A,B
LEAD	50.2 J	A,C
MANGANESE	596 J	A
MERCURY	0.22 J	A,C
NICKEL	27.9 J	A,C
SILVER	1.3 J	A,C
VANADIUM	37.5 J	C
ZINC	148 J	C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.58989	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	74200 J	C
Energetics (mg/kg)		
NITROCELLULOSE	4 J	

MTC009		
Volatile Organics (ug/kg)		
ACETONE	160 J	
CARBON DISULFIDE	45 J	A
Inorganics (mg/kg)		
ALUMINUM	13400 J	C
ARSENIC	6.8 J	B,C
BARIUM	152 J	A,C
BERYLLIUM	1.4 J	C
CADMIUM	4.1 J	A,C
CHROMIUM	31.6 J	C
COBALT	22.2 J	A,C
COPPER	36.3 J	A,C
IRON	32800 J	A,B,C
LEAD	47.2 J	A,C
MANGANESE	945 J	A,C
MERCURY	0.24 J	A,C
NICKEL	30.6 J	A,C
SILVER	1.4 J	A,C
VANADIUM	43.5 J	C
ZINC	143 J	C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.36658	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	56100 J	
Energetics (mg/kg)		
NITROCELLULOSE	3.8 J	
Field (%)		
PERCENT CLAY	14.8	
PERCENT GRAVEL	0	
PERCENT SAND	7.2	
PERCENT SILT	78	C

MTC006		
Volatile Organics (ug/kg)		
ACETONE	72 J	
CARBON DISULFIDE	21 J	A
Inorganics (mg/kg)		
ALUMINUM	11100 J	
ARSENIC	4.2 J	B,C
BARIUM	129 J	A,C
BERYLLIUM	1.1 J	
CADMIUM	3.2 J	A
CHROMIUM	25.4 J	C
COBALT	16.8 J	A
COPPER	26.1 J	C
IRON	26500 J	A,B
LEAD	35.5 J	C
MANGANESE	703 J	A
MERCURY	0.23 J	A,C
NICKEL	24.2 J	A,C
SILVER	1.2 J	A,C
VANADIUM	35.1 J	C
ZINC	146 J	C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	9.87702	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	26700 J	
Energetics (mg/kg)		
NITROCELLULOSE	7.7 J	

MTC007		
Volatile Organics (ug/kg)		
ACETONE	13 J	
CARBON DISULFIDE	2 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	96.877	C
BENZO(A)ANTHRACENE	76 J	C
BENZO(A)PYRENE	78 J	C
BENZO(B)FLUORANTHENE	92 J	C
CHRYSENE	77 J	C
FLUORANTHENE	140 J	C
HIGH MOLECULAR WEIGHT PAHS	583	C
LOW MOLECULAR WEIGHT PAHS	77	C
PHENANTHRENE	77 J	C
PYRENE	120 J	C
TOTAL PAHS	660	C
Inorganics (mg/kg)		
ALUMINUM	2790	
ARSENIC	1.9 K	B
BARIUM	32.4	
BERYLLIUM	0.29	
CADMIUM	0.95 K	
CHROMIUM	7	
COBALT	6.7	
COPPER	6.9	
IRON	7470	
LEAD	11.2	
MANGANESE	123	
NICKEL	6.9 K	
SILVER	0.24 L	
VANADIUM	9.3	
ZINC	43 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	2.89762	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	8240	
Energetics (mg/kg)		
NITROCELLULOSE	2.5 J	

MTC012		
Volatile Organics (ug/kg)		
CARBON DISULFIDE	11 J	A
Semivolatile Organics (ug/kg)		
ACENAPHTHYLENE	52 J	A,C
ANTHRACENE	49 J	C
BAP EQUIVALENT	392.6	C
BENZO(A)ANTHRACENE	290 J	A,C
BENZO(A)PYRENE	310 J	B,C
BENZO(B)FLUORANTHENE	340 J	C
BENZO(G,H,I)PERYLENE	170 J	C
BENZO(K)FLUORANTHENE	130 J	C
CHRYSENE	300 J	C
FLUORANTHENE	520 J	C
HIGH MOLECULAR WEIGHT PAHS	2810	A,C
INDENO(1,2,3-CD)PYRENE	180 J	C
LOW MOLECULAR WEIGHT PAHS	311	C
PHENANTHRENE	190 J	C
PYRENE	570 J	C
TOTAL PAHS	3121	C
Inorganics (mg/kg)		
ALUMINUM	3170	
ARSENIC	5.6	B,C
BARIUM	24.5	
BERYLLIUM	0.39	
CADMIUM	0.074 K	
CHROMIUM	16.5	
COBALT	5.9	
COPPER	4.4	
IRON	13800	
LEAD	10.3	
MANGANESE	135	
NICKEL	5.3	
VANADIUM	16	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.36452	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	5350	
Field (%)		
PERCENT CLAY	1.6	
PERCENT GRAVEL	3.5	C
PERCENT SAND	88.4	C
PERCENT SILT	6.5	
MTC012 (DUP)		
Volatile Organics (ug/kg)		
CARBON DISULFIDE	37 J	A
Semivolatile Organics (ug/kg)		
4-METHYLPHENOL	80 J	C
ACENAPHTHYLENE	340 J	A,C
ANTHRACENE	540 J	A,C
BAP EQUIVALENT	2509	C
BENZO(A)ANTHRACENE	1700 J	A,B,C
BENZO(A)PYRENE	1800 J	A,B,C
BENZO(B)FLUORANTHENE	2000 J	B,C
BENZO(G,H,I)PERYLENE	1100 J	A,C
BENZO(K)FLUORANTHENE	730	A,C
CARBAZOLE	110 J	C
CHRYSENE	1700 J	A,C
DIBENZO(A,H)ANTHRACENE	220 J	A,B,C
DIBENZOFURAN	80 J	C
DIETHYL PHTHALATE	65 J	C
FLUORANTHENE	4000 J	A,C
FLUORENE	180 J	A,C
HIGH MOLECULAR WEIGHT PAHS	18350	A,C
INDENO(1,2,3-CD)PYRENE	1100 J	A,B,C
LOW MOLECULAR WEIGHT PAHS	3660	A,C
PHENANTHRENE	2600 J	A,C
PYRENE	4000 J	A,C
TOTAL PAHS	22010	A,C
Inorganics (mg/kg)		
ALUMINUM	2800	
ARSENIC	3.6 K	B
BARIUM	26.5	
BERYLLIUM	0.32	
CADMIUM	0.084 K	
CHROMIUM	12	
COBALT	5.5	
COPPER	5.1	
CYANIDE	3.8 J	A,C
IRON	11800	
LEAD	12.9	
MANGANESE	164	
NICKEL	4.2	
VANADIUM	16.3	
ZINC	46.1 J	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	8.82176	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	8780	
Energetics (mg/kg)		
NITROCELLULOSE	2 J	
Field (%)		
PERCENT CLAY	6.1	
PERCENT GRAVEL	2.2	C
PERCENT SAND	85.8	C
PERCENT SILT	5.9	

MTC013		
Volatile Organics (ug/kg)		
ACETONE	13 J	
CARBON DISULFIDE	3 J	A
Inorganics (ug/kg)		
ALUMINUM	5590	
ARSENIC	9.6	A,B,C
BARIUM	106	A
BERYLLIUM	1	
CHROMIUM	17.6	
COBALT	5.5 K	
COPPER	15 L	
IRON	27400	A,B
LEAD	19.3	
MANGANESE	144	
NICKEL	7.4 K	
VANADIUM	34.6	C
ZINC	36.5	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.16479	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	4310	
Energetics (mg/kg)		
NITROCELLULOSE	4.2	
Field (%)		
PERCENT CLAY	30.3	C
PERCENT GRAVEL	4.8	C
PERCENT SAND	34.9	
PERCENT SILT	30	

MTC014		
Volatile Organics (ug/kg)		
ACETONE	170 J	
CARBON DISULFIDE	17 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	15	C
BENZO(B)FLUORANTHENE	150 J	C
FLUORANTHENE	160 J	C
HIGH MOLECULAR WEIGHT PAHS	480	C
PYRENE	170 J	C
TOTAL PAHS	480	C
Inorganics (ug/kg)		
ALUMINUM	10400 J	
BARIUM	120 J	A,C
BERYLLIUM	1.2 J	
CADMIUM	0.93 J	
CHROMIUM	24.5 J	
COBALT	17.3 J	A
COPPER	28.7 J	C
IRON	25900 J	A,B
LEAD	36.5 J	C
MANGANESE	693 J	A
MERCURY	0.24 J	A,C
NICKEL	24 J	A,C
SILVER	2 J	A,C
VANADIUM	35.1 J	C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	5.31961	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	33000	
Energetics (mg/kg)		
NITROCELLULOSE	65.7	C
Field (%)		
PERCENT CLAY	35.6	C
PERCENT GRAVEL	0	
PERCENT SAND	18	
PERCENT SILT	46.4	

MTC015		
Volatile Organics (ug/kg)		
ACETONE	53 J	
CARBON DISULFIDE	10 J	A
CHLOROFORM	10 J	C
TOLUENE	3 J	C
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	118.12	C
BENZO(A)ANTHRACENE	100 J	C
BENZO(A)PYRENE	96 J	B,C
BENZO(B)FLUORANTHENE	120 J	C
CHRYSENE	120 J	C
DIETHYL PHTHALATE	840	A,C
FLUORANTHENE	110 J	C
HIGH MOLECULAR WEIGHT PAHS	676	C
PYRENE	130 J	C
TOTAL PAHS	676	C
Inorganics (ug/kg)		
ALUMINUM	3290	
BARIUM	41.3	
BERYLLIUM	0.43	
CADMIUM	1.4 K	A
CHROMIUM	10.1	
COBALT	7.4 K	
COPPER	9.9	
IRON	9190	
LEAD	13.4	
MANGANESE	208	
NICKEL	7.8 K	
SILVER	4.8 L	A,C
VANADIUM	12 K	
ZINC	59.7	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-0.01653	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	11300	
Energetics (mg/kg)		
NITROCELLULOSE	23.2	
Field (%)		
PERCENT CLAY	6	
PERCENT GRAVEL	3	C
PERCENT SAND	81.9	C
PERCENT SILT	9.1	

MTC016		
Volatile Organics (ug/kg)		
ACETONE	100 J	
CARBON DISULFIDE	20 J	A
Semivolatile Organics (ug/kg)		
HIGH MOLECULAR WEIGHT PAHS	130	C
PYRENE	130 J	C
TOTAL PAHS	130	C
Inorganics (ug/kg)		
ALUMINUM	12400 J	C
BARIUM	154 J	A,C
BERYLLIUM	1.5 J	C
CADMIUM	1.5 J	A
CHROMIUM	29 J	C
COBALT	21.7 J	A,C
COPPER	37.1 J	A,C
IRON	31500 J	A,B,C
LEAD	45.8 J	C
MANGANESE	851	A
MERCURY	0.22 J	A,C
NICKEL	28.4 J	A,C
SILVER	2.7 J	A,C
VANADIUM	40.3 J	C
ZINC	204 J	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-2.04119	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	42400	
Energetics (mg/kg)		
NITROCELLULOSE	122	C
Field (%)		
PERCENT CLAY	14.6	
PERCENT GRAVEL	0	
PERCENT SAND	25	
PERCENT SILT	60.4	

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
B = Value exceeds the EPA Region 3 RBC for Residential Soil.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

SITE KEY
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREAS 2 AND 3
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 8	0

S39SD06
Volatile Organics (ug/kg)

CARBON DISULFIDE	10 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	11.12	C
BENZO(B)FLUORANTHENE	110 J	C
BIS(2-ETHYLHEXYL)PHTHALATE	86 J	C
CHRYSENE	120 J	C
DI-N-BUTYL PHTHALATE	470 J	C
FLUORANTHENE	97 J	C
HIGH MOLECULAR WEIGHT PAHS	437	C
LOW MOLECULAR WEIGHT PAHS	77	C
N-NITROSODIPHENYLAMINE	180 J	A,C
PHENANTHRENE	77 J	C
PYRENE	110 J	C
TOTAL PAHS	514	C
Inorganics (ug/kg)		
ALUMINUM	1920	
ARSENIC	5.0	B,C
BARIUM	32.7	
BERYLLIUM	0.19	
CHROMIUM	5.4 J	
COBALT	2.6	
COPPER	6.6	
IRON	5510	
LEAD	14.5	
MANGANESE	46.6	
MERCURY	0.29	A,C
NICKEL	4.2	
SILVER	1.7	A,C
VANADIUM	6.8	
ZINC	27.3 K	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.58627	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	29200	
Energetics (mg/kg)		
NITROCELLULOSE	158	C

S39SD08
Volatile Organics (ug/kg)

2-BUTANONE	200 J	C
ACETONE	1100 J	A,C
CARBON DISULFIDE	14 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	22.6	C
BENZO(A)ANTHRACENE	95 J	C
BENZO(B)FLUORANTHENE	130 J	C
BIS(2-ETHYLHEXYL)PHTHALATE	88 J	C
CHRYSENE	100 J	C
DI-N-BUTYL PHTHALATE	640 J	C
FLUORANTHENE	170 J	C
HIGH MOLECULAR WEIGHT PAHS	655	C
LOW MOLECULAR WEIGHT PAHS	150	C
N-NITROSODIPHENYLAMINE	3100 J	A,C
PHENANTHRENE	150 J	C
PYRENE	160 J	C
TOTAL PAHS	805	C
Pesticides/PCB*s (ug/kg)		
4,4'-DDD	6 J	C
4,4'-DDE	4.1 J	A,C
Inorganics (ug/kg)		
ALUMINUM	13400	C
ARSENIC	12.2	A,B,C
BARIUM	92.6	A
BERYLLIUM	0.44	
CADMIUM	0.88	
CHROMIUM	24.3 J	
COBALT	10.4	A
COPPER	28.2	C
IRON	23600	A,B
LEAD	61.4	A,C
MANGANESE	310	A
MERCURY	2.0	A,C
NICKEL	17.1	
SILVER	6.8	A,C
VANADIUM	33.5	C
ZINC	188 K	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-37.5003	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	37700	
Energetics (mg/kg)		
NITROCELLULOSE	1580	C

MTC020
Volatile Organics (ug/kg)

ACETONE	19 J	
CARBON DISULFIDE	3 J	A
DIETHYL ETHER	6 J	C
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	48 J	C
ACENAPHTHENE	50 J	A,C
ANTHRACENE	160 J	A,C
BAP EQUIVALENT	998.29	C
BENZO(A)ANTHRACENE	720	A,C
BENZO(A)PYRENE	700	A,B,C
BENZO(B)FLUORANTHENE	1100	B,C
BENZO(G,H,I)PERYLENE	270 J	C
BENZO(K)FLUORANTHENE	350 J	A,C
CARBAZOLE	96 J	C
CHRYSENE	790	A,C
DIBENZO(A,H)ANTHRACENE	83 J	A,C
FLUORANTHENE	1100	A,C
FLUORENE	64 J	A,C
HIGH MOLECULAR WEIGHT PAHS	6403	A,C
INDENO(1,2,3-CD)PYRENE	290 J	C
LOW MOLECULAR WEIGHT PAHS	942	A,C
N-NITROSODIPHENYLAMINE	270 J	A,C
NAPHTHALENE	50 J	C
PHENANTHRENE	570	A,C
PYRENE	1000	A,C
TOTAL PAHS	7345	A,C
Inorganics (ug/kg)		
ALUMINUM	2140	
ARSENIC	13.9	A,B,C
BARIUM	92.6	A
BERYLLIUM	0.79	
CADMIUM	0.35 K	
CHROMIUM	9.7	
COBALT	10.7 K	A
COPPER	15.6	
CYANIDE	0.18	C
IRON	15600	
LEAD	16.3	
MANGANESE	101	
MERCURY	0.13	C
NICKEL	16.8 K	
THALLIUM	1.3	C
VANADIUM	31.7	
ZINC	59.4	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.29488	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	43400	
Energetics (mg/kg)		
NITROCELLULOSE	80.7	C
Field (%)		
PERCENT CLAY	1.2	
PERCENT GRAVEL	3.4	C
PERCENT SAND	92.6	C
PERCENT SILT	2.8	

S39SD04
Semivolatile Organics (ug/kg)

BIS(2-ETHYLHEXYL)PHTHALATE	410 J	C
Inorganics (ug/kg)		
ALUMINUM	834	
ANTIMONY	0.69 L	C
ARSENIC	1.8	B
BARIUM	7.6	
BERYLLIUM	0.29	
CHROMIUM	12.3 J	
COBALT	8.1	
COPPER	6.7	
IRON	14200	
LEAD	15.9	
MANGANESE	83.3	
MERCURY	0.05	C
NICKEL	21.1	A
SILVER	308	A,C
VANADIUM	9.3	
ZINC	63.4 K	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.39136	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	1460	
Energetics (mg/kg)		
NITROCELLULOSE	135	C

MTC018
Volatile Organics (ug/kg)

ACETONE	110 J	
CARBON DISULFIDE	7 J	A
Inorganics (ug/kg)		
ALUMINUM	9010 J	
BARIUM	119 J	A,C
BERYLLIUM	1.1 J	
CADMIUM	1.3 J	A
CHROMIUM	21.6 J	
COBALT	15.7 J	A
COPPER	25.7 J	
IRON	24100 J	A,B
LEAD	34.4 J	C
MANGANESE	932 J	A,C
MERCURY	0.37 J	A,C
NICKEL	20.6 J	
SILVER	1.5 J	A,C
VANADIUM	30 J	
ZINC	158 J	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	2.79199	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	45700	
Energetics (mg/kg)		
NITROCELLULOSE	226	C
Field (%)		
PERCENT CLAY	17.8	
PERCENT GRAVEL	0	
PERCENT SAND	55.1	
PERCENT SILT	27.1	

S39SD03
Semivolatile Organics (ug/kg)

BIS(2-ETHYLHEXYL)PHTHALATE	48 J	C
Pesticides/PCB*s (ug/kg)		
ALPHA-BHC	0.7 J	C
Inorganics (ug/kg)		
ALUMINUM	990	
ARSENIC	3.6 K	B
BARIUM	7.8	
BERYLLIUM	0.61	
CADMIUM	0.81 K	
CHROMIUM	27.8 J	C
COBALT	13.8	A
COPPER	27.6	C
IRON	20700	A
LEAD	87.9	A,C
MANGANESE	121	
MERCURY	0.1	C
NICKEL	39.8	A,C
SILVER	66.4	A,C
VANADIUM	8.1	
ZINC	151 K	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.81443	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	1400	
Energetics (mg/kg)		
NITROCELLULOSE	23.5	

S39SD02
Inorganics (ug/kg)

ALUMINUM	1310	
ARSENIC	3.6	B
BARIUM	35.4	
BERYLLIUM	0.44	
CADMIUM	0.21	
CHROMIUM	8.9 J	
COBALT	34.7	A,C
COPPER	4.8	
IRON	9860	
LEAD	15.6	
MANGANESE	620	A
MERCURY	0.02	C
NICKEL	7.9	
SILVER	2.6	A,C
VANADIUM	8.7	
ZINC	65.2 K	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.35846	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	1070	

S39SD01
Inorganics (ug/kg)

ALUMINUM	3670	
ARSENIC	3.2	B
BARIUM	16.3	
BERYLLIUM	0.18	
CHROMIUM	7.4 J	
COBALT	24.1	A,C
COPPER	5.4	
IRON	11300	
LEAD	7.5	
MANGANESE	162	
MERCURY	0.02	C
NICKEL	4.4	
VANADIUM	11.2	
ZINC	18.7 K	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.14918	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	1480	

MTC017
Semivolatile Organics (ug/kg)

BAP EQUIVALENT	190.68	C
BENZO(A)ANTHRACENE	150 J	C
BENZO(A)PYRENE	150 J	B,C
BENZO(B)FLUORANTHENE	170 J	C
BENZO(G,H,I)PERYLENE	71 J	C
BENZO(K)FLUORANTHENE	83 J	C
CHRYSENE	150 J	C
FLUORANTHENE	200 J	C
HIGH MOLECULAR WEIGHT PAHS	1241	C
INDENO(1,2,3-CD)PYRENE	77 J	C
PYRENE	190 J	C
TOTAL PAHS	1241	C
Inorganics (ug/kg)		
ALUMINUM	975	
BARIUM	8.8	
BERYLLIUM	0.25	
CADMIUM	0.42 K	
CHROMIUM	5.4	
COBALT	2 K	
COPPER	6.8 K	
IRON	3840	
LEAD	10.5	
MANGANESE	28.2	
NICKEL	3.1 K	
VANADIUM	6.2 K	
ZINC	13.3	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	2.69658	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	2370	
Energetics (mg/kg)		
NITROCELLULOSE	2.6	
Field (%)		
PERCENT CLAY	0.2	
PERCENT GRAVEL	44.3	C
PERCENT SAND	52.3	
PERCENT SILT	3.2	

S39SD05
Volatile Organics (ug/kg)

CARBON DISULFIDE	4 J	A
Inorganics (ug/kg)		
ALUMINUM	3000	
ARSENIC	1.6	B
BARIUM	22.4	
BERYLLIUM	0.17	
CHROMIUM	5.9 J	
COBALT	5.0	
COPPER	3.8	
IRON	4960	
LEAD	6.7	
MANGANESE	48.7	
MERCURY	0.03	C
NICKEL	4.5	
SILVER	0.27	
VANADIUM	8.9	
ZINC	21.0 K	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	0.23589	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	9800	
Energetics (mg/kg)		
NITROCELLULOSE	27.4	

MTC019
Volatile Organics (ug/kg)

CARBON DISULFIDE	16 J	A
TOLUENE	4 J	C
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	25.22	C
BENZO(B)FLUORANTHENE	250 J	C
CHRYSENE	220 J	C
FLUORANTHENE	170 J	C
HIGH MOLECULAR WEIGHT PAHS	820	C
N-NITROSODIPHENYLAMINE	140 J	A,C
PYRENE	180 J	C
TOTAL PAHS	820	C
Inorganics (ug/kg)		
ALUMINUM	13900 J	C
BARIUM	163 J	A,C
BERYLLIUM	1.6 J	C
CADMIUM	1.7 J	A
CHROMIUM	30.7 J	C
COBALT	21.2 J	A,C
COPPER	35.2 J	A,C
IRON	34000 J	A,B,C
LEAD	46.5 J	C
MANGANESE	1470 J	A,C
MERCURY	0.26 J	A,C
NICKEL	28.6 J	A,C
SILVER	1.6 J	A,C
THALLIUM	2.7 J	C
VANADIUM	41.7 J	C
ZINC	210 J	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	3.04193	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	44000	
Energetics (mg/kg)		
NITROCELLULOSE	213	C
Field (%)		
PERCENT CLAY	19.8	
PERCENT GRAVEL	0	
PERCENT SAND	8.4	
PERCENT SILT	71.8	

S39SD07
Volatile Organics (ug/kg)

2-BUTANONE	390	C
ACETONE	2400 J	A,C
CARBON DISULFIDE	23 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	13.16	C
BENZO(B)FLUORANTHENE	130 J	C
CHRYSENE	160 J	C
DI-N-BUTYL PHTHALATE	620 J	C
FLUORANTHENE	190 J	C
HIGH MOLECULAR WEIGHT PAHS	720	C
LOW MOLECULAR WEIGHT PAHS	150	C
N-NITROSODIPHENYLAMINE	2000 J	A,C
PHENANTHRENE	150 J	C
PYRENE	240 J	C
TOTAL PAHS	870	C
Pesticides/PCB*s (ug/kg)		
4,4'-DDD	7.7 J	C
4,4'-DDE	6 J	A,C
Inorganics (ug/kg)		
ALUMINUM	19600	A,C
ARSENIC	16.6	A,B,C
BARIUM	98.9	A
BERYLLIUM	1.0	
CHROMIUM	32.3 J	C
COBALT	15.7	A
COPPER	49.1	A,C
IRON	43800	A,B,C
LEAD	58.1	A,C
MANGANESE	384	A
MERCURY	8.7	A,C
NICKEL	25.6	A,C
SILVER	26.8	A,C
VANADIUM	49.7	C
ZINC	273 K	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-17.92843	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	40500	
Energetics (mg/kg)		
NITROCELLULOSE	1460	C

MTC021
Volatile Organics (ug/kg)

ACETONE	34 J	
CIS-1,2-DICHLOROETHENE	2 J	C
DIETHYL ETHER	57 J	C
TRICHLOROETHENE	5 J	C
Semivolatile Organics (ug/kg)		
2-METHYLNAPHTHALENE	85 J	A,C
ACENAPHTHENE	120 J	A,C
ACENAPHTHYLENE	83 J	A,C
ANTHRACENE	480 J	A,C
BAP EQUIVALENT	1476.4	C
BENZO(A)ANTHRACENE	1400	A,B,C
BENZO(A)PYRENE	1000 J	A,B,C
BENZO(B)FLUORANTHENE	1500 J	B,C
BENZO(G,H,I)PERYLENE	330 J	C
BENZO(K)FLUORANTHENE	1500 J	A,C
CARBAZOLE	140 J	C
CHRYSENE	1400	A,C
DIBENZO(A,H)ANTHRACENE	130 J	A,B,C
DIBENZOFURAN	94 J	C
FLUORANTHENE	2600	A,C
FLUORENE	200 J	A,C
HIGH MOLECULAR WEIGHT PAHS	12560	A,C
INDENO(1,2,3-CD)PYRENE	400 J	C
LOW MOLECULAR WEIGHT PAHS	2539	A,C
N-NITROSODIPHENYLAMINE	4800 J	A,C
NAPHTHALENE	71 J	C
PHENANTHRENE	1500	A,C
PYRENE	2300	A,C
TOTAL PAHS	15099	A,C
Inorganics (ug/kg)		
ALUMINUM	4200	
ARSENIC	16.1	A,B,C
BARIUM	114	A,C
BERYLLIUM	0.8	
CADMIUM	1.2 K	
CHROMIUM	18.6	
COBALT	17 K	A
COPPER	120	A,C
IRON	21600	A
LEAD	85.7	A,C
MANGANESE	294	A
MERCURY	0.7	A,C
NICKEL	37.6	A,C
SILVER	1.2 L	A,C
THALLIUM	5.9	C
VANADIUM	53.4	C
ZINC	216	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	7.23572	
Miscellaneous Parameters (mg/kg)		
TOTAL ORGANIC CARBON	40200	
Energetics (mg/kg)		
NITROCELLULOSE	4780	C
Field (%)		
PERCENT CLAY	6.7	
PERCENT GRAVEL	1	C
PERCENT SAND	82.7	C
PERCENT SILT	9.6	

500 0 500 Feet

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREA4TAGS.APR SD TAGS AREA4 3/21/03 KMP

LEGEND

- TINUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
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J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

SITE KEY
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREA 4
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 9	0

MTC023
Volatile Organics (ug/kg)

ACETONE	100 J	
CARBON DISULFIDE	7 J	A
Inorganics (ug/kg)		
ALUMINUM	9860	
BARIUM	103	A
BERYLLIUM	1	
CADMIUM	1.3 K	A
CHROMIUM	21.3	
COBALT	11.3 K	A
COPPER	24.1	C
IRON	22300	A
LEAD	43.5	C
MANGANESE	522	A
MERCURY	0.12	C
NICKEL	16.2 K	
SILVER	3.3 L	A,C
VANADIUM	29.5 K	
ZINC	117	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	1.63255	
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	38100	
Energetics (mg/kg)		
NITROCELLULOSE	265	C
Field (%)		
PERCENT CLAY	13.4	
PERCENT GRAVEL	0	
PERCENT SAND	31.7	
PERCENT SILT	54.9	

MTC023 (DUP)
Volatile Organics (ug/kg)

ACETONE	150 J	
CARBON DISULFIDE	16 J	A
CHLOROFORM	12 J	C
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	117.18	C
BENZO(A)PYRENE	95 J	B,C
BENZO(B)FLUORANTHENE	220 J	C
CHRYSENE	180 J	C
FLUORANTHENE	180 J	C
HIGH MOLECULAR WEIGHT PAHS	855	C
N-NITROSODIPHENYLAMINE	500 J	A,C
PYRENE	180 J	C
TOTAL PAHS	855	C
Inorganics (ug/kg)		
ALUMINUM	9710	
BARIUM	112	A
BERYLLIUM	1.1	
CADMIUM	1.4 K	A
CHROMIUM	22.6	
COBALT	13.1 K	A
COPPER	25.9	C
IRON	25200	A,B
LEAD	47.2	A,C
MANGANESE	684	A
MERCURY	0.21	A,C
NICKEL	17.8 K	
SILVER	5.9 L	A,C
VANADIUM	32 K	
ZINC	128	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-0.27257	
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	41600	
Energetics (mg/kg)		
NITROCELLULOSE	277	C
Field (%)		
PERCENT CLAY	12.8	
PERCENT GRAVEL	0	
PERCENT SAND	29.2	
PERCENT SILT	58	

MTC024
Volatile Organics (ug/kg)

ACETONE	150 J	
CARBON DISULFIDE	13 J	A
Semivolatile Organics (ug/kg)		
N-NITROSODIPHENYLAMINE	120 J	A,C
Inorganics (ug/kg)		
ALUMINUM	7210	
BARIUM	84.9	A
BERYLLIUM	0.8	
CADMIUM	2.3 K	A
CHROMIUM	16.2	
COBALT	9.7 K	
COPPER	12.7	
IRON	15400	
LEAD	18.7	
MANGANESE	401	A
MERCURY	0.12	C
NICKEL	11.9 K	
SILVER	0.43 L	
VANADIUM	23 K	
ZINC	74.2	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	3.44154	
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	44700	
Energetics (mg/kg)		
HMX	0.1 J	A
NITROCELLULOSE	112	C
Field (%)		
PERCENT CLAY	20.1	
PERCENT GRAVEL	1.7	C
PERCENT SAND	47.2	
PERCENT SILT	31	

MTC025
Volatile Organics (ug/kg)

ACETONE	18 J	
CARBON DISULFIDE	5 J	A
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	137.1	C
BENZO(A)ANTHRACENE	70 J	C
BENZO(A)PYRENE	110 J	B,C
BENZO(B)FLUORANTHENE	140 J	C
BENZO(G,H,I)PERYLENE	51 J	C
BENZO(K)FLUORANTHENE	50 J	C
CHRYSENE	100 J	C
FLUORANTHENE	43 J	C
HIGH MOLECULAR WEIGHT PAHS	759	C
INDENO(1,2,3-CD)PYRENE	55 J	C
PYRENE	120 J	C
TOTAL PAHS	759	C
Inorganics (ug/kg)		
ALUMINUM	545	
ARSENIC	13.8	A,B,C
BARIUM	8.7	
BERYLLIUM	0.11	
CADMIUM	0.4 K	
CHROMIUM	1.8 K	
IRON	1710	
LEAD	16	
MANGANESE	33.9	
VANADIUM	3.5 K	
ZINC	35.3	
AVS/SEM (umo/g)		
TOTAL SEM-AVS	-0.42754	
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	1800	
Energetics (mg/kg)		
NITROCELLULOSE	6.9	
Field (%)		
PERCENT CLAY	5.1	
PERCENT GRAVEL	11.6	C
PERCENT SAND	81.4	C
PERCENT SILT	1.9	

MTC026
Volatile Organics (ug/kg)

ACETONE	42	
Inorganics (ug/kg)		
ALUMINUM	1130	
ARSENIC	70.7 J	A,B,C
BARIUM	29.6	
BERYLLIUM	0.16	
CADMIUM	116 J	A,B,C
CHROMIUM	10.9 K	
COBALT	3.2 K	
COPPER	229 J	A,C
IRON	14000	
LEAD	3010 J	A,B,C
MANGANESE	80.2 J	
NICKEL	8.7 K	
SILVER	0.4 L	
THALLIUM	2.4 K	C
VANADIUM	7.4 K	
ZINC	71000 J	A,B,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	734.96312	C
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	5040 J	
Energetics (mg/kg)		
NITROCELLULOSE	57.5 J	C
Field (%)		
PERCENT CLAY	0.4	
PERCENT GRAVEL	43.6	C
PERCENT SAND	54.6	
PERCENT SILT	1.4	

MTC026 (DUP)
Volatile Organics (ug/kg)

ACETONE	32	
Semivolatile Organics (ug/kg)		
N-NITROSODIPHENYLAMINE	42 J	A,C
Inorganics (ug/kg)		
ALUMINUM	993	
ARSENIC	45.5 J	A,B,C
BARIUM	19.1	
BERYLLIUM	0.16	
CADMIUM	43.8 J	A,C
CHROMIUM	7.6 K	
COBALT	1.6 K	
COPPER	92.4 J	A,C
IRON	9620	
LEAD	1330 J	A,B,C
MANGANESE	46.1 J	
NICKEL	3.7 K	
SILVER	0.12 L	
THALLIUM	1.1 K	C
VANADIUM	6.9 K	
ZINC	52800 J	A,B,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	963.08542	C
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	2640 J	
Energetics (mg/kg)		
NITROCELLULOSE	27.4 J	
Field (%)		
PERCENT CLAY	2	
PERCENT GRAVEL	37.7	C
PERCENT SAND	59.1	
PERCENT SILT	1.2	

MTC022
Volatile Organics (ug/kg)

ACETONE	140 J	
CARBON DISULFIDE	21 J	A
METHYL TERT-BUTYL ETHER	3 J	C
Semivolatile Organics (ug/kg)		
BAP EQUIVALENT	140.14	C
BENZO(A)ANTHRACENE	120 J	C
BENZO(A)PYRENE	110 J	B,C
BENZO(B)FLUORANTHENE	180 J	C
CHRYSENE	140 J	C
FLUORANTHENE	170 J	C
HIGH MOLECULAR WEIGHT PAHS	960	C
N-NITROSODIPHENYLAMINE	240 J	A,C
PYRENE	240 J	C
TOTAL PAHS	960	C
Inorganics (ug/kg)		
ALUMINUM	9450	
BARIUM	122	A,C
BERYLLIUM	1.2	
CADMIUM	1.7 K	A
CHROMIUM	23.1	
COBALT	15.9 K	A
COPPER	28.3	C
IRON	23300	A,B
LEAD	43.6	C
MANGANESE	691	A
MERCURY	0.34	A,C
NICKEL	22 K	A
SILVER	3.4 L	A,C
VANADIUM	33.6 K	C
ZINC	183	A,C
AVS/SEM (umo/g)		
TOTAL SEM-AVS	2.31363	
Miscellaneous Parameters	(mg/kg)	
TOTAL ORGANIC CARBON	46000	
Energetics (mg/kg)		
NITROCELLULOSE	399	C

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
B = Value exceeds the EPA Region 3 RBC for Residential Soil.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

SITE KEY

28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREA 5
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREATAGS.APR SD TAGS AREA5 3/21/03 KMP

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 10	0

LEGEND

- CH2M Hill Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the Ecological Sediment Criteria.
B = Value exceeds the EPA Region 3 RBC for Residential Soil.
C = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.
L = The associated value may be biased low. The actual value is expected to be higher than reported.

SITE KEY
11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
28 - Original Burning Ground
39 - Organics Plant
41 - Scrap Yard
57 - TCE Building 292 Area

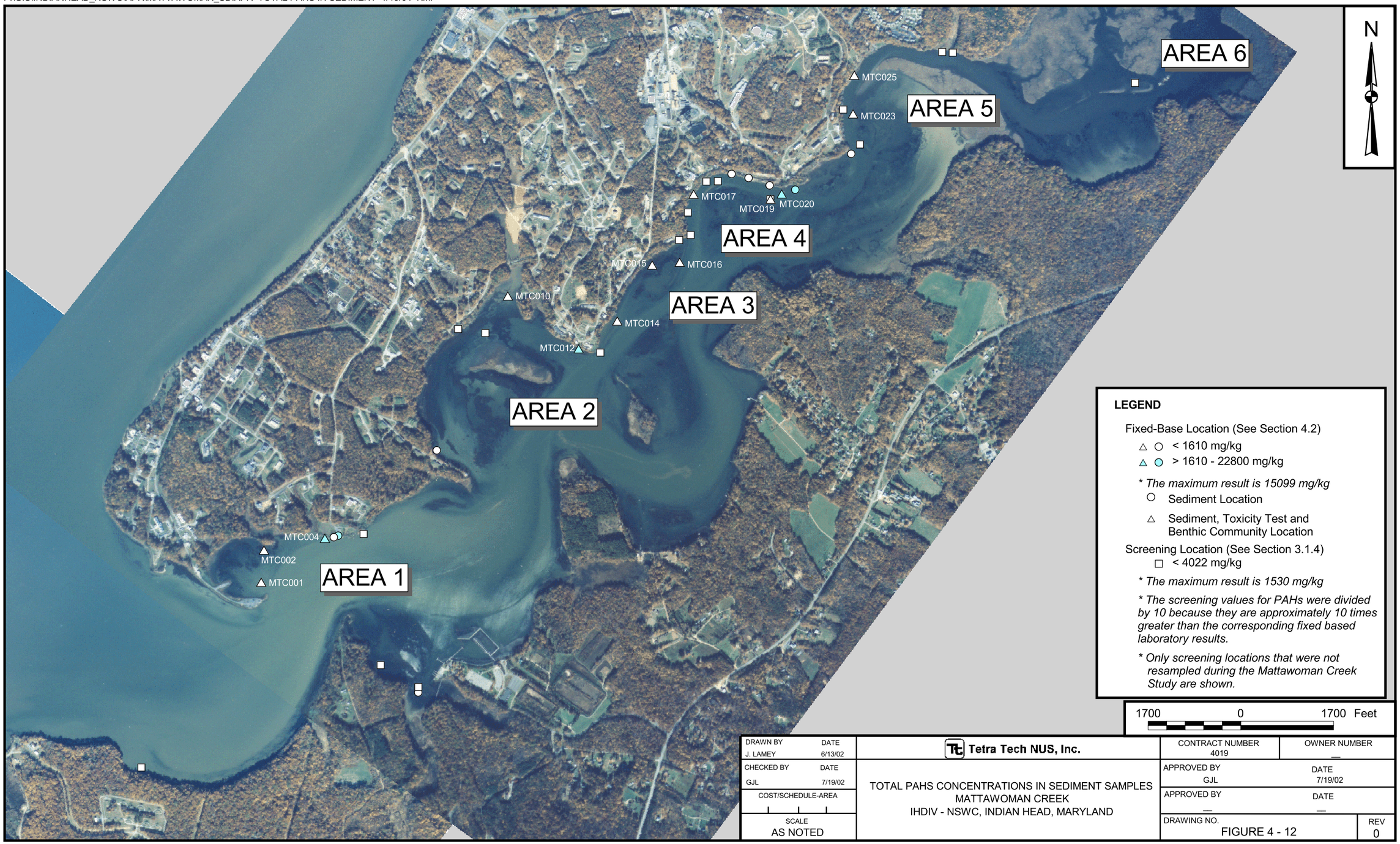
DRAWN BY K. PEILA	DATE 1/27/03
CHECKED BY G. LATULIPPE	DATE 1/27/03
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN SEDIMENT SAMPLES
AREA 4 - HISTORIC TtNUS LOCATIONS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

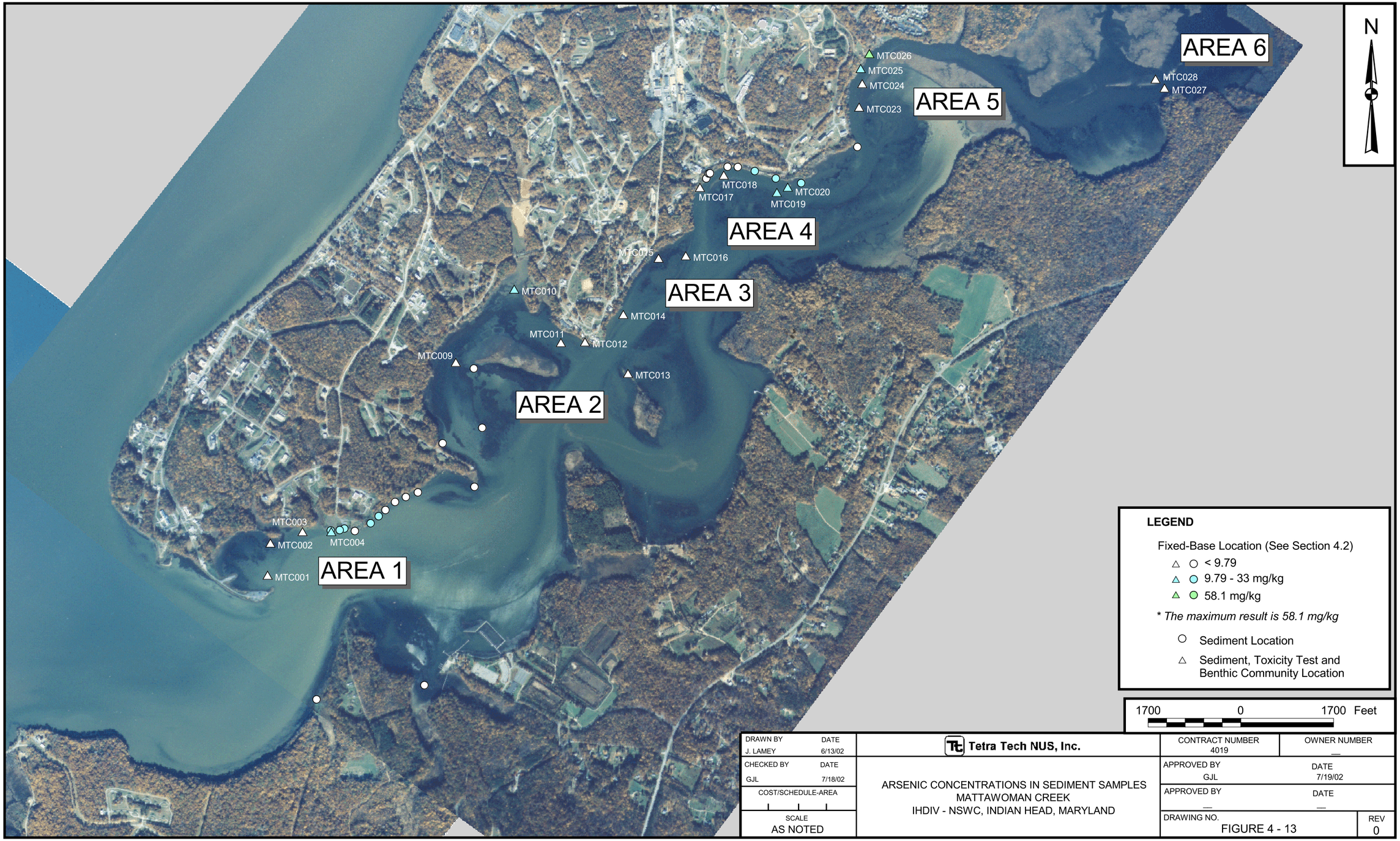
CONTRACT NO. 4019	OWNER NO. 0820
APPROVED BY G. LATULIPPE	DATE 1/27/03
APPROVED BY	DATE
DRAWING NO. FIGURE 4 - 11	REV. 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR TOTAL PAHS IN SEDIMENT 1/19/04 KMP



DRAWN BY J. LAMEY DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL DATE 7/19/02	TOTAL PAHS CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL DATE 7/19/02	
COST/SCHEDULE-AREA		APPROVED BY — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 4 - 12	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR ARSENIC IN SEDIMENT 1/19/04 KMP

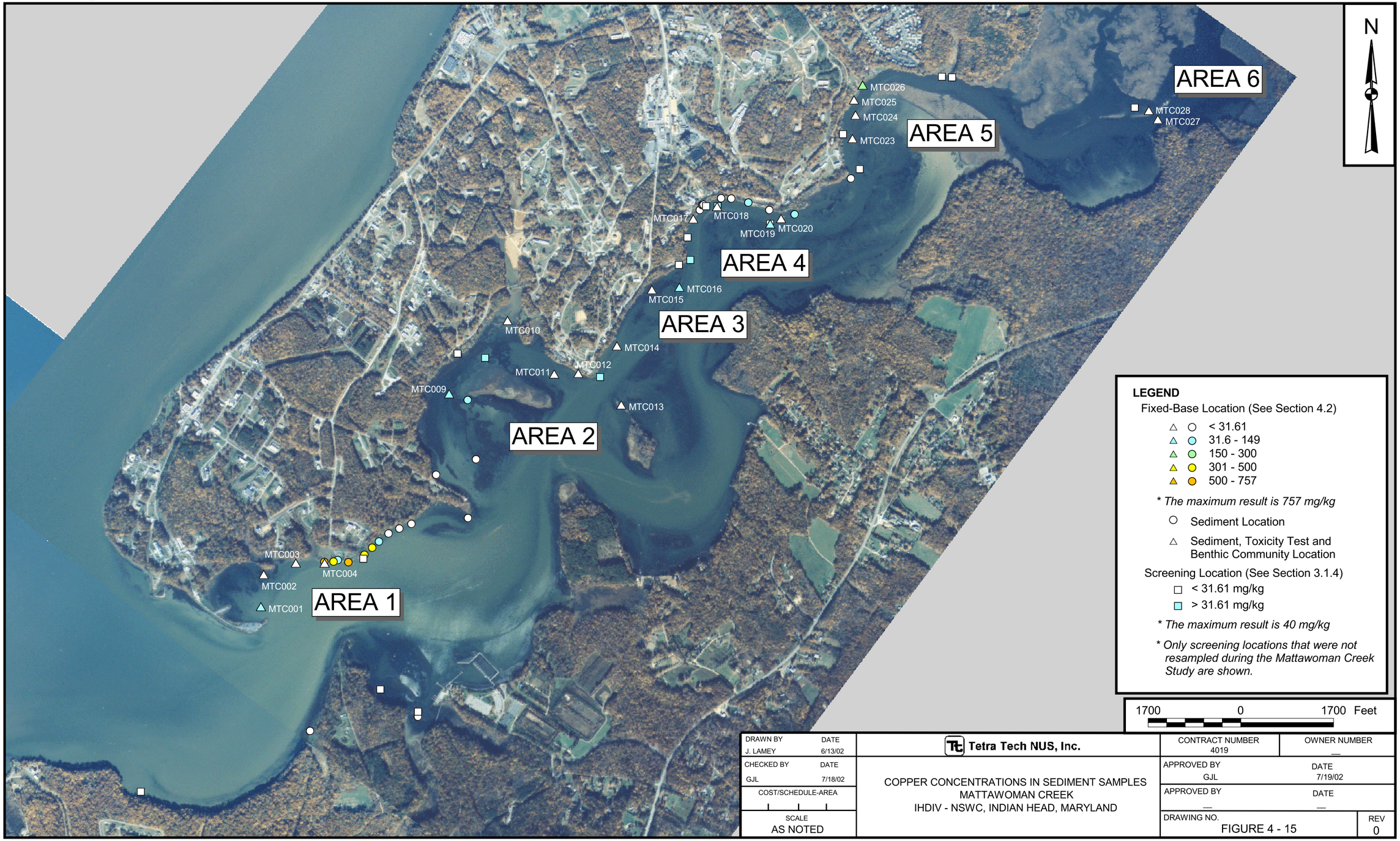


DRAWN BY J. LAMEY	DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	ARSENIC CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 13	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR CADMIUM IN SEDIMENT 1/19/04 KMP

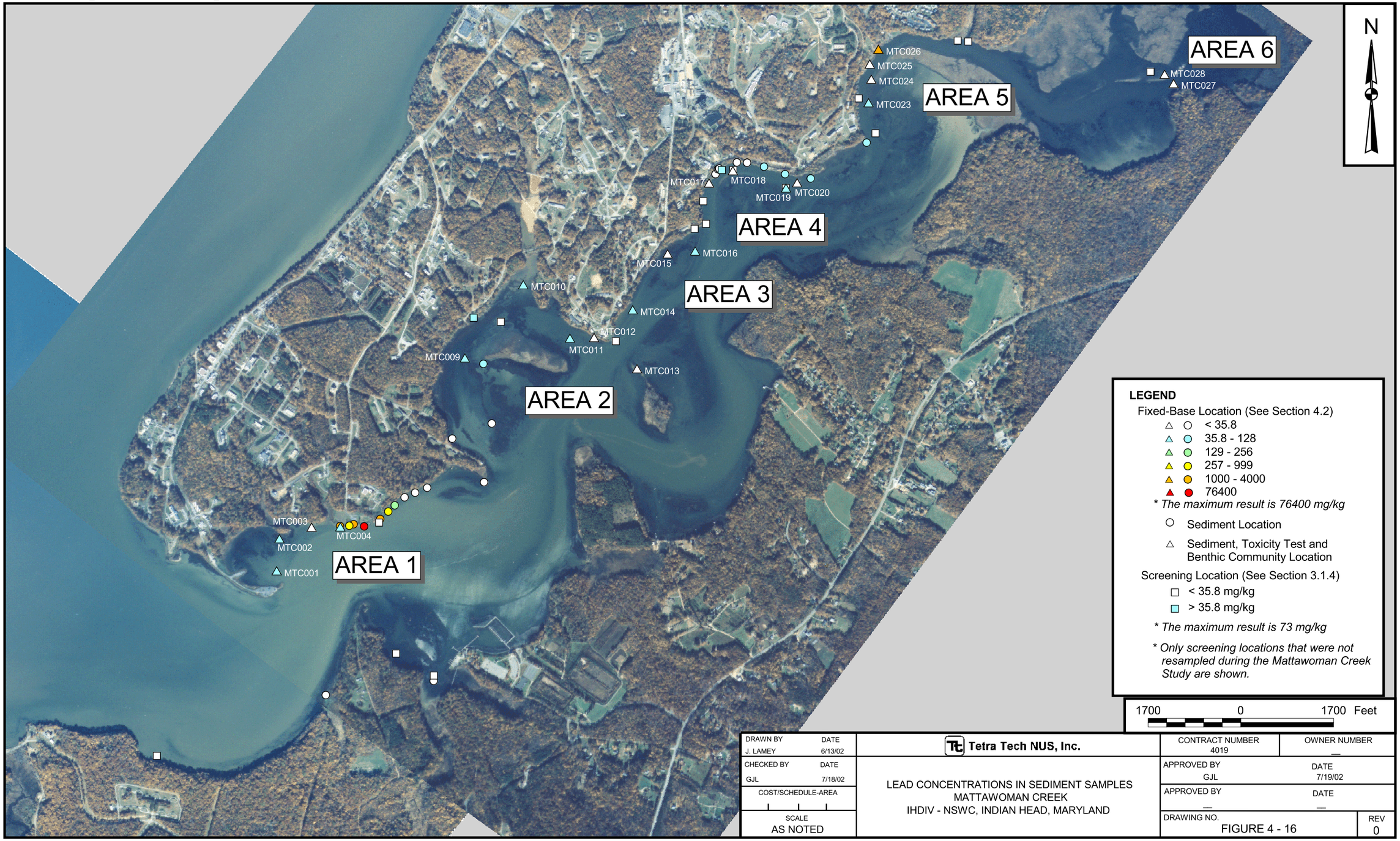
DRAWN BY J. LAMEY	DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	CADMIUM CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 14 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR COPPER IN SEDIMENT 1/19/04 KMP



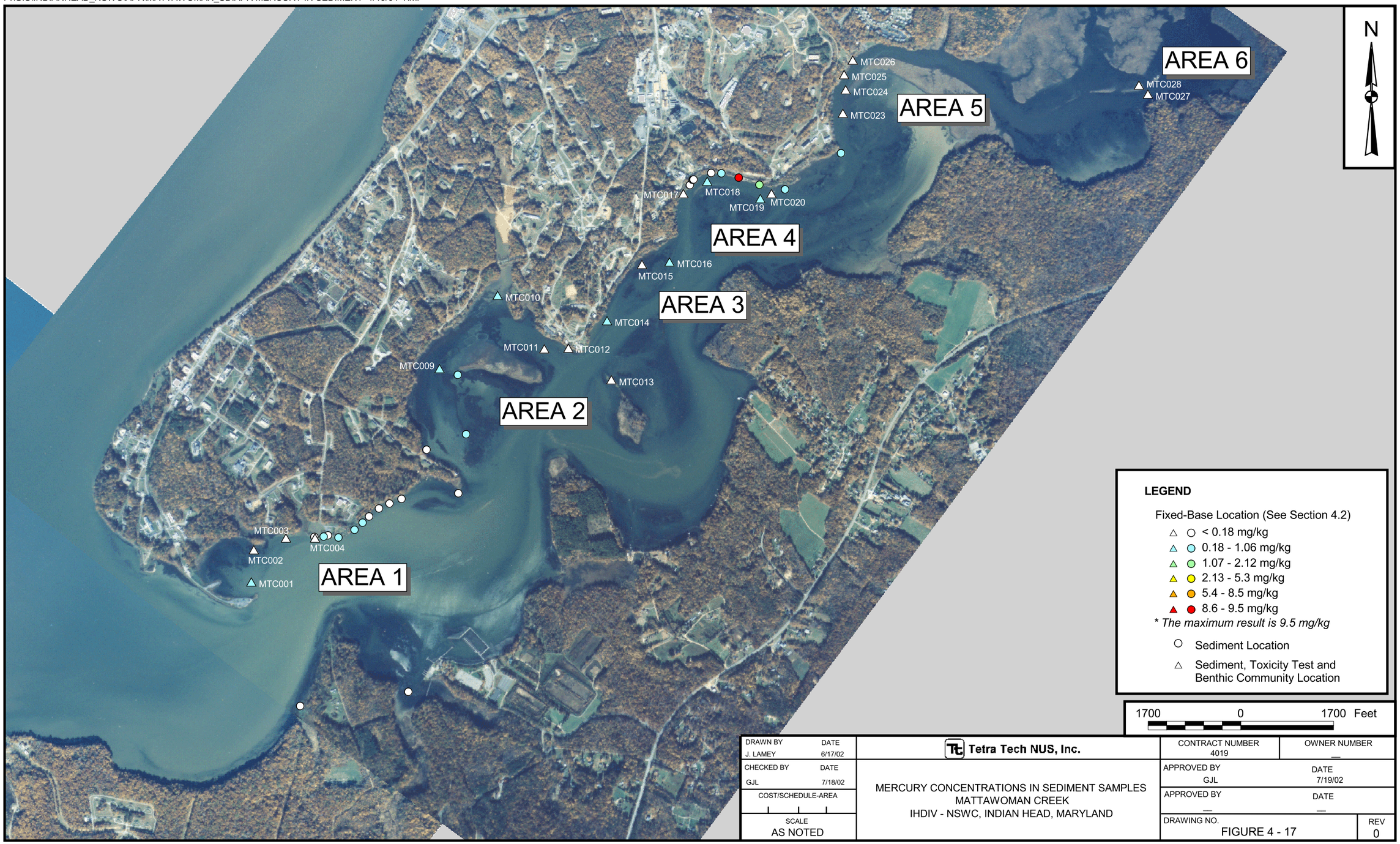
DRAWN BY J. LAMEY	DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	COPPER CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 15 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR LEAD IN SEDIMENT 1/19/04 KMP



DRAWN BY J. LAMEY	DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	LEAD CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 16	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR MERCURY IN SEDIMENT 1/19/04 KMP

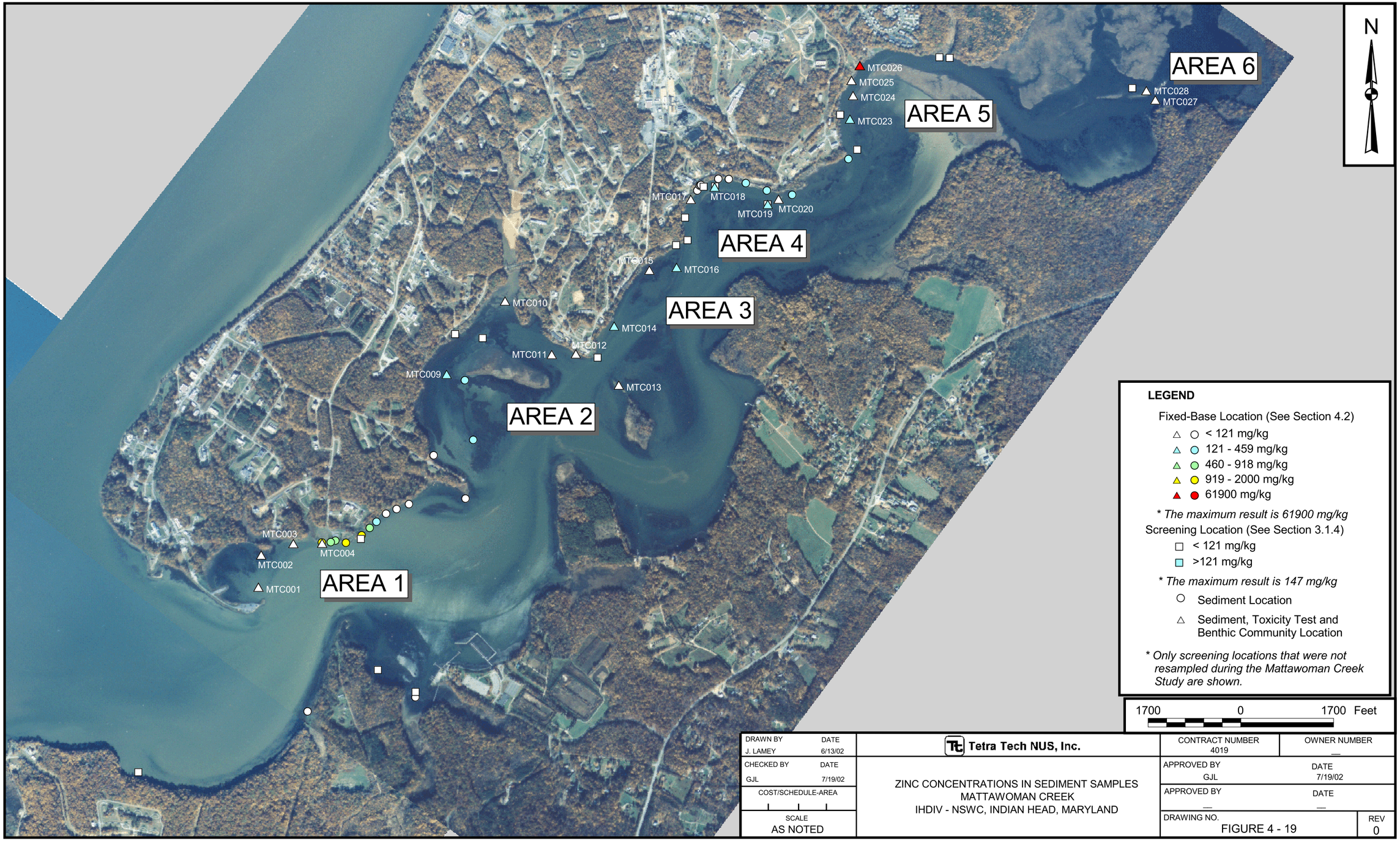


DRAWN BY J. LAMEY	DATE 6/17/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	MERCURY CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 17	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR SILVER IN SEDIMENT 1/19/04 KMP

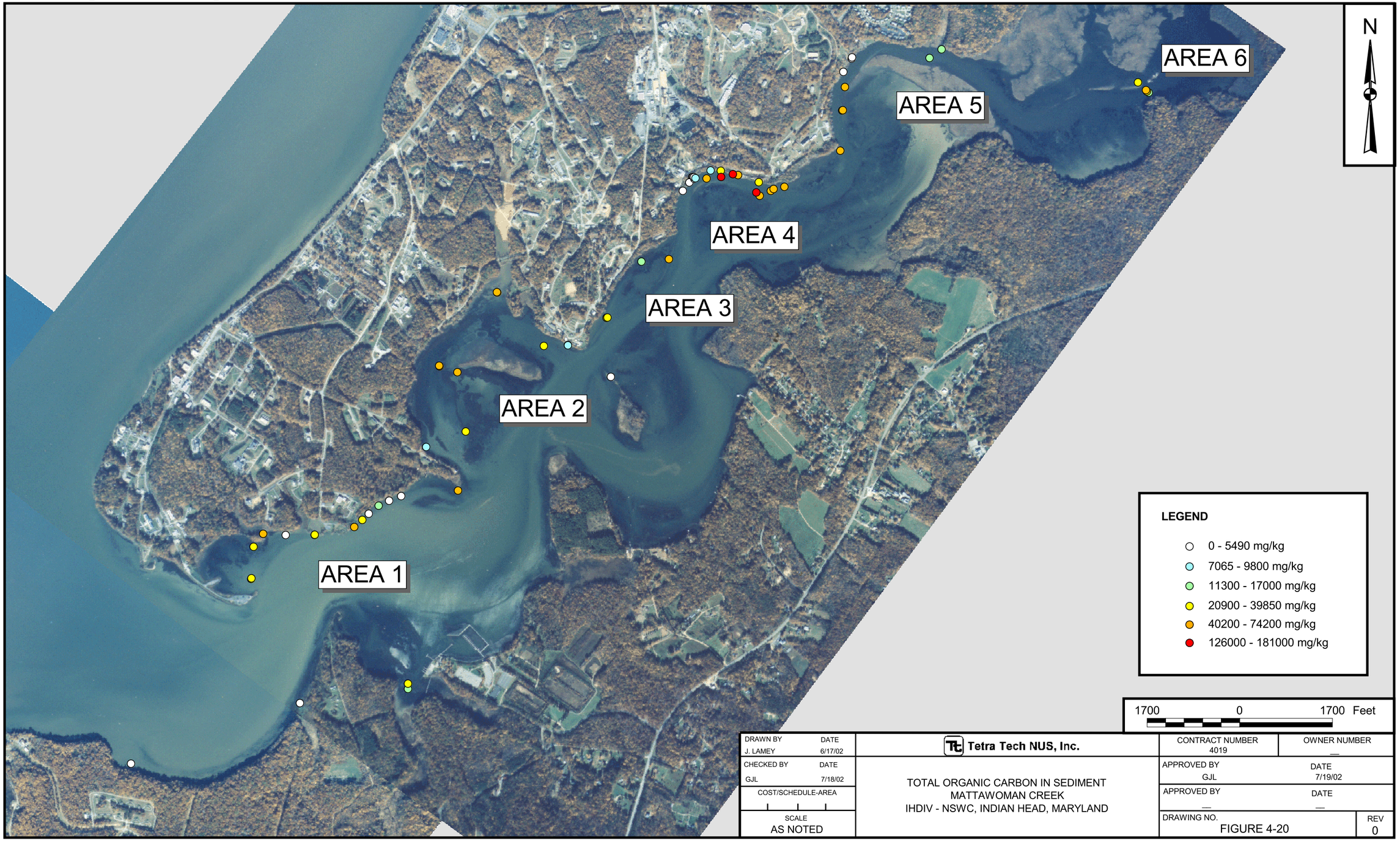
DRAWN BY J. LAMEY — DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER —
CHECKED BY GJL — DATE 7/18/02	SILVER CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL	DATE 7/19/02
COST/SCHEDULE-AREA —		APPROVED BY —	DATE —
SCALE AS NOTED		DRAWING NO. FIGURE 4 - 18	REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR ZINC IN SEDIMENT 1/19/04 KMP



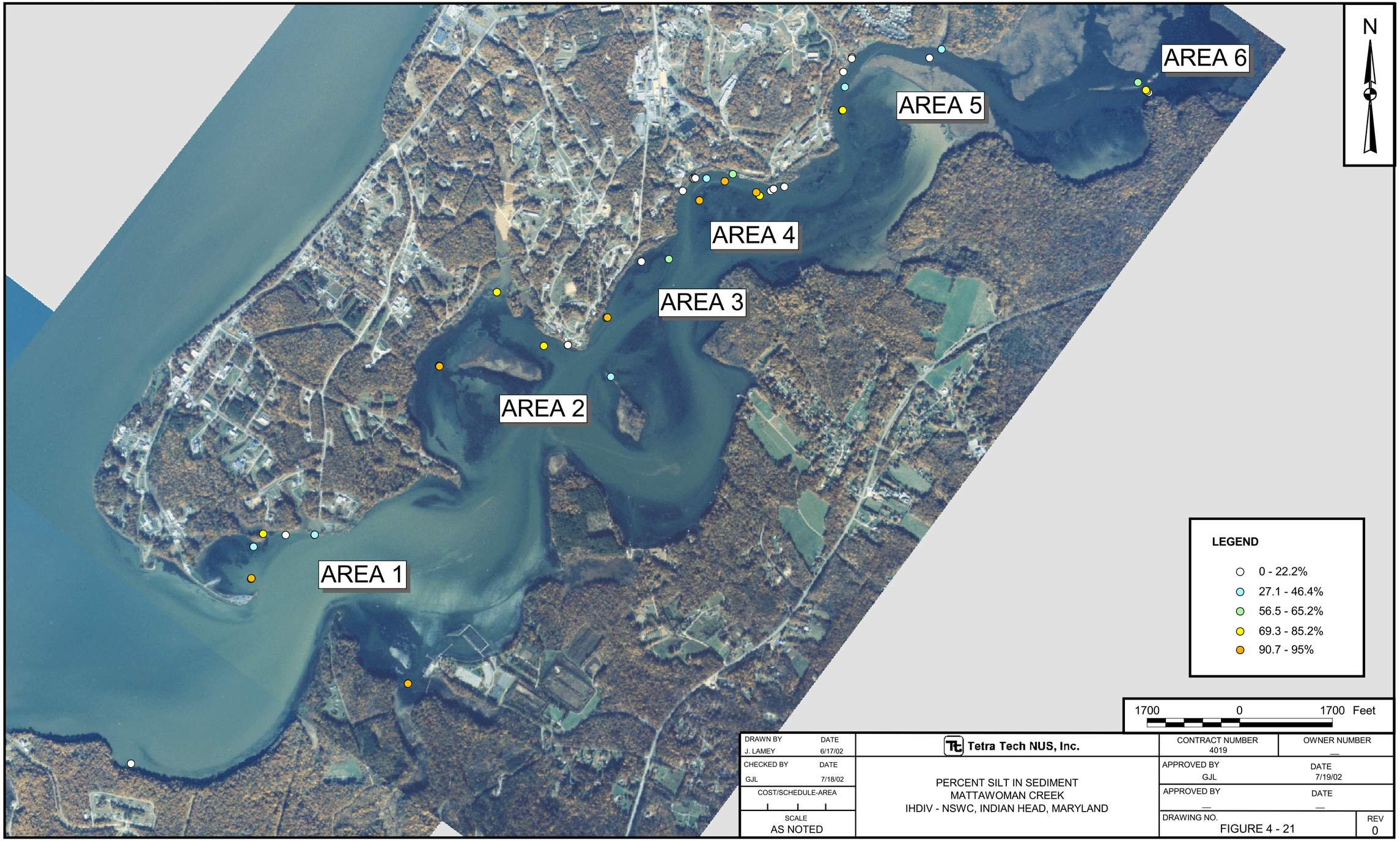
DRAWN BY J. LAMEY	DATE 6/13/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/19/02	ZINC CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 19 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR TOC IN SEDIMENT 5/16/03 KMP



DRAWN BY J. LAMEY	DATE 6/17/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	TOTAL ORGANIC CARBON IN SEDIMENT MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4-20 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR PERCENT SILT 5/16/03 KMP



DRAWN BY J. LAMEY	DATE 6/17/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 7/18/02	PERCENT SILT IN SEDIMENT MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 7/19/02
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 4 - 21 / REV 0

CATFISH - MTCCT00403
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	16000	A
BIS(2-ETHYLHEXYL)PHTHALATE	2200	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	5	
AROCLOR-1260	39	A
Inorganics (mg/kg)		
ARSENIC	0.67	A
CADMIUM	0.033	B
CALCIUM	877	
IRON	8.7 J	
LEAD	0.2	B
MAGNESIUM	140	
MANGANESE	1.7 J	
POTASSIUM	1930 J	
SODIUM	401	
ZINC	6.7 J	
Miscellaneous Parameters	(%)	
LIPIDS	3.04	(%) B

CATFISH - MTCCT00402
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	200 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1300	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	41	A,B
AROCLOR-1260	230	A,B
ENDRIN	5	B
Inorganics (mg/kg)		
CADMIUM	0.017	
CALCIUM	1400	
IRON	10 J	
MAGNESIUM	142	
MANGANESE	3.5 J	
POTASSIUM	1600 J	
SODIUM	431	
Miscellaneous Parameters	(%)	
LIPIDS	1.91	(%) B
Energetics (mg/kg)		
2-AMINO-4,6-DINITROTOLUENE	0.096 J	A,B
NITROCELLULOSE	5.7	B

CATFISH - MTCCT00302
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	64000	A,B
BIS(2-ETHYLHEXYL)PHTHALATE	1200 J	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	35	A,B
AROCLOR-1260	240 J	A,B
Inorganics (mg/kg)		
ARSENIC	0.65	A
BARIUM	0.67	
CADMIUM	0.019	
CALCIUM	3220	
IRON	11.8 J	
LEAD	0.29	B
MAGNESIUM	164	
MANGANESE	4 J	
POTASSIUM	1400 J	
SODIUM	200	
ZINC	9.2 J	
Miscellaneous Parameters	(%)	
LIPIDS	0.97	(%) B

LRG MTH BASS - MTCLB00402
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	23000	A
BIS(2-ETHYLHEXYL)PHTHALATE	980 J	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	8.6 J	
AROCLOR-1260	59	A
Inorganics (mg/kg)		
CALCIUM	2770	
MAGNESIUM	232	
MANGANESE	0.52 J	
POTASSIUM	2240 J	
SODIUM	391	
ZINC	6.1 J	
Miscellaneous Parameters	(%)	
LIPIDS	0.75	(%) B

CATFISH - MTCCT00301
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	14000	A
BIS(2-ETHYLHEXYL)PHTHALATE	480	A
Pesticides/PCB's (ug/kg)		
4,4'-DDE	110	A,B
AROCLOR-1260	380 J	A,B
DIELDRIN	7.3 J	A,B
GAMMA-CHLORDANE	8.5 J	B
Inorganics (mg/kg)		
CADMIUM	0.021	
CALCIUM	801	
IRON	7.3 J	
LEAD	0.2	B
MAGNESIUM	151	
MANGANESE	0.67 J	
POTASSIUM	1990 J	
SODIUM	322	
ZINC	8.6 J	
Miscellaneous Parameters	(%)	
LIPIDS	5.15	(%) B

LRG MTH BASS - MTCLB003
Semivolatile Organics (ug/kg)

BENZALDEHYDE	43 J	
BIS(2-ETHYLHEXYL)PHTHALATE	640 J	A
Pesticides/PCB's (ug/kg)		
4,4'-DDE	8.4 J	
AROCLOR-1260	51 J	A
Inorganics (mg/kg)		
CALCIUM	207	
MAGNESIUM	220	
POTASSIUM	2810 J	
SODIUM	395	
Miscellaneous Parameters	(%)	
LIPIDS	0.89	(%) B
Energetics (mg/kg)		
NITROGUANIDINE	0.12 J	B

CATFISH - MTCCT005
Semivolatile Organics (ug/kg)

PHENOL	150 J	B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	4.5	
Inorganics (mg/kg)		
ALUMINUM	8.5	
CADMIUM	0.033 K	B
CALCIUM	856	
COPPER	3.6	B
IRON	16.6	
MAGNESIUM	176	
MANGANESE	0.64 K	
POTASSIUM	2690	
SODIUM	880	
ZINC	10.9	
Miscellaneous Parameters	(%)	
LIPIDS	0.03	(%)
Energetics (mg/kg)		
1,3-DINITROBENZENE	0.057 J	B
HMX	0.083 J	B

CATFISH - MTCCT00401
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	9800	A
BIS(2-ETHYLHEXYL)PHTHALATE	1400	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	30	A,B
AROCLOR-1260	180 J	A,B
Inorganics (mg/kg)		
CADMIUM	0.017	
CALCIUM	220	
IRON	9.3 J	
MAGNESIUM	113	
MANGANESE	1.9 J	
POTASSIUM	1670 J	
SODIUM	338	
Miscellaneous Parameters	(%)	
LIPIDS	1.52	(%) B

LRG MTH BASS - MTCLB005
Semivolatile Organics (ug/kg)

BENZALDEHYDE	91 J	
Inorganics (mg/kg)		
ALUMINUM	3.2	
ARSENIC	1.5 K	A
BARIUM	0.74	
CALCIUM	16900	
CHROMIUM	0.92 K	B
MAGNESIUM	611	
MANGANESE	2 K	
MERCURY	0.098	
POTASSIUM	3680	B
SODIUM	698	
ZINC	11.5	
Miscellaneous Parameters	(%)	
LIPIDS	0.12	(%)

LRG MTH BASS - MTCLB00201
Semivolatile Organics (ug/kg)

BENZALDEHYDE	75 J	
BIS(2-ETHYLHEXYL)PHTHALATE	140 J	
Pesticides/PCB's (ug/kg)		
AROCLOR-1260	47 J	A
Inorganics (mg/kg)		
ALUMINUM	5	
ARSENIC	0.89 K	A
BARIUM	0.36	
CALCIUM	7900	
CYANIDE	5.5	B
MAGNESIUM	402	
MANGANESE	0.93 K	
MERCURY	0.052	
POTASSIUM	3130	
SODIUM	554	
ZINC	11.9	
Miscellaneous Parameters	(%)	
LIPIDS	1.16	(%) B
PERCHLORATE	10200	(UG/KG) B

LRG MTH BASS - MTCLB00202
Semivolatile Organics (ug/kg)

BENZALDEHYDE	77 J	
BIS(2-ETHYLHEXYL)PHTHALATE	75 J	
Pesticides/PCB's (ug/kg)		
AROCLOR-1260	43 J	A
Inorganics (mg/kg)		
ALUMINUM	14	
ARSENIC	1.6 K	A
BARIUM	0.3	
CADMIUM	0.03	B
CALCIUM	6740	
CHROMIUM	6.2	A,B
IRON	48	B
LEAD	1.1	B
MAGNESIUM	330	
MANGANESE	1.7 K	
POTASSIUM	2290	
SODIUM	431	
ZINC	7.8	
Miscellaneous Parameters	(%)	
LIPIDS	0.6	(%)

LRG MTH BASS - MTCLB00203
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	80 J	
BENZALDEHYDE	43 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1200 J	A,B
Inorganics (mg/kg)		
ALUMINUM	3.7	
ARSENIC	1.2 K	A
CALCIUM	2320	
MAGNESIUM	233	
MANGANESE	0.56 K	
POTASSIUM	2440	
SODIUM	367	
Miscellaneous Parameters	(%)	
LIPIDS	1.19	(%) B

CATFISH - MTCCT00102
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	2500 J	
BIS(2-ETHYLHEXYL)PHTHALATE	1800 J	A,B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	46	A,B
AROCLOR-1260	280	A,B
ENDOSULFAN I	2.1 J	B
GAMMA-CHLORDANE	7 J	B
Inorganics (mg/kg)		
ALUMINUM	22.4	B
ARSENIC	0.75 K	A
CADMIUM	0.031	B
CALCIUM	544	
CYANIDE	0.49	B
MAGNESIUM	150	
MANGANESE	1.6 K	
POTASSIUM	1760	
SODIUM	256	
ZINC	7.4	
Miscellaneous Parameters	(%)	
LIPIDS	4.82	(%) B

CATFISH - MTCCT00101
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	620	
BIS(2-ETHYLHEXYL)PHTHALATE	720 J	A
PHENOL	54 J	B
Pesticides/PCB's (ug/kg)		
4,4'-DDE	35	A,B
AROCLOR-1260	160 J	A,B
GAMMA-CHLORDANE	3.2 J	B
Inorganics (mg/kg)		
ALUMINUM	6.8	
CADMIUM	0.034	B
CALCIUM	101	
MAGNESIUM	125	
MANGANESE	0.39 K	
POTASSIUM	1740	
SODIUM	219	
Miscellaneous Parameters	(%)	
LIPIDS	7.23	(%) B

LRG MTH BASS - MTCLB001
Semivolatile Organics (ug/kg)

4-METHYLPHENOL	8300	A
BIS(2-ETHYLHEXYL)PHTHALATE	380 J	A
Pesticides/PCB's (ug/kg)		
4,4'-DDE	4.2	
Inorganics (mg/kg)		
ALUMINUM	2.8	
ARSENIC	1.5 K	A
CALCIUM	3630	
MAGNESIUM	229	
MANGANESE	0.81 K	
POTASSIUM	1870	
SODIUM	342	
Miscellaneous Parameters	(%)	
LIPIDS	0.91	(%) B

800 0 800 Feet

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MATTAWOMANCREEKAREATAGS.APR FILLET TAGS 12/30/03 KMP

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the EPA Region 3 RBC for fish.
B = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY

11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY K. PEILA	DATE 1/27/03
CHECKED BY G. LATULIPPE	DATE 1/27/03
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN FISH (FILLET) SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO. 4019	OWNER NO. 0820
APPROVED BY G. LATULIPPE	DATE 1/27/03
APPROVED BY	DATE
DRAWING NO. FIGURE 4 - 22	REV. 0

SPOTTAIL SHINER - MTCSS005
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 870
BIS(2-ETHYLHEXYL)PHTHALATE 150 J A
Pesticides/PCB's (ug/kg)
4,4'-DDE 8.1
AROCLOR-1260 58
Inorganics (mg/kg)
ALUMINUM 20.6
ARSENIC 1.9 K
BARIUM 4.8
CADMIUM 0.022 K
CALCIUM 6260
CHROMIUM 0.58 K
IRON 48.6
MAGNESIUM 224
MANGANESE 6.1
POTASSIUM 1620
SODIUM 397
VANADIUM 0.1
ZINC 24.9
Miscellaneous Parameters (%)
LIPIDS 0.56
Energetics (mg/kg)
NITROGLYCERIN 0.22 J A
NITROGUANIDINE 0.068 J A

PUMPKINSEED - MTCFS003
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 11000
BIS(2-ETHYLHEXYL)PHTHALATE 780 J A
PHENOL 140 J A
Inorganics (mg/kg)
ALUMINUM 16.4
ARSENIC 2
BARIUM 1.3
CADMIUM 0.022
CALCIUM 9580
IRON 17.4 J
LEAD 0.41 A
MAGNESIUM 274
MANGANESE 8.2 J
POTASSIUM 1360 J
SODIUM 493
VANADIUM 0.078
ZINC 16 J
Miscellaneous Parameters (%)
LIPIDS 1.17

SPOTTAIL SHINER - MTCSS004
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 12000
BIS(2-ETHYLHEXYL)PHTHALATE 880 J A
PHENOL 94 J
Pesticides/PCB's (ug/kg)
4,4'-DDD 3.9 J A
4,4'-DDE 17 A
AROCLOR-1260 130 J A
Inorganics (mg/kg)
ARSENIC 0.7
BARIUM 2.6
CADMIUM 0.017
CALCIUM 1800
IRON 13 J
MAGNESIUM 100
MANGANESE 2.3 J
POTASSIUM 726 J
SODIUM 169
ZINC 12.1 J
Miscellaneous Parameters (%)
LIPIDS 0.53

GOLDEN SHINER - MTCGS003
Semivolatile Organics (ug/kg)
2-METHYLPHENOL 170 J A
4-METHYLPHENOL 150 J
BIS(2-ETHYLHEXYL)PHTHALATE 120 J A
Pesticides/PCB's (ug/kg)
4,4'-DDE 3.3 J
Inorganics (mg/kg)
ALUMINUM 7.3
ARSENIC 0.7
BARIUM 1.6
CALCIUM 2990
CYANIDE 0.45 A
IRON 17.9 J
MAGNESIUM 181
MANGANESE 5.6 J
POTASSIUM 1420 J
SODIUM 400
ZINC 12.1 J
Miscellaneous Parameters (%)
LIPIDS 2.38 A

PUMPKINSEED - MTCFS005
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 31000
BENZALDEHYDE 53 J
Pesticides/PCB's (ug/kg)
4,4'-DDE 5.3 A
AROCLOR-1260 34 J
Inorganics (mg/kg)
ALUMINUM 5.4
ARSENIC 1.7 K
BARIUM 1
CALCIUM 7800
IRON 13.5
MAGNESIUM 211
MANGANESE 7.3
POTASSIUM 1270
SODIUM 413
VANADIUM 0.24
ZINC 14.2
Miscellaneous Parameters (%)
LIPIDS 1.06

PUMPKINSEED - MTCFS002
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 35 J
BENZALDEHYDE 46 J
Pesticides/PCB's (ug/kg)
AROCLOR-1260 36 J
Inorganics (mg/kg)
ALUMINUM 3.6
ARSENIC 1.6 K
BARIUM 0.95
CALCIUM 10800
IRON 10.2
MAGNESIUM 293
MANGANESE 7.8
POTASSIUM 1130
SODIUM 429
VANADIUM 0.076
ZINC 17.4
Miscellaneous Parameters (%)
LIPIDS 0.95

PUMPKINSEED - MTCFS004
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 39000
BIS(2-ETHYLHEXYL)PHTHALATE 1300 J A
Pesticides/PCB's (ug/kg)
4,4'-DDE 4.8 A
AROCLOR-1260 50 J A
Inorganics (mg/kg)
ARSENIC 1.2
BARIUM 0.82
CADMIUM 0.025
CALCIUM 6340
CHROMIUM 0.74 A
IRON 12.5 J
LEAD 0.2 A
MAGNESIUM 200
MANGANESE 4.8 J
POTASSIUM 1200 J
SODIUM 463
ZINC 13.3 J
Miscellaneous Parameters (%)
LIPIDS 1.3
Energetics (mg/kg)
NITROGLYCERIN 0.1 J A

GOLDEN SHINER - MTCGS002
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 2800
PHENOL 120 J A
Inorganics (mg/kg)
ALUMINUM 8.7
ARSENIC 0.59
BARIUM 1.5
CADMIUM 0.023
CALCIUM 2840
CHROMIUM 6.6 A
IRON 166 J
MAGNESIUM 176
MANGANESE 6.3 J
POTASSIUM 1210 J
SODIUM 309
VANADIUM 0.38
ZINC 16.7 J
Miscellaneous Parameters (%)
LIPIDS 0.57
Energetics (mg/kg)
NITROGLYCERIN 0.18 J A

SPOTTAIL SHINER - MTCSS001
Semivolatile Organics (ug/kg)
2-METHYLPHENOL 73 J A
Pesticides/PCB's (ug/kg)
4,4'-DDE 5.3 J
AROCLOR-1260 46
Inorganics (mg/kg)
ALUMINUM 18 A
ARSENIC 1.7 K A
BARIUM 2.3
CADMIUM 0.025 A
CALCIUM 3240
CYANIDE 0.4 A
IRON 38.7 A
MAGNESIUM 145
MANGANESE 7.8
POTASSIUM 866
SODIUM 225
ZINC 16.5
Miscellaneous Parameters (%)
LIPIDS 0.64

PUMPKINSEED - MTCFS001
Semivolatile Organics (ug/kg)
4-METHYLPHENOL 5400
BENZALDEHYDE 34 J
BIS(2-ETHYLHEXYL)PHTHALATE 1900 J A
Pesticides/PCB's (ug/kg)
4,4'-DDE 5.2 J A
Inorganics (mg/kg)
ALUMINUM 6.6
ARSENIC 1.5 K
BARIUM 0.54
CALCIUM 5020
IRON 9.6
MAGNESIUM 180
MANGANESE 4.1 K
POTASSIUM 1000
SODIUM 331
ZINC 12.4
Miscellaneous Parameters (%)
LIPIDS 1.23
Energetics (mg/kg)
NITROGLYCERIN 0.1 J A

LEGEND

- TtNUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the EPA Region 3 RBC for fish.
B = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY

11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

1000 0 1000 Feet

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREATAGS.APR WHOLE TAGS 5/16/03 KMP

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN FISH (WHOLE-BODY) SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 23	0

500 0 500 Feet

P:\GIS\INDIANHEAD_NSWC\APR\
MATTAWOMANCREEKAREATAGS.APR VEGETATION 5/16/03 KMP

LEGEND

- TINUS Sample Location
- Installation Restoration (IR) Site Boundary
- Building
- Road
- Railroad
- (11) IR Site Number

A = Value exceeds the maximum background value for the analyte.
J = The associated value is an estimated concentration.
K = The associated value may be biased high. The actual value is expected to be lower than reported.

SITE KEY

11 Caffee Road Landfill
17 Disposed Metal Parts Along Shoreline
28 Original Burning Ground
39 Organics Plant
41 Scrap Yard
57 TCE Building 292 Area

DRAWN BY	DATE
K. PEILA	1/27/03
CHECKED BY	DATE
G. LATULIPPE	1/27/03
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

POSITIVE DETECTIONS IN VEGETATION SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MD

CONTRACT NO.	OWNER NO.
4019	0820
APPROVED BY	DATE
G. LATULIPPE	1/27/03
APPROVED BY	DATE
DRAWING NO.	REV.
FIGURE 4 - 24	0

5.0 ECOLOGICAL RISK ASSESSMENT

The goal of this Ecological Risk Assessment (ERA) is to determine whether adverse ecological impacts are present as a result of exposure to chemicals in Mattawoman Creek. This ERA provides information to scientists and managers that will enable them to determine if the risks to ecological receptors in the creek are great enough to warrant additional studies, a removal action, or determine that no further action is needed. The ERA methodology follows the guidance presented in the Department of Navy Environmental Policy Memorandum 97-04, Use of Ecological Risk Assessments (May 16, 1997), Chief of Naval Operations Letter 5090 SER N453E/9U 59 5335 (April 5, 1999), Navy Policy for Conducting Ecological Risk Assessment, the Final Guidelines for Ecological Risk Assessment (EPA, April 1998) and the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, June 1997). Figure 5-1 presents the Navy's Ecological Risk Assessment Tiered Approach.

Although a Screening Level Ecological Risk Assessment (SERA) was not conducted for Mattawoman Creek, based on the potential sources of contamination and previous investigations conducted in Mattawoman Creek, the IHDIV-NSWC Partnering Team decided to collect the appropriate samples so that a Baseline Ecological Risk Assessment (BERA) could be conducted for Mattawoman Creek. The terrestrial habitats affected by the sites along the banks of Mattawoman Creek that were discussed in the conceptual site model in Section 2 were not evaluated in this BERA; they were or will be evaluated separately as part of the investigations for those sites.

This ERA consists of the eight steps required by the EPA guidance (EPA, June 1997; April 1998) and the Navy Policy for Conducting Ecological Risk Assessments. Steps 1 and 2 are the SERA. Step 3a is the first step of the BERA and consists of refining the list of COPCs that are retained following the SERA. Steps 3b through 6 were conducted to collect site-specific biological data so that potential risks to the ecological receptors could be better evaluated. Step 7 (Risk Characterization) was then conducted. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with Region 3 BTAG. The remainder of this section presents the results of the ERA conducted for Mattawoman Creek.

5.1 PROBLEM FORMULATION

Problem formulation is the first phase of an ERA and discusses the goals, breadth, and focus of the assessment. It includes general descriptions of the site with emphasis on the habitats and ecological receptors present. This phase also involves characterization of site-related chemicals, chemical sources, migration routes, and an evaluation of routes of chemical exposure. Preliminary assessment and

measurement endpoints are selected, and a preliminary conceptual model is developed that describes how chemicals associated with the sites in question may come into contact with ecological receptors.

5.1.1 Mattawoman Creek Environmental Setting

Section 2.0 of this report presents the conceptual model for Mattawoman Creek. Included in that section is a detailed description of the ecological setting of the creek. In summary, a variety of aquatic (i.e., fish, invertebrates) and semi-aquatic (i.e., piscivorous wildlife) receptors are present and/or feed within Mattawoman Creek.

5.1.2 Identification of Chemicals Potentially Present

Section 2.0 of this report includes a description of the potential sources of contamination to Mattawoman Creek and previous investigations of these sources. In summary, these chemicals include PAHs, pesticides, PCBs, explosives/energetics and metals. Sections 3.0 and 4.0 of this report present the field investigation activities that were conducted during the current Mattawoman Creek investigation and summarize the results from the investigation.

5.1.3 Physical and Chemical Characteristics

VOCs, SVOCs, pesticides, PCBs, energetics, and metals were detected in surface water, sediment, and/or tissue samples collected from Mattawoman Creek. Appendix C-1 presents toxicity information for these parameters, as well as various physical/chemical characteristics.

5.1.4 Identification of Exposure Pathways and Potential Receptors

The conceptual site model in Section 2.0 of this report presents the exposure pathways in detail. In summary, aquatic and semi-aquatic organisms may be exposed to chemicals via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items.

5.2 IDENTIFICATION OF ASSESSMENT AND MEASUREMENT ENDPOINTS

Based on the conceptual site model in Section 2.0, several risk questions were developed in the Work Plan (TtNUS, August 2001) (see Table 5-1). These risk questions were evaluated through the use of assessment and measurement endpoints (see Table 5-1).

Assessment endpoints are explicit expressions of the environmental value that is to be protected (EPA, June 1997). The selection of these endpoints is based on the habitats present, the migration pathways of

chemicals, and the routes that chemicals may take to enter receptors. Measurement endpoints are estimates of biological impacts (i.e., mortality, reproduction) that are used to evaluate the assessment endpoints. The selection of measurement endpoints for the ERA was based on the data that were available to evaluate the assessment endpoints.

5.2.1 Assessment Endpoints

Not all of the receptors that are potentially exposed to chemicals in Mattawoman Creek were evaluated in the ERA. As indicated in EPA (June 1997), "it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals from the site." Therefore, the ERA focused on the endpoints that tend to yield the greatest risks, which accounts for endpoints that will have lower risks.

Omnivores were not specifically evaluated in this ERA because exposure to chemicals in plants will be greatest for herbivores, and exposure to chemicals in fish will be greatest for piscivores. Therefore, the omnivores should be protected by protecting the herbivores and piscivores. Also, because of the lack of available data to evaluate risks to amphibians and reptiles, fish were used as surrogates for amphibians, and birds and mammals were used as surrogates for reptiles. Finally, as indicated in Section 5.0, risks to ecological receptors from chemicals in the soils associated with the sites along Mattawoman Creek were or will be evaluated as part of the ERAs conducted for each site.

Table 5-1 presents the assessment endpoints as they were in the final Work Plan (TtNUS, August 2001). The following paragraphs describe why each of the assessment endpoints was selected.

Piscivorous Birds and Mammals: Piscivorous birds and mammals feed on fish in Mattawoman Creek. These birds and mammals may be exposed to and accumulate chemicals that are present in the fish.

Herbivorous Birds: Herbivorous birds feed on aquatic vegetation (i.e., hydrilla) in Mattawoman Creek. Their role in the community is essential because they serve as food items for higher trophic level animals (Smith, 1966). They may be exposed to and accumulate chemicals that are present in the plants they consume.

Benthic Invertebrates: Benthic macroinvertebrates are present in Mattawoman Creek and serve as a food source for higher trophic level animals (i.e., fish, amphibians, birds, mammals). They also can accumulate chemicals, which can be transferred to higher trophic level organisms that consume invertebrates.

Fish: Fish are present in Mattawoman Creek and feed primarily on invertebrates, plants, and/or other fish. Fish are exposed to and can accumulate chemicals from the surface water, sediment, or the food items they consume.

Aquatic Vegetation: Aquatic vegetation is abundant in Mattawoman Creek. It serves as a food source and provides cover for many organisms. It also can accumulate some chemicals, which can then be transferred to the higher trophic level organisms that consume plants.

Aquatic Organisms: Aquatic organisms are present in Mattawoman Creek and serve in part as the base of the aquatic food chain. Aquatic organisms include fish, invertebrates, and aquatic plants, all of which are taken into account when developing water quality criteria for chemicals. Aquatic organisms can accumulate chemicals from the surface water and could bioaccumulate in species that consume them.

Amphibians and Reptiles: Amphibians and reptiles are present in Mattawoman Creek. They feed on a variety of food sources such as invertebrates, plants, fish, and/or small mammals. Amphibians and reptiles are exposed to and can accumulate chemicals from the surface water, sediment, and/or the food items they consume.

5.2.2 Measurement Endpoints

Measurement endpoints, also known as “measures of effects,” represent "measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint" (EPA, 1997). Specifically, they provide analyses to investigate the assessment endpoints and ultimately answer the project risk questions. Under the eight-step ERA guidance, selection of baseline ERA measurement endpoints occurs in Step 4. The measurement endpoints outlined in Table 5-1 and their specific analyses are discussed in detail in this section.

5.2.2.1 Assessment of Benthic Macroinvertebrates

Base-related chemicals have been detected in Mattawoman Creek sediments. As indicated in Section 5.2.1, sediment-dwelling organisms, or benthic macroinvertebrates, serve in part as the base of the aquatic food chain. As a result, benthic macroinvertebrates represent a portion of the Mattawoman Creek ecosystem potentially at risk. In addition, several chemicals are present or potentially present in Mattawoman Creek sediments for which no screening guidelines are available. Therefore, to assess risks to benthic invertebrates, the sediment chemistry data was used in conjunction with sediment toxicity testing and benthic community analysis in a weight of evidence approach. The following paragraphs discuss each of these measures.

Sediment Chemistry

Facility-related chemicals have been detected in Mattawoman Creek sediments near the main area. Concentrations of various chemicals have the potential to impact the benthic community so chemical analysis of the sediment was conducted. The chemistry results were then compared to various criteria/guidelines to evaluate potential impacts to benthic receptors. However, because various site-specific factors determine the actual bioavailability, and thus toxicity of the chemicals, there is uncertainty in using these criteria/guidelines alone to evaluate potential risks to the benthic community. This is why the following two measures of effects were evaluated in conjunction with the chemistry data to make an overall assessment of the health of the benthic population.

Amphipod (*Hyalella azteca*) Toxicity Testing

Ten-day toxicity tests using the amphipod *Hyalella azteca* were conducted as a second measure to evaluate risks to benthic invertebrates. This test organism was selected due to its widely accepted use and standard protocols, relative sensitivity to chemicals, and its tolerance of a range of salinity (from zero to several parts per thousand) and grain sizes from fine silts to sand. Additionally, this species is more sensitive to copper, lead, and zinc (among other metals) than *Chironomus tentans* or *Lumbriculus variegatus* (ASTM 2000, EPA, March 2000). A 10-day test was selected for this study versus some of the longer-duration toxicity tests that can evaluate reproductive effects for the following reasons:

- There are potential complications with longer test duration (e.g., ammonia buildup).
- Short exposures can be used to identify high levels of contamination (EPA, March 2000; Ingersoll et al., 1998), and it was known, based on the available historic data, that some areas in Mattawoman Creek had high levels of contamination

Therefore, this endpoint was used to evaluate if the chemicals in the sediment may be acutely toxic to benthic invertebrates or if the growth of benthic invertebrates is being inhibited.

Benthic Macroinvertebrate Community Analysis

Benthic infauna have long been used for water quality assessments because of their tendency to be more sedentary, and thus more reliable site indicators compared to fish and plankton (EPA, December 2000). The advantage of this measure is that it provides an "*in situ"* evaluation of the current benthic community that is inhabiting the area. However, while current methods can distinguish severely impacted sites from those that are minimally impacted, it is difficult to discriminate between slightly and moderately impaired sites, particularly in estuaries (EPA, December 2000). Various metrics are used to evaluate the benthic community data to determine potential impacts to the benthic community and to elucidate these impacts

(see Section 5.6.1 of this report). In general, however, evidence of a healthy benthic macroinvertebrate community will be interpreted as successful reproduction of benthic species.

5.2.2.2 Assessment of Piscivorous and Herbivorous Wildlife

Facility-related chemicals have been detected in Mattawoman Creek surface water, sediments, fish, and plant tissue near the main area. As indicated in Section 5.2.1, fish-eating (piscivorous) birds and mammals and plant eating (herbivorous) birds are important and sensitive portions of the food web. As a result, piscivorous birds and mammals and herbivorous birds could potentially be at risk. To assess these risks, food-chain modeling was conducted to determine the daily dose of chemicals that the receptors may be getting from consuming food collected in Mattawoman Creek. The daily dose was then compared to toxicity data (see Appendix C-1) to determine potential impacts to the receptors. Sections 5.3 and 5.4 discuss the food-chain modeling and toxicity data in more detail. Toxicity data for reproductive endpoints were preferentially sought, which is the most sensitive endpoint, and is assumed to be protective of survival and growth.

As previously mentioned, ingestion is the primary route of exposure for most receptor species. Indicator species are selected based on their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservative purposes, indicator species may be small and have small home ranges. Species known to be sensitive to particular chemicals may be selected, or toxicity values for those species may be used. For example, mink are sensitive to PCBs for reproductive endpoints; and therefore, mink toxicity reference values (TRVs) are selected for a scenario involving exposure to PCBs from an aquatic or sedimentary source. The availability of exposure parameters, such as body mass, feeding rate, and drinking rate may also be a factor in selecting indicator species. The following indicator species were selected for the food-chain modeling:

- Piscivorous bird: great blue heron
- Piscivorous mammal: mink
- Herbivorous bird: mallard duck

Receptor profiles for each of these species are presented in Appendix C-2. These receptors were selected because they are representative of the species that may be present in their trophic level and feeding guild. Also, exposure parameters (i.e., ingestion rates, body weights), which are needed to calculate daily doses, are available for these species.

5.2.2.3 Assessment of Aquatic Vegetation

Facility-related chemicals have been detected in Mattawoman Creek surface water, sediments, and plants near the main area. As indicated in Section 5.2.1, aquatic vegetation is an important component of the food web and the aquatic ecosystem. As a result, these receptors could be potentially at risk. To aid in assessing these risks, hydrilla was collected and analyzed for inorganics and pesticides/PCBs. Chemical concentrations in hydrilla were used to represent concentrations in food items of the mallard. Plant tissues that are eaten by herbivorous birds were preferentially collected. There is little data for determine if chemical concentrations in the hydrilla tissue are impacting the plant. Therefore, risks to hydrilla were evaluated by comparing the chemical concentrations in the tissue from the site samples to the chemical concentrations in the upgradient and reference samples. Also, visual observations and studies in the literature data were used to evaluate risks to this assessment endpoint.

5.2.2.4 Assessment of Aquatic Organisms

Facility-related chemicals have been detected in Mattawoman Creek surface water near the base. As indicated in Section 5.2.1, aquatic organisms (in the water column) serve in part as the base of the aquatic food chain. As a result, these organisms represent a portion of the Mattawoman Creek ecosystem potentially at risk. In addition, surface water chemicals could bioaccumulate in the aquatic and semi-aquatic food chains. To assess these risks, in part, surface water chemical analyses were conducted.

The chemistry results are then compared to various criteria/guidelines to determine if there are potential impacts to benthic receptors. However, because various site-specific factors determine the actual bioavailability, and thus toxicity of the chemicals, there is uncertainty in using these criteria/guidelines alone to evaluate potential risks to the aquatic community.

5.2.2.5 Assessment of Fish

Facility-related chemicals have been detected in Mattawoman Creek surface water, sediments, and fish near the main area. As indicated in Section 5.2.1, the fish community is an important component of the Mattawoman Creek food web. As a result, these receptors could be potentially at risk. To assess these risks, in part, fish were collected for chemical analysis. Whole-body fish samples were collected for use in the ERA, including the food-chain model. The fillet fish samples were collected primarily for the HHRA; however, these samples were also evaluated as part of the ERA since some different chemicals were detected in the fillet samples.

Several species of fish were collected for analysis based on availability, abundance (including representative species of the area), and functional role (i.e., catfish are bottom feeders and are likely to accumulate the greatest levels of organic chemicals from sediment, while piscivorous fish such as largemouth bass typically accumulate the greatest levels of mercury). Table 3-5 presents a summary of the species collected and the requested analytical parameters. Overall, catfish (including channel, white, and brown bullhead) and largemouth bass were collected for fillet samples. Pumpkinseed and spot tailed shiner were collected for whole body samples.

The tissue chemical data were used to evaluate risks to piscivorous wildlife, as described in Section 5.2.2.2. The tissue chemical data also were used to evaluate potential risks to fish using information from the literature. The two primary sources of these data were:

- Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals (Ankley and Jarvinen, 1999)

- U.S. Army Corps of Engineers, Environmental Residue-Effects Database (ERED) (http://www.wes.army.mil/el/ered/index.html)

5.2.3 Preliminary Conceptual Site Model

Section 2.0 of this report presents the preliminary ecological conceptual site model.

5.3 EXPOSURE ASSESSMENT

Section 4.0 of this report includes identification of chemical concentration data used to represent ecological exposure in various media. For each exposure pathway selected for quantitative evaluation, exposure point concentrations (EPCs) were estimated using environmental sampling data.

The following data were collected and used in the ERA:

- Surface water samples for chemical analysis
- Sediment samples for chemical analysis
- Whole body and fillet fish tissue samples for chemical analysis
- Aquatic vegetation samples for chemical analysis
- Sediment samples for 10-day mortality and growth toxicity testing using the amphipod *Hyalella azteca*
- Sediment samples for a benthic community survey

5.3.1 Ecological Effects

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as surface water for aquatic organisms or sediment for sediment invertebrates. For other receptors, such as wildlife, toxicity data are typically available as doses, with units equal to mass of chemical per unit of body mass per unit of time (usually mg/kg-day).

5.3.1.1 Surface Water/Sediment

In the ecological effects assessment, screening values for toxicity of the chemicals to terrestrial and aquatic organisms were compiled. Tables 4-8 and 4-9 present the surface water and sediment screening values that were used to evaluate each chemical detected in the surface water or sediment samples. The Region III BTAG screening values were used for most of the parameters. When BTAG screening values were not available for a chemical, supplemental guidance documents were used and documented as presented in Tables 4-8 and 4-9.

5.3.1.2 Toxicity Reference Values

Most of the BTAG screening values are not designed to evaluate risks to wildlife. Therefore, an intake model was used to estimate the exposure of COPCs to wildlife receptors. Risk to wildlife receptors from exposure to COPCs in sediment, surface water, fish, and vegetation were determined by estimating the Chronic Daily Intake (CDI) and comparing the CDI to TRVs representing acceptable daily doses in mg/kg-day. The TRVs were developed from NOAELs and LOAELs obtained from wildlife studies, if available. The majority of the TRVs were obtained from the Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., June 1996) and supplemented with other toxicity data sources when necessary.

Table 5-2 presents the TRVs for mammals and birds that were used in the ERA. Appendix C-3 presents the sources of the TRVs. If a subchronic or acute study was used to develop the TRV, the value in Appendix C-3 was multiplied by factors of 0.1 or 0.01, respectively, to account for uncertainty between subchronic and chronic effects. Also, if only a LOAEL study was available, then the LOAEL was multiplied by a factor of 0.1 to obtain the NOAEL TRV.

This rationale was based on the EPA's guidance document Ecological Risk Assessment Guidance for Superfund (EPA, 1997), which indicates in Section 1.3.1, "When a LOAEL value, but not a NOAEL value, is available from the literature; a standard practice is to multiply the LOAEL by 0.1 and to use the product

as the screening ecotoxicity value. Also, literature reviews by McNamara (1976) and Weil and McCollister (1963) indicate that the chronic NOAELs can be lower than subchronic (90-day duration for rats) NOAELs by up to a factor of ten.

5.4 EXPOSURE ESTIMATE

This section describes the potential for actual contact or co-occurrence of the chemicals with the receptors to determine their exposure dose.

Benthic invertebrates and fish are exposed to chemicals in the surface water and sediment through direct contact and/or ingestion of contaminated media. Therefore, the surface water and sediment concentrations are used as the exposure concentrations (see Tables 5-3 and 5-4). The exposures of chemicals for mammals and birds are more complex, and need to account for bioaccumulation in various food items. Therefore, exposure of the terrestrial receptors to the chemicals in the surface water and sediment were determined by estimating the daily doses in mg/kg-day using exposure equations.

Only chemicals that are designated as bioaccumulative chemicals by EPA (EPA, February 2000) were included in the food-chain models. For the mallard duck, it was assumed that 100 percent of the diets were based on aquatic plants. For the mink and great blue heron, the diet was assumed to be 100 percent fish. The following equation presents the food-chain model that was used for the mink, mallard, and great blue heron:

$$CDI = \frac{[(Cf * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

where:

CDI	=	Chronic daily intake (mg/kg-day)
Cf	=	Chemical concentration in food (mg/kg)
If	=	Ingestion rate of food (kg/day)
Cs	=	Chemical concentration in sediment (mg/kg)
Is	=	Rate of incidental sediment ingestion (kg/day)
Cw	=	Chemical concentration in unfiltered water (mg/L)
Iw	=	Ingestion rate of water (L/day)
H	=	Contaminated area/home area range area ratio (unitless)
BW	=	Body weight (kg)

The exposure assumptions (i.e., ingestion rate, body weight) were obtained primarily from the Wildlife Exposure Factors Handbook (EPA, December 1993), but other literature sources were used, when necessary. Table 5-5 presents the exposure parameters that were used in the ERA. Appendix C-2 presents the values that were used to calculate the exposure parameters and a discussion of how these values were calculated.

The following input parameters were used in the CDI equation for the wildlife surrogate species:

- Maximum surface water, sediment, and tissue concentrations
- Conservative receptor body weights (provided in Table 5-5)
- Conservative receptor ingestion rate (provided in Table 5-5)
- Contaminated area/home range equal to 1 (i.e., receptors obtain 100 percent of their food from the site)

5.5 RISK CHARACTERIZATION

The risk characterization is the final phase of an ERA that compares exposure concentrations/doses to ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor were evaluated. An ecological effects quotient (EEQ) approach was used to characterize the risk to potential ecological receptors. This approach characterizes the potential effects by comparing exposure concentration with the effects data. A calculated EEQ value less than 1.0 indicates that the potential risk to aquatic and terrestrial receptors is low. A calculated EEQ greater than 1.0 does not indicate that ecological receptors are at risk; it only indicates that the conservative screening values were exceeded and that the available data should be further evaluated. The EEQ is not an expression of probability, and the meaning of values greater than 1.0 must be interpreted in light of uncertainties in risk management.

The EEQ for aquatic receptors was calculated as follows:

$$EEQ = \frac{C_{sw}}{SwSV} \text{ or } \frac{C_{sd}}{SSV}$$

where:

EEQ = Ecological effects quotient (unitless)

C_{sw} = Chemical concentration in surface water (µg/L)

C_{sd} = Chemical concentration in sediment (µg/kg or mg/kg)

SwSV = Surface water screening value (µg/L)

SSV = Sediment screening value (µg/kg or mg/kg)

The EEQ for the terrestrial wildlife model was calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where:

EEQ = Ecological effects quotient (unitless)

CDI = Chronic daily intake dose (mg/kg-day)

TRV = Toxicity reference value (NOAEL or LOAEL) (mg/kg-day)

5.5.1 Selection of Chemicals of Potential Concern

Ecological COPCs were selected by the following procedures:

- Chemicals with EEQs greater than 1.0 (using screening values) were retained as COPCs for further evaluation because they have a potential to cause risks to aquatic organisms, such as benthic invertebrates and fish. Chemicals without screening values were retained as COPCs.

- Chemicals with EEQs greater than 1.0 based on the food-chain model using NOAELs were selected as COPCs because they have the potential to cause risks to mammals and birds.

- No screening values were available to evaluate the fish tissue and hydrilla samples. Therefore, chemicals in these media that were detected below the concentrations in the upgradient or reference tissue samples were not retained as COPCs. Also, chemicals that were not bioaccumulative and were not detected or were detected infrequently in the surface water and sediment samples were not retained as COPCs.

- Calcium, magnesium, potassium, and sodium were excluded as COPCs in all media because they are essential nutrients that can be tolerated by living systems even at high concentrations. Also, there is no evidence that these chemicals are related to site operations. Therefore, these chemicals are not discussed further in the ERA.

As presented in Section 4.0, two types of sediment data were collected from Mattawoman Creek; samples that were analyzed using screening techniques and samples that were analyzed at a fixed-

based laboratory. Only the data from the fixed-based laboratory were used to select COPCs. However, the screening data were used in Section 4.0 as part of the nature and extent discussion.

5.5.1.1 Chemicals of Potential Concern for Benthic Invertebrates, Fish, and Vegetation

Surface Water

Table 5-3 is the surface water COPC screening table. Two VOCs (diethyl ether and methyl tert-butyl ether) and two SVOC parameters (low molecular weight PAHs and total PAHs) were retained as COPCs because no toxicity data were available for the chemicals.

Perchlorate and 4-nitrotoluene were retained as COPCs because no toxicity information was available for these chemicals. As discussed in Section 4.0, because the CH2M Hill data reported perchlorate as ammonia perchlorate, while the TtNUS data reported perchlorate, the ammonia perchlorate concentrations in the CH2M Hill samples were used to calculate the perchlorate values in Table 5-3.

Ten total inorganic parameters (nine metals and cyanide) were retained as COPCs because the maximum detected concentrations exceeded the associated surface water screening values (SWSVs). Eight filtered metals were retained as COPCs because the maximum detected concentrations exceeded the SWSVs.

Sediment

Table 5-4 is the sediment COPC screening table. Of the detected VOCs in sediment, five were retained as COPCs. Three VOCs (chloromethane, diethyl ether, and methyl tert-butyl ether) were retained as COPCs because no toxicity information was available for these chemicals. Two VOCs (acetone and carbon disulfide) were retained as COPCs because the maximum detected concentrations exceeded the sediment screening values (SSVs).

Twenty-one SVOCs in sediment were retained as COPCs. Of these, 20 were retained as COPCs because the maximum concentrations exceeded the SSVs. One SVOC, carbazole, was retained as a COPC because no toxicity information was available for comparison.

Two pesticides were retained as COPCs. 4,4'-DDE was retained as a COPC because the maximum concentration exceeded the SSV. Alpha-BHC was retained as a COPC because no toxicity information was available for comparison.

Four energetics (1,3,5-trinotrobenzene, 1,3-dinitrobenzene, 2,4,6-trinotrobenzene, and HMX) were retained as COPCs because their maximum detections exceeded the SSVs. Four energetics were retained as COPCs because no toxicity information was available for comparison.

Fifteen inorganics (including 14 metals and cyanide) were retained as COPCs because maximum detected concentrations exceeded the SSVs. Two additional metals (beryllium and thallium) were retained as COPCs because no toxicity information was available for comparison.

Fish Tissue

The whole body fish tissue samples were collected for the ERA, while the fillet fish tissue samples were primarily collected for the HHRA. However, both the whole body data and fillet data were evaluated as part of the ERA.

Whole Body COPCs

Table 5-6 is the whole body fish tissue COPC screening table. No screening values were available to select the chemicals as COPCs in the whole body fish tissue. Therefore, chemicals that were detected at concentrations below those detected in the upgradient/reference fish were not selected as COPCs. For that reason, barium, manganese, zinc, and benzaldehyde were not retained as COPCs. Also, metals that are not considered important bioaccumulative chemicals were not retained as COPCs (EPA, February 2000). These chemicals include aluminum, cyanide, iron, and vanadium.

In summary, the following chemicals were retained as COPCs: four SVOCs [2-methylphenol, 4-methylphenol, bis(2-ethylhexyl)phthalate, and phenol], two energetics (nitroglycerin and nitroguanidine), four metals (arsenic, cadmium, chromium, and lead), two pesticides (4,4'-DDD and 4,4'-DDE) and one PCB (aroclor-1260). Note that although the energetics are not considered to be bioaccumulative chemicals according to EPA (EPA, February 2000), they were retained as COPCs because they may be related to site activities.

Fillet COPCs

Table 5-7 is the fillet fish tissue COPC screening table. No screening values were available to select the chemicals as COPCs in the fillet fish tissue. Therefore, chemicals that were detected at concentrations below those detected in the upgradient/reference fish were not selected as COPCs. For that reason, arsenic, barium, manganese, mercury, zinc, and benzaldehyde were not retained as COPCs. Also, metals that are not considered important bioaccumulative chemicals were not retained as COPCs (EPA, February 2000). These chemicals include aluminum, cyanide, iron, vanadium. Finally, the following

organic chemicals were not retained as COPCs because they are not considered important bioaccumulative chemicals (EPA, February 2000), and either were not detected in the surface water or sediment samples, or were detected infrequently: 4-methylphenol, bis(2-ethylhexyl)phthalate, and phenol.

In summary the following chemicals were retained as COPCs: five energetics (1,3-dinitrobenzene, 2-amino-4,6-dinitrotoluene, HMX, nitrocellulose, and nitroguanidine), four metals (cadmium, chromium, copper, and lead), five pesticides (4,4'-DDE, dieldrin, endosulfan I, endrin, and gamma-chlordane) and one PCB (aroclor-1260). Note that although the energetics are not considered to be bioaccumulative chemicals, according to EPA (EPA, February 2000), they were retained as COPCs because they may be related to site activities.

Vegetation

Table 5-8 is the hydrilla tissue COPC screening table. No screening values were available to select the chemicals as COPCs for the hydrilla tissue. Therefore, chemicals that were detected at concentrations below the concentrations detected in the upgradient/reference hydrilla were not selected as COPCs. Zinc was the only chemical that was detected in the site samples at greater concentrations than the concentrations in the upgradient/reference, so it was the only chemical that was retained as a COPC.

5.5.1.2 Chemicals of Potential Concern for Terrestrial Wildlife

VOCs are generally not considered bioaccumulative and are not expected to pose risk to higher trophic level species. For this reason, VOCs were not considered in the terrestrial wildlife models and were not retained as COPCs. All bioaccumulative chemicals were included in the food chain model even if they were not retained as COPCs for some media (i.e., fish) to be conservative. Table 5-9 presents a summary of the conservative input terrestrial wildlife model NOAEL and LOAEL EEQs. Appendix C-3 contains calculation sheets for the food chain model.

Of the pesticides detected, 4,4'-DDE was retained as a COPC because the NOAEL EEQ exceeded 1.0 in the heron food-chain model.

Seven metals were retained as COPCs because the calculated NOAEL EEQs exceeded 1.0 in the surrogate species' food-chain models. Chromium, lead, mercury, and zinc had NOAEL EEQs that exceeded 1.0 in all three species' food-chain models. Cadmium was retained as a COPC because the NOAEL EEQ exceeded 1.0 in the duck and mink models. Arsenic and silver had NOAEL EEQs that exceeded 1.0 in the mink food-chain model only.

5.6 EVALUATION OF RISKS

This section of the ERA further evaluates the chemicals that were retained as COPCs to determine if they should be retained as chemicals of concern (COCs) for further evaluation and study. Assessment endpoints are also evaluated. The evaluation includes (but is not necessarily limited to) a consideration of the following topics:

- Magnitude of criterion exceedence: Although risks may not relate directly to the magnitude of a criterion exceedence, the magnitude was one factor used in a weight-of-evidence approach to determine the need for further site evaluation.

- Frequency of chemical detection/spatial distribution: A chemical that was detected at a low frequency typically was of less concern than a chemical detected at higher frequency provided that toxicity and concentrations of the constituents are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical was evaluated to determine if the contamination was bounded.

- Chemical bioavailability: Many chemicals (especially metals) are present in the environment in forms that are typically not bioavailable, and the limited bioavailability was considered when evaluating the exposures of receptors to site chemicals. Site-specific bioavailability was evaluated by collecting tissue samples and conducting toxicity tests/benthic community surveys.

- Alternate Benchmarks: Less conservative values/toxicity data were used to reevaluate the chemicals that were retained as COPCs to determine if the detected concentrations exceed the higher effects levels. Appendix C-4 contains the alternate benchmarks that are used in the ERA.

- Average Food-Chain Models: The exposure doses from the terrestrial food-chain models were recalculated using less conservative exposure assumptions (e.g., average ingestion rates, body weights and chemical concentrations) to determine an average risk.

5.6.1 Risks to Benthic Invertebrates

As presented in Section 5.2.2, three measurement endpoints were used to evaluate risks to benthic invertebrates:

- Sediment chemistry
- Sediment toxicity tests
- Benthic community analysis

This section first discusses each of these endpoints separately, and then combines the three endpoints in a weight-of-evidence approach to conclude if there are risks to the benthic community at any of the stations, and if the benthic community in Mattawoman Creek, as a whole, is being impacted.

5.6.1.1 Sediment Chemistry

Refinement of COPCs

As presented on Table 5-4 and in Section 5.5.1.1, several chemicals were retained as COPCs because they either exceeded screening values or did not have screening values.

Acetone and carbon disulfide were retained as COPCs because their maximum detected values exceeded the screening value. Acetone and carbon disulfide are common laboratory contaminants, as evidenced by their detections in three of the four background samples (see Table 4-2). Acetone concentrations exceeded the screening value and maximum background concentrations in only 2 of 40 samples, and the maximum detection of carbon disulfide did not exceed the maximum background concentration. Therefore, these VOCs are not retained as COCs for further evaluation in the ERA. Chloromethane, diethyl ether, and methyl tert-butyl ether do not have screening values but were detected in only 1 of 40; 2 of 28; and 1 of 32 samples, respectively. Because these VOCs were detected infrequently, and because VOCs are typically not toxic to aquatic receptors at low concentrations (as evidenced by the relatively high screening values for most of the other VOCs), these VOCs are not retained as COCs for further evaluation in the ERA.

Several SVOCs were retained as COPCs including PAHs and other SVOCs. As presented in Swartz (1999), because PAHs are often present as mixtures in sediment and because toxicity from PAHs are likely the result of the cumulative effects of the various PAHs in the mixture, guidelines based on total PAHs are appropriate for evaluating sediments with PAH mixtures. Total values for high molecular weight (HMW) PAHs, low molecular weight (LMW) PAHs, and total PAHs were calculated as presented in Section 4.0. The PAHs included in the total include a few more PAHs than those typically considered in the guidelines (Swartz, 1999) to ensure that all PAHs that were detected are accounted for in the evaluation of the Mattawoman Creek sediments. Because the values for the HMW, LMW, and total PAHs exceeded the screening value, these groups were retained as COCs for further evaluation.

The non-PAH SVOCs that were retained as COPCs include carbazole, diethyl phthalate and, n-nitrosodiphenylamine. Carbazole, although not a PAH, is often found in samples where PAHs are present. It was not retained as a COC for further evaluation because it was infrequently detected (in 3 of 40 samples), and risks are expected to be low compared to the risks from PAHs, based on its relatively

low concentration (140 µg/kg). Diethyl phthalate was not retained as a COC because it was infrequently detected (in 3 of 40 samples) and was detected at concentrations above the screening value in 1 of 40 samples. Therefore, any risks from this compound are expected to be low. Finally, n-nitrosodiphenylamine was detected in 10 of 40 samples and exceeded the screening value in all 10 samples. No additional toxicity data was found to further evaluate this chemical, so it was retained as a COC for further evaluation.

4,4'-DDE, alpha-BHC, and aroclor-1248 were retained as COPCs because they exceeded screening value or did not have a screening value (alpha-BHC). 4,4'-DDE was detected infrequently (in 2 of 36 samples) at a maximum concentration of 6 µg/kg. This concentration is slightly greater than the Ontario lowest effects level (LEL) of 5 µg/kg but is well below the Ontario severe effects level (SEL) of 190 µg/kg (OMOE, August 1993) and other higher effects levels, as presented in Appendix C-4. Alpha-BHC was detected infrequently (in 1 of 36 samples) at a maximum concentration of 0.7 µg/kg. This concentration is lower than the Ontario LEL of 6 µg/kg (OMOE, August 1993). Finally, aroclor-1248 also was detected infrequently (in 1 of 36 samples) at a maximum concentration of 170 µg/kg. This concentration is greater than the Ontario LEL of 30 µg/kg but is well below the Ontario SEL of 1,500 µg/kg (OMOE, 1993) and other higher effects levels for total PCBs, as presented in Appendix C-4. In summary, no pesticides or PCBs were retained as COCs for further evaluation because they were detected infrequently, were detected at concentrations below or just slightly exceeding the lower effects levels, and/or were detected at concentrations that were well below the higher effects levels.

Four energetics (1,3,5-trinotrobenzene, 1,3-dinitrobenzene, 2,4,6-trinotrobenzene, and HMX) were retained as COPCs because their maximum detections exceeded the screening values. These chemicals were not retained as COCs because they were detected infrequently (in 1, 1, 2, and 1 of 46 samples, respectively). 2-Amino-4,6-dinitrotoluene, 3-nitrotoluene, and 4-nitrotoluene (retained as COPCs because they lacked screening values) were not retained as COCs for further evaluation because they were detected infrequently (in 1, 2, and 1 of 46 samples, respectively). Also, their maximum detections are well below the screening values for the other energetics that were detected, and there is no reason to suspect that these three energetics are significantly more toxic than the energetics that have screening values. The only toxicity data located for nitrocellulose was an abstract from a study that indicated that "studies with sediments containing nitrocellulose indicated no adverse effects among chironomid populations exposed to 540 mg nitrocellulose/kg of sediment over two generations, based on an application factor of 0.1 and an EC50 of 579 mg/L for the most sensitive aquatic organisms tested (*Selenastrum capicornutum*)" (Bentley et al., 1976). Three samples in Area 4 had detections of nitrocellulose that were greater than the no effects levels in the study above. However, because other chemicals that have more toxicity data were detected at elevated levels in Area 4 and retained as COCs, and because the detected concentrations of nitrocellulose only exceeded a no effects level, nitrocellulose

was not retained as a COC for further evaluation. It should be noted, however, that due to the apparent low toxicity of nitrocellulose to aquatic organisms, a larger concern from nitrocellulose in an aquatic environment is related to the chemical's physical characteristics. Because of its fibrous nature, nitrocellulose blankets benthic invertebrates, depriving the organisms of oxygen (Ryon, 1986). However, the concentrations of nitrocellulose causing toxicity have not been reported. Habitat alteration caused by nitrocellulose fibers also includes the filling of interstitial spaces typically used for cover by benthic invertebrates and substrates for periphyton. General consensus of the regulatory community is that the threat posed to benthic invertebrates is greatest for habitat alterations as opposed to direct toxicity and that the best measure for evaluating this exposure pathway is through the measurements of water quality parameters for discharges such as percent suspended solids.

Although 15 inorganic chemicals were retained as COPCs because they were detected at concentrations that exceeded screening values, eight were not retained as COCs for various reasons. The following bullets list the chemicals and reasons why they were not retained as COCs:

- Aluminum was detected in only 1 of 46 samples at concentrations that exceeded the screening value. Also, its maximum detection (19,600 mg/kg) was well below the probable effects concentration (PEC) (58,030 mg/kg) that was developed by the EPA Great Lakes National Program Office as part of the Assessment and Remediation of Contaminated Sediment (ARCS) Project. Therefore, risks from aluminum are expected to be low and do not warrant further evaluation.

- Beryllium was detected in 40 of 46 samples, with a maximum concentration of 1.6 mg/kg. Only three detected concentrations of beryllium exceeded the maximum background concentration (1.3 mg/kg). No screening value or alternate benchmark was available for beryllium, but the low maximum detection relative to the background concentrations indicates that beryllium does not appear to be related to site activities.

- Cobalt was detected in 44 of 46 samples, with a maximum concentration of 34.7 mg/kg. Ten detected concentrations of cobalt exceeded the screening value (10 mg/kg) but only 7 detected concentrations exceeded the maximum background concentration (19.8 mg/kg). Also, the maximum detection was below the 50 mg/kg value for sediments acceptable for open water disposal as referenced in OMOE (OMOE, August 1993). Therefore, risks from cobalt are expected to be low and do not warrant further evaluation.

- Cyanide was detected in 4 of 46 samples. The maximum detections in two samples (4.7 and 3.8 mg/kg) exceeded the screening value (0.667 mg/kg), but cyanide was not detected in the

duplicates of either sample. Therefore, risks from cyanide are expected to be low and do not warrant further evaluation.

- Iron was detected in all 46 sediment samples. Iron is typically not considered a toxic metal, and it is found at high concentrations in sediment from natural conditions. Only four locations had detections greater than the SEL of 40,000 (OMOE, August 1993). Three of these locations, including the maximum detections of iron were in the samples adjacent to Site 11 and Site 17 in Area 1; the other location was by Site 39/41 in Area 4. Other more toxic metals, including copper, lead, mercury, silver, and zinc (which were retained as COCs for further evaluation) were detected in the samples with the high iron concentrations. Therefore, risks from metals in these stations will be accounted for by evaluating risks from the other more toxic metals at the stations with the elevated iron detections. For that reason, iron is not retained as a COC for further evaluation.

- Nickel was detected in 44 of 46 samples at a maximum concentration of 46.4 mg/kg. The maximum detection was lower then the SEL of 75 mg/kg (OMOE, August 1993), and the Effects Range-Median (ER-M) of 51.6 mg/kg (Long et al., 1995), and the maximum screening EEQ was only 2.2. Therefore, risks from nickel are expected to be low and do not warrant further evaluation.

- Selenium was only detected in 1 of 45 samples. The maximum detection (1.7 mg/kg) slightly exceeded the screening value (1 mg/kg). Therefore, risks from selenium are expected to be low and do not warrant further evaluation. Although the selenium detection limits for many samples exceeded the screening level of 1 mg/kg, all of the detection limits were relatively low (most were less than 5 mg/kg) using the standard and accepted EPA analytical methods. In addition, the selenium concentrations in the SPARWAR confirmation data (which had lower detection limits for selenium) were less than the screening levels (see Appendix B-8).

- Thallium was detected in 9 of 46 samples at a maximum concentration of 4.2 mg/kg. No screening values, alternate benchmarks, or background concentrations were available for thallium. The samples were detected in a tight range of concentrations (1.1 to 4.2 mg/kg) and were detected at different locations along the shoreline (not all in one area). This, along with the relatively low frequency of detection indicates that thallium is not likely a site related chemical, and it does not warrant further evaluation.

The following metals were retained as COCs for further evaluation because their maximum detections exceeded the alternate benchmarks and because the spatial distribution of the metals are indicative of releases from various sources:

- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Silver
- Zinc

Weight of Evidence

The weight of evidence approach that was used for the sediment chemistry data incorporated the number of chemicals that exceed the consensus-based sediment quality guidelines for freshwater ecosystems (MacDonald et al., 2000). Also, the mean quotients using the threshold effect concentration (TEC) and probable effect concentration (PEC) from MacDonald (MacDonald et al., 2000) were used in the weight of evidence approach. The mean TEC (or PEC) quotients were calculated as follows:

$$\text{TEC-Q (or PEC-Q)} = [(C_a/SQG_a) + (C_b/SQG_b) + C_c/SQG_c \ldots)/n$$

Where:

TEC-Q	=	Threshold effects concentration quotient
PEC-Q	=	Probable effects concentration quotient
C_a	=	Chemical concentration for the first chemical
SQC_a	=	Sediment quality guidelines for the first chemical
C_c	=	Chemical concentration for the second chemical
SQC_c	=	Sediment quality guidelines for the second chemical
C_c	=	Chemical concentration for the third chemical
SQC_c	=	Sediment quality guidelines for the third chemical
n	=	Total number of chemicals

The consensus-based sediment guidelines were selected for this ERA because they were developed by calculating the geometric mean of available guidelines in the literature, thereby reducing the weight given to any particular set of guidelines. The mean quotient approach also was selected for this ERA because the quotient method is a way to account for effects based on chemical mixtures. Several papers have indicated that there is an increased likelihood of toxicity to benthic invertebrates when the number of chemicals that exceed sediment guidelines increase, or when the mean quotient increases (Fairey et al., 2001; Long et al, 2000; MacDonald et al., 2000).

Tables 5-10 and 5-11 present the calculation of the TEC and PEC ecological effects quotients and the mean quotients, respectively. The quotients were calculated only for the chemicals that were retained as COCs. The Effects Range-Low (ER-L) and Effects Range-Median (ER-M) values from Long et al., (1995) were used for silver because a TEC or PEC is not available for this chemical. Quotients were not calculated for n-nitrosodiphenylamine because a TEC or PEC was not available for this chemical, and it was only detected in 3 of the 24 site toxicity test samples. Therefore, no trends can be made with n-nitrosodiphenylamine.

Table 5-12 summarizes the mean quotients and indicates the number of guidelines that are exceeded in a particular sample. A weighting system was then used to create an overall score for the sample. The weighting system, has values of 0, 2, 4, and 6, with the higher numbers indicating greater exposure concentration versus the guidelines, and thus an increase in potential risks to benthic invertebrates. The following bullets describe the weighting system which is based primarily on professional judgement, which is supported in part by articles in the literature:

- 0 – This value was assigned to a sample if none of the chemicals in the sample were detected at concentrations that exceeded the TEC or if the mean TEC Quotient was less than the maximum mean TEC Quotient in the upgradient and reference samples. Because the TEC is intended to identify chemical concentrations below which harmful effects on sediment dwelling organisms are not expected (MacDonald et al., 2000); samples with no chemicals that exceed the TEC are not expected to be toxic to benthic invertebrates. Although samples with some chemicals that have concentrations greater than the TEC may pose a slight risk to benthic receptors, if the mean TEC Quotient is lower than the TEC Quotient in the upgradient or reference samples, risks are expected to be in the background range.

- 2 – This value was assigned to a sample if none of the chemicals in the sample were detected at concentrations that exceeded the PEC but the mean TEC Quotient was greater than the maximum mean TEC Quotient in the upgradient and reference samples. Because samples with some chemicals that have concentrations greater than the TEC may pose a slight risk to benthic receptors, a mean TEC Quotient that is greater than the TEC Quotient in the upgradient or reference samples indicates that risks to benthic organisms are greater than background risks.

- 4 – This value was assigned to a sample if one of the chemicals in the sample was detected at concentrations that exceeded the PEC. Because the PEC is intended to identify chemical concentrations above which harmful effects on sediment dwelling organisms are expected to occur

frequently (MacDonald et al., 2000), samples with one chemical that exceed the PEC may be toxic to benthic invertebrates.

- 6 – This value was assigned to a sample if multiple chemicals in the sample were detected at concentrations that exceeded the PEC and the Mean PEC Quotient was greater than 1.0. Because the PEC is intended to identify chemical concentrations above which harmful effects on sediment dwelling organisms are expected to occur frequently (MacDonald et al., 2000), samples with multiple chemicals that exceed the PEC may be toxic to benthic invertebrates. Also, samples with mean PEC (or other higher effect levels) Quotients greater than 1.0 have a greater probability of being toxic (Long et al., 2000; Fairey et al., 2001; MacDonald et al., 2000)

Table 5-12 presents the weight-of-evidence scores for the sediment chemistry. In summary, samples from one location (MTCSD026 and its duplicate) had a score of 6, and two samples (MTCSD015 and 023D) had scores of 4. Eight samples had scores of 2 and 12 samples had scores of 0.

5.6.1.2 Sediment Toxicity Tests

Sediment samples collected for toxicity testing were submitted to Tetra Tech Inc.'s Biological Research Facility in Owings Mills, Maryland for 10-Day Survival and Growth toxicity testing, using the amphipod *Hyalella azteca*. A total of 28 sediment samples were submitted for testing comprised of 26 samples collected from Mattawoman Creek (including four duplicate samples), and two samples collected from reference locations in Nanjemoy Creek; two of the Mattawoman Creek samples were collected from upgradient locations and are considered to be background samples. The laboratory report with all of the results and raw data is included as Appendix C-5.

The EPA (EPA, March 2000) Test Method 100.1 (*Hyalella azteca* 10-d Survival and Growth Test for Sediments) was used for the testing. Supplemental guidance included ASTM standards (ASTM 2000), and Tetra Tech Inc. Standard Operating Procedures (Tetra Tech, January 1997). Survival and growth (as indicated by weight) were the endpoints measured for each sample.

Each of the tests consisted of eight replicates with 10 test organisms per replicate. Prior to introduction into the test chambers, all 28 submitted sediment samples were thoroughly homogenized in a stainless steel bowl with a teflon spoon. During homogenization, the sediments were inspected for the presence of indigenous organisms and if found, removed. The laboratory did not report any indigenous predatory organisms that may have affected the test results being found upon test initiation or termination. Test sediments were overlaid with moderately hard, reconstituted water (hardness of 74 - 104 mg/L as $CaCO_3$ and alkalinity of 48 - 76 mg/L as $CaCO_3$) and aerated according to method guidelines following acclimation. Numbers of test organisms were counted at the beginning and end of the test. Daily

monitoring was performed for temperature and dissolved oxygen. Hardness, alkalinity, conductivity, pH, and ammonia were measured at the beginning of the test and upon test termination. Specific information regarding toxicity test conditions may be found in Tetra Tech Inc.'s report located in Appendix C-5.

The performed tests met the minimum mean control survival criteria of 80 percent and measurable growth of test organisms in the control sediment. All test water quality parameters were within acceptable limits except for dissolved oxygen (DO). DO was observed to fall below the test minimum recommended concentration of 2.5 mg/L in 15 of the tested samples. Slow aeration was started on Day 3 for the tests initiated on September 18, 2002, and on Day 0 for the tests initiated on September 22, 2002. The highest ammonia concentration recorded was 10 ppm for Sample MTCSD01901.

The results of the studies from the site samples were statistically compared to the results of the upgradient, reference, and control data sets using an analysis of variance (ANOVA) and Tukey Honestly Significantly Different (HSD) test. Appendix C-6 describes in more detail the statistical tests that were used. The reasons for these different comparisons are presented in the following bullets:

- The site samples, the upgradient samples, and the reference samples were compared to the laboratory control samples. The comparison to laboratory controls is important because this determines if the samples are considered toxic relative to a clean sediment. However, it does not account for toxicity that may be caused from non-site related factors present in the sediment themselves, such as ammonia, sulfides, and other potentially confounding factors.

- The upgradient and reference samples were compared to each other to determine if combining the data sets for the comparison to the site samples would be appropriate. The upgradient samples are more representative of the inherent toxicity of the sediment in Mattawoman Creek, while the reference samples are more representative of the inherent toxicity of similar sediment in the area.

- Finally, site data were compared to the upgradient and reference data sets independently, and then the site data were compared to the combined upgradient and reference data sets. The comparison to the upgradient and reference sediments can help determine if there are regional confounding factors (not related to site activities) in the sediment that may be causing toxicity.

Results

Table 5-13 presents the mean number of survivors per replicate, the mass of the organism per survivor, the ammonia and dissolved oxygen concentrations. The ammonia concentrations were measured at the beginning and end of the test; so those values are presented in Table 5-13. The dissolved oxygen was measured daily (with a few exceptions), so only the minimum values were presented in Table 5-13 along

with the average of the daily measurements. The table also presents the number of days where the DO concentration was less than 2.5 mg/L. The number of survivors per replicate and mass of the organisms per survivor are presented graphically in Figures 5-2 and 5-3, respectively.

As can be seen from Table 5-13, the two laboratory control samples had the same mean survival results of 86.25 percent. Mean survival in the two reference samples (NJCSD00101 and 00201) were 61.3 and 50 percent respectively, and were 31.3 and 40.0, respectively, in the two upgradient samples (MTCSD02701 and 02801). The mean survival in the site samples ranged from 0 to 85 percent. Growth, expressed as the mean weight of the surviving organisms ranged from 0.59 to 0.66 mg in the two control samples. Mean growth in the two reference samples (NJCSD00101 and 00201) were 0.20 and 0.48 mg, respectively, and were 0.28 and 0.39 mg, respectively, in the two upgradient samples (MTCSD02701 and 02801). Mean growth in the site samples ranged from 0 to 0.48 mg.

The cause for the low survival rates in the sediment samples does not appear to be caused by the typical confounding factors (i.e., percent fines, high ammonia concentrations) with the exception of perhaps low DO concentrations. Figures 5-4, 5-5, and 5-6 present the mean survivor rates versus the percent fines (percent silt and clay), maximum ammonia concentration, and minimum dissolved oxygen concentrations, respectively, using all the site samples, reference and upgradient samples, and laboratory control samples. Based on the figures, it is apparent that percent survival is not related to percent fines, ammonia, or dissolved oxygen. The plots were then regenerated by removing the following samples:

- The sample (and its duplicate) from station MTCSD026 was removed because the extremely high concentrations of several metals (arsenic, cadmium, zinc) were biasing the regression lines. It is suspected that the high mortality (100 percent) was due to elevated chemical concentrations in the samples from this station. Therefore, the samples were removed so the correlations from the confounding factors in the other samples could be discerned.

- The sample from station MTCSD017 was removed because the sample had 100 percent mortality. This sample had some of the lowest chemical concentrations of any of the samples tested, so toxicity was not related to any of the analyzed chemicals. Also, it had high DO concentrations and low ammonia concentrations, so toxicity was not related to these factors (see Table 5-13). For these reasons the sample was removed so it would not bias the regression lines for the confounding factors.

Figures 5-7, 5-8, and 5-9 present the mean survivor rates versus the percent fines, maximum ammonia concentration, and minimum dissolved oxygen concentrations, respectively, using all the site samples (except MTCSD017 and 026 and its duplicate), reference and upgradient samples, and laboratory control

samples. Based on the figures, percent survival is not related to percent fines. However, there is a slight and high relationship of survivor rates to ammonia, and DO with correlation coefficients of R^2=0.21 and 0.63, respectively.

Figures 5-10, 5-11, and 5-12 present the mean mass per survivor versus the percent fines, maximum ammonia concentration, and minimum DO concentrations, respectively, using all the site samples, reference and upgradient samples, and laboratory control samples. Based on the figures, growth is not related to percent fines, ammonia, or DO. Figures 5-13, 5-14, and 5-15 present the mean mass per survivor versus the percent fines, maximum ammonia concentration, and minimum DO concentrations, respectively using all the site samples (except MTCSD017 and 026 and its duplicate), reference and upgradient samples, and laboratory control samples. Based on the figures, mean mass per survivor is not related to percent fines or ammonia. However, there is a moderate relationship of mean mass to DO (R^2=0.41).

The DO concentrations dropped below 2.5 mg/L in several samples (see Table 5-13) which is the concentration where toxicity to *Hyalella azteca* may occur (ASTM, 2002; EPA, March 2000). Although aeration was started on the third day, a few samples had low DO concentrations (< 2.5 mg/L) for 2 or 3 days. Therefore, it is likely that the low dissolved oxygen values played a part in the toxicity of the site samples. All of the ammonia concentrations were well below the Lethal Concentration (LC) 50 of 20 mg/L for ammonia (ASTM, 2001). Therefore, the data indicate that ammonia concentrations did not impact the test results.

Statistical Comparisons

Table 5-14 summarizes the results of the various statistical comparisons. The statistical tests are presented in Appendix C-6. Survival in all of the upgradient and reference samples were statistically lower than survival in the control samples, while survival in one of the upgradient samples was lower than survival in the reference samples (see Appendix C-6). As listed on Table 5-14, significantly lower survival was found in three, 11, and five site samples compared to the upgradient samples, reference samples, and combined upgradient and reference data set, respectively, and survival in 19 site samples was significantly lower than survival in the control samples. These results indicate that although most of the samples (including all of the upgradient and reference samples) appeared to be toxic versus the control samples, there may be some confounding factors either in the sediment, or with the sediment toxicity test itself that adversely impacted survival in the site samples. As indicated above, there is a correlation between the percent survival and DO concentrations, so it is possible that the low DO contributed to the low survival in the samples.

Growth was significantly lower in three of the upgradient and reference samples compared to the control samples, while growth was not lower in either of the upgradient samples compared to the reference samples (see Appendix C-6). As shown on Table 5-14, only three site samples had significantly lower growth compared to the upgradient samples, reference samples, and combined upgradient and reference data set. Four of the samples had lower survival compared to the control samples. These results indicate that lower growth in one of the site samples (MTCSD023D) is lower than the upgradient, reference and control samples. This sample had low DO concentrations (< 2.5 mg/L) for three days (see Table 5-13). As indicated above, there is a correlation between the growth and DO concentrations, so it is possible that the low dissolved concentrations cause the low growth in the sample.

Finally, the survival was statistically similar between the upgradient and reference samples with one exception (MTCSD027), but the growth was similar between all of the upgradient and reference samples (see Appendix C-6).

Correlation Plots

PAHs, n-nitrosodiphenylamine, and select metals (arsenic, cadmium, copper, lead, mercury, silver, and zinc) were retained as COCs for further evaluation. Part of this evaluation included generating plots of percent survival and growth versus concentrations of the various COCs to determine if there were any relationships between chemical concentrations and either survival or growth. These plots are presented in Appendix C-7. Plots were not generated for n-nitrosodiphenylamine because only three of the samples selected for the toxicity tests had detected concentrations of this chemical.

The plots include half of the detection limit for non-detects for the metals, but rejected data were not included in the plots. Only positive detections were used to calculate the values for LMW, HMW, and total PAHs. Finally, plots were first generated using all of the site samples, upgradient samples and reference samples. The plots for the metals were then regenerated by removing the following samples:

- The sample (and its duplicate) from station MCSD026 were removed because the extremely high concentrations of several metals (arsenic, cadmium, zinc) were biasing the regression lines. It is suspected that the elevated chemical concentrations in the samples from this station caused the toxicity. Therefore, the samples were removed so the correlations from the chemicals in the other samples could be discerned.

- The sample from station MCSD017 was removed because the sample had 100 percent mortality. This sample had some of the lowest chemical concentrations of any of the samples tested, so toxicity was not related to any of the analyzed chemicals. Also, it had high DO concentrations and low

ammonia concentrations, so toxicity was not related to these factors (see Table 5-13). For that reason, the sample was removed so it would not bias the regression lines.

Table 5-14 summarizes the correlation coefficients for the plots in Appendix C-7. The following is a common ranking that may be used to determine the strength of association suggested by the absolute value of the correlation coefficient:

0.64-1.00	Strong association between variables
0.36-0.63	Strong to moderate association
0.16-0.35	Moderate association
0.09-0.15	Moderate to weak association
0.04-0.08	Weak association
0.00-0.039	Little, if any association

The following bullets summarize the results of the plots and Table 5-14:

- Arsenic: The concentrations of arsenic in the samples have a weak to moderate correlation with survival and growth, with R^2 values of 0.12 and 0.19, respectively, when including all of the samples. There is little correlation after samples from locations MTCSD017 and 026 are removed. This indicates that the correlation is being driven by sample MTCSD026 and its duplicate, which had the maximum arsenic concentration in the toxicity test samples. However, these samples also had elevated levels of several other metals, so it is not clear if arsenic was the source of toxicity.

- Cadmium: The concentrations of cadmium in the samples moderately correlate with survival and growth with R^2 = 0.36 for survival and R^2 = 0.19 for growth after the samples from stations MTCSD017 and 026 were removed. Therefore, there is a relationship between increased cadmium concentrations and decreased survival and growth in the toxicity test.

- Copper: The concentrations of copper weakly correlates with survival with low R^2 values. There is a moderate to strong correlation with growth both before and after the samples from stations MTCSD017 and 026 were removed (R^2 = 0.46 and 0.5, respectively). The maximum copper concentration in the toxicity test samples (besides the samples from MTCSD026) was 37 mg/kg, which is just above the screening value (34 mg/kg). Also, there is a lot of scatter in the data 30 to 37 mg/kg range, with the two greatest concentrations having the greatest growth results for the samples in that range. Therefore, although the correlation is high, it is not likely that the low copper concentrations would be toxic to aquatic organisms.

- Lead: The concentrations of lead in the samples have a weak to moderate correlation with survival (R^2=0.17) when including all of the samples, but there was little correlation after samples from locations MTCSD017 and 026 were removed (R^2=0.064). There is a moderate to strong correlation with growth both before and after the samples from stations MTCSD017 and 026 were removed (R^2 = 0.37 and 0.38, respectively). The maximum lead concentration in the toxicity test samples (besides the samples from MTCSD026) was 60.5 mg/kg, which is just above the screening value (46.7 mg/kg). Also, there is a lot of scatter in the data 40 to 67 mg/kg range, with the two greatest concentrations having some of the greatest growth results for the samples in that range. Therefore, although the correlation is high, it is not likely that the low lead concentrations would be toxic to aquatic organisms.

- Mercury: The concentrations of mercury in the samples have a weak correlation with survival (R^2=0.10) when including all of the samples, but the correlation increased slightly after samples from locations MTCSD017 and 026 were removed (R^2=0.19). There was little correlation with growth both including all of the samples (R^2=0.046), but the correlation was moderate after the samples from stations MTCSD017 and 026 were removed (R^2 = 0.21). However, because of the considerable scatter in the plots, it is not likely that the mercury concentrations would be toxic to aquatic organisms.

- Silver: The concentrations of silver in the samples have a low correlation with survival and growth, with R^2 values of 0.015 and 0.040, respectively, when including all of the samples. There is weak to moderate correlation after samples from locations MTCSD017 and 026 are removed. From viewing the plots, it is difficult to see a meaningful relationship between silver concentrations in a decrease in survival or growth. Therefore, it is not likely that silver is the source of toxicity in the samples.

- Zinc: The concentrations of zinc in the samples have moderate association with survival or growth with R^2 values of 0.16 and 0.25, respectively, when including all of the samples. The correlations decrease (R^2 = 0.08 for survival and R^2 = 0.13 for growth) after the samples from stations MTCSD017 and 026 were removed. This indicates that the correlation is being driven by sample MTCSD026 and its duplicate, which had the maximum arsenic concentration in the toxicity test samples. Therefore, it is not likely that zinc is the source of toxicity in the samples, with the exception of MTCSD026, which had the greatest zinc concentration in the toxicity test samples.

- PAHs: PAHs were not detected in all of the samples where toxicity tests were conducted. Therefore, the plots consist of fewer sample points than the ones for metals. The correlations for some of the PAH groups are high, and indicate a moderate to strong association of PAH concentrations and survival and growth in the toxicity tests. With the exception of LMW PAHs for growth, the PAH correlations are low (R^2 < 0.33 for survival and R^2 < 0.05 for growth). The correlation for LMW PAHs

is high (R^2 = 0.74 for growth), but the data set consists of only five points, four of which were rather tightly grouped (Appendix C-7). A visual examination of the data indicates that the correlation is not significant. In either case, all of the trends for PAHs are toward greater survival and growth at greater chemical concentrations, so it does not appear that PAHs are impacting the benthic community.

Since concentrations of several metals were slightly correlated with survival or growth results, groupings that evaluate metal mixtures were evaluated. These consisted of AVS-SEM and PEC quotients (only using the chemicals retained as COCs) as calculated in Section 5.6.1.1.

- AVS-SEM: The concentrations of AVS-SEM in the samples have a moderate correlation with survival and growth, with R^2 values of 0.16 and 0.25, respectively, when including all of the samples. There is little correlation after samples from locations MTCSD017 and 026 are removed. This indicates that the correlation is being driven by sample MTCSD026 and its duplicate, which had the greatest metals concentration in the toxicity test samples. Sample MTCSD026 had the greatest concentrations of metals in any of the toxicity test samples, so it is likely that metals are causing toxicity in this sample.

- PEC Quotient: The concentrations of PEC quotient in the samples have a moderate correlation with survival and growth, with R^2 values of 0.16 and 0.33, respectively, when including all of the samples. There is lower correlation with survival after samples from locations MTCSD017 and 026 are removed (R^2=0.089), but a strong correlation with mass (R^2=0.41). Sample MTCSD026 had the greatest concentrations of metals in any of the toxicity test samples so it is likely that metals are causing toxicity in this sample. Metals also may be contributing to some of the toxicity in the other samples.

In summary, from the various plots in Appendix C-7, it appears that some metals may be causing the observed effects; however, the correlations for the metals are lower than the correlations to DO. Therefore, conclusions regarding toxicological effects of metals are confounded by the effects of low DO levels, so there is considerable uncertainty in relating chemical concentrations to the toxicity of the site samples.

<u>Weighting of Toxicity Test Data</u>

The toxicity test data were weighted lower than either the sediment chemistry data or benthic macroinvertebrate community data because it does not appear that the chemical concentrations were the primary cause of toxicity in the sediment samples for the following reasons:

- There was some correlation of toxicity to low DO levels in the overlying water.

- There was low overall correlation of greater chemical concentrations to the increased toxicity.

- Toxicity was exhibited in the upgradient and reference samples, which had low chemical concentrations.

- Similar findings of elevated toxicity in the Mattawoman Creek samples with low chemical concentrations were found in the Toxicity Identification Evaluation (TIE) study (SAIC, October 2001).

Overall, these findings may indicate that the sediments are inherently toxic to *Hyallela azteca,* but all of the toxicity is not accounted for by increased chemical concentrations in the sediment. For that reason, a weighting system of 0, 1, 2, and 3 was assigned to the samples based on the toxicity test results. The comparisons of the survival and growth in the site samples to the combined upgradient and reference data set were used to help select the score for the sample because the survival was statistically similar between the upgradient and reference samples with one exception, but the growth was similar between all of the upgradient and reference samples (see Appendix C-6). The basis for these designations is as follows:

- 0: Survival and growth in site samples are similar to or greater than in control samples. If survival and growth are similar to or greater than the survival and growth in the control samples, the samples are considered to be non-toxic, since the control samples met the criteria for being non-toxic (i.e., >80 percent survival).

- 1: Survival or growth in site samples is lower than in control samples, but survival and growth in site samples are similar to or greater than in combined reference/upgradient samples. These samples may be considered toxic compared to the controls but would not be considered toxic relative to the upgradient or reference samples. This is important because it implies that there may be confounding factors within the sediment, not related to site contaminants, that may be causing toxicity.

- 2: Survival or growth in site samples are lower than in control samples, and survival (but not growth) in site samples is lower than in combined reference/upgradient samples. These samples may be considered acutely toxic compared to the controls and upgradient or reference samples. This is important because it implies that other factors (i.e., chemicals) may be present in the site samples that may be causing toxicity.

- 3: Survival and growth in site samples are lower than in control samples, and survival and growth in site samples are lower than in combined reference/upgradient samples. These samples have the

greatest potential to be toxic to benthic organisms because all of the endpoints are considered to be toxic.

Conclusions

Based on the results of the toxicity testing, it appears that sampling locations MTCSD003, 010, 17, 026 and 026D have the greatest potential for being toxic to benthic organisms based on site-specific conditions (Table 5-15). Of these samples, MTCSD017, 026, and 026D were the most toxic with 100 percent mortality. Although other samples are considered toxic in comparison to controls, the toxicity in those samples is within the range of the toxicity in the reference and upgradient samples.

It is also important to note that low DO concentrations appeared to play a role in the toxicity of the samples. Although there is a correlation between low DO and survival, it is not clear that low DO was the sole cause of the toxicity for the following reasons:

- There was low survival in the reference samples which had low chemical concentrations and high DO levels. Therefore, the source of toxicity in these samples is not known.

- There was low survival in the toxicity test samples conducted as part of the TIE investigation (SAIC 2001) but DO was not low in those samples. There were various reasons indicated for the toxicity in those samples.

- Based on several articles in the literature that were referenced in the ASTM methods, the levels of DO in the samples would not be expected to cause toxicity in the samples (ASTM, 2000).

However, because of the uncertainties in the results of the toxicity tests, the toxicity tests were given less weight than the sediment chemistry data or the benthic invertebrate data. This was done by assigning a weighting scale of 0 to 3 for the toxicity test data but assigning a scale of 0 to 6 for the sediment chemistry data and the benthic invertebrate data.

5.6.1.3 Benthic Invertebrate Survey

Samples of sediment submitted for benthic macroinvertebrate community analysis were co-located and sampled at the same time as sediment collected for chemical analyses and toxicity tests. Sediment samples were collected at four locations at each of the five investigative areas of Mattawoman Creek. Additionally, two samples each were collected at an upgradient location near the Highway 225 bridge (Area 6) and at reference sampling locations in Nanjemoy Creek (Area 7). A total of 24 sediment samples (plus four duplicate samples QA/QC purposes) were collected and submitted for analysis.

Locations of the sediment sampling locations for Mattawoman Creek and Nanjemoy Creek are presented on Figures 3-3 and 3-4, respectively.

All collected samples were submitted to Pennington and Associates, Incorporated, for analysis, which included removing the organisms from the sediment and identifying them to the lowest practical taxonomic level. A series of metrics were calculated from the data that included the following:

- Total number of organisms
- Total number of taxa
- Shannon Diversity Index
- Biotic Index
- Number of dominant taxa

Species richness reflects the health of the benthic community through a measurement of the variety of taxa (Plafkin *et. al*., 1989). In general, species richness is expected to be higher in clean waters and lower in polluted waters assuming that all other factors (i.e., habitat, sediment type) are similar. The species richness indicators that were calculated for this project were total number of organisms and total number of taxa.

The Shannon Diversity Index was calculated to determine the overall diversity of the benthic macroinvertebrate population at the stations. Diversity data are useful because they condense a substantial amount of data into a single value. The operative assumption in the interpretation of diversity values is that relatively undisturbed environments tend to support communities that consist of a large number of species with no single species present in overwhelming abundance. Many forms of stress tend to reduce diversity by producing an environment that is less desirable for some taxa and, therefore, give a competitive advantage to other taxa. Shannon's diversity was calculated using the following equation:

$$H' = \left[\Sigma(P_i)(\ln P_i)\right]$$

where:

H' = species diversity

P_i = The proportion, or relative abundance, of each individual species to the total (measures from 0 to 1)

Most of the benthic macroinvertebrates collected during this ecological investigation were assigned a family and/or species pollution tolerance rating or tolerance value (TV) based on their sensitivity to pollution. The lower the TV the more sensitive the organism is to pollution. The raw benthic macroinvertebrate data from the taxonomic laboratory (Appendix C-8) presents the TVs for each of the organisms (when available). The TVs are intended for the examination of the general level of pollution regardless of the source. A Biotic Index (BI) was then generated as an average of the TVs weighed by individual abundance. Lower BIs indicate that more sensitive organisms are present in that particular sample, which may indicate that there is less pollution in that sample. However, because organisms that are more tolerant to pollution can live in unpolluted areas, a sample with a high BI does not necessarily indicate that a sample is contaminated. Also, many of the TVs are based on non-chemical stressors such as low DO. Therefore, an organism may have a high TV just because it can tolerate environments with low DO. The BI was calculated as follows:

$$BI = \frac{\Sigma (n_i * TV)}{N}$$

where:

BI = Biotic Index
n_i = Number of individuals occurring in the ith taxa
TV = Tolerance Value assigned to the ith taxa
N = Total number of individuals in the sample

The number of dominant taxa metric consists of the highest percentage of specimens in any one taxon. A community dominated by relatively few species may indicate a stressed environment. This metric is of questionable use in Mattawoman Creek because the natural stresses in estuarine environments (i.e., low DO, salinity changes) often lead to benthic communities that are dominated by a few types of organisms that are able to tolerate this type of environment.

Results

Table 5-16 presents a summary of the various metrics that were calculated for each of the samples. The raw benthic invertebrate data used to generate then metrics are provided in Appendix C-8. These metrics are also presented graphically in Figures 5-16 through 5-20. The figures present the stations as they were divided into the areas and includes the upgradient samples (Area 6) and the reference samples (Area 7).

The following summarizes the results of the metrics:

Metric	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7
# of Organisms	13-133	25-307	13-90	7-237	1-95	25-40	15-86
# of Taxa	2-16	10-22	6-19	4-12	1-23	7-10	4-14
Biotic Index	5.2-7.2	5.4-7.8	5.6-7.6	4.4-7.7	6.3-7.9	6.7-7.6	8.1
Diversity Index	0.24-2.8	1.8-2.7	1.9-3.4	1.1-2.7	0-4.1	1.8-2.9	1.0-2.1
% Dom. Taxa	45-96	32-53	19-62	30-85	19-100	32-60	66-80

As can be seen from the above summary and Figures 5-16 through 5-20, some stations have greater metrics than the upgradient and reference stations, and other stations have lower metrics. Because some of the metrics at the site stations are greater and others are lower than the metrics at the upgradient and reference stations, a weight-of-evidence approach was used to determine the overall biological condition of the station. This approach is presented in the following section.

Weight of Evidence

A procedure was developed in the Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA, 1989) for comparing metrics from site stations to the metrics at reference stations to calculate an overall biological condition of the benthic community at a station. Although this procedure was developed for wadable streams, the approach was used to evaluate the data from Mattawoman Creek (which is not wadable) because it presents a logical way to summarize the benthic data and reach some conclusions as to the relative biological condition at each station.

Note that the percent dominant taxa metric was not included in the overall scoring of the sites because as discussed above, the metric does not appear to be an appropriate indicator of benthic community health in Mattawoman Creek. The percent dominant taxa ranged from 32 to 80 percent in the upgradient/reference samples, which provides further evidence that the natural stressors in Mattawoman Creek may be causing benthic communities that are dominated by a few types of organisms that are able to tolerate this type of environment.

Appendix C-9 contains the page from EPA (EPA, May 1989) that describes the scoring system in detail. In general, the following metrics for the site samples were divided by the metrics for the upgradient/reference samples: number of organisms, number of taxa, and diversity index. The biotic index metric for the upgradient/reference samples was divided by the site samples. Based on the ratio of the metrics between the site samples and the upgradient/reference samples, the metric was assigned a score of 0, 2, 4, or 6, depending upon the similarity of the metric at the site station compared to the upgradient/reference stations. A composite score for each sample is then calculated by summing the

scores for the individual metrics and then dividing that sum by the total potential score (24). A biological condition is then assigned to a sample based on the composite score as presented in Appendix C-9.

Table 5-17 presents the scores for each metric, and presents the composite score and overall biological condition of the sample. Note that the site samples were compared to the upgradient and reference samples separately and to the combined upgradient/reference sample data set, and a biological condition was assigned to each comparison. In most cases, the biological condition for a sample was similar based on the comparison to the upgradient, reference or combined upgradient/reference sample data set. An overall biological condition was then assigned to the sample based on the results of the combined data set.

A score was then given to each sample based on overall biological condition following the Rapid Bioassessment Protocols. The weighting system, has values of 0, 2, 4, and 6, with the higher numbers indicating lower overall biological condition of sample, and thus an increase in potential risks to benthic invertebrates. The following bullets describe the weighting system:

- 0: Non-impaired biological condition
- 2: Slightly impaired biological condition
- 4: Moderately impaired biological condition
- 6: Severely impaired biological condition

5.6.1.4 Overall Weight of Evidence

As discussed in the previous three sections, a score was given to each of the following measurement endpoints used to evaluate risks to benthic macroinvertebrates: sediment chemistry data, toxicity test data, and benthic community data. The results of the scores from each of the measurement endpoints were then averaged to obtain an overall score and relative impact to benthic invertebrates at each of the locations (see Table 5-18). The possible range of average scores was 0 to 5 with the higher numbers indicating lower overall biological condition of a sample, and thus an increase in potential risks to benthic invertebrates. The following bullets describe the scores:

- 0 to 1: Negligible risk to benthic macroinvertebrates
- to 2.0: Slight risk to benthic macroinvertebrates
- 2.1 to 4: Moderate risk to benthic macroinvertebrates
- 4.1 to 5: High risk to benthic macroinvertebrates

As observed in Table 5-18, 13, four, five, and two samples were classified as having negligible, slight, moderate, and high risks to benthic macroinvertebrates, respectively. The samples with biological scores indicative of moderate and high risk are discussed in section 5.6.1.6.

5.6.1.5 Summary of Remaining Sediment Chemistry Data

The weight-of-evidence portion of Section 5.6.1.1 discusses only the sediment data that was co-located with the toxicity test data and the benthic community data. There were additional locations where sediment samples were collected only for chemical analysis, not toxicity testing or benthic community surveys. The analytical data from these locations were discussed in the nature and extent section in Section 4 of this report and were presented on tag maps in that section. In addition to the tag maps in Section 4, eight color coded figures (Figures 4-12 through 4-19) were generated to present the concentrations of select chemicals (total PAHs, arsenic, cadmium, copper, lead, mercury, silver, and zinc). These figures include data from samples that were collected during the SPAWAR sampling event (which were not included in the risk assessment), along with the all of the data that was used in the risk assessment and are discussed in Section 4. Only the SPAWAR data from areas where fixed-based samples, were not collected during the Mattawoman Creek sampling were included in Figures 4-12 through 4-19 because the SPAWAR data were screening data. Therefore, the fixed-based results from the same locations are considered more reliable data. The SPAWAR data is presented in Appendix B-8. Also, as noted in Appendix B-8, the SPAWAR values for PAHs are approximately 10 times greater than the corresponding fixed-based confirmation samples. Therefore, the SPAWAR data were divided by 10 prior to their inclusion on Figure 4-12.

Sample points on the figures are different colors based on their concentrations. A sample is white if it is below the TEC; it is blue if it is between the TEC and PEC; and green if it is greater than the PEC. Because there is not a TEC or PEC for silver, the ER-L and ER-M values were used in place of the TEC and PEC, respectively. Yellow, orange, and red colors were used in the sample figures to indicate greater concentrations of the chemicals in the sediment samples. The following observations were made by reviewing the figures:

- The greatest arsenic concentration was located in Area 5, which had a maximum detection of 58 mg/kg (average of duplicate samples). Areas 1 through 4 had several locations with concentrations that exceeded the TEC but were below the PEC.

- The greatest cadmium concentration was located in Area 5, which had a maximum detection of 80 mg/kg (average of duplicate samples). Area 1 also had two samples with cadmium concentrations that were greater than the PEC. Areas 2 through 4 had several locations with concentrations that exceeded the TEC but were below the PEC.

- The greatest copper concentrations were located in Area 1, which had a maximum detection of 757 mg/kg, along with several samples with copper concentrations greater than the PEC. A few locations in Areas 2 through 4 had concentrations that exceeded the TEC but were below the PEC. Finally, one location in Area 5 had a copper concentration greater than the PEC.

- The greatest lead concentrations were located in Area 1, which had a maximum detection of 76,400 mg/kg, along with several samples with copper concentrations greater than the PEC. A few locations in Areas 2 through 4 had concentrations that exceeded the TEC but were below the PEC. Finally, one location in Area 5 had a lead concentration greater than the PEC.

- The greatest mercury concentrations were located in Area 4, which had a maximum detection of 9.5 mg/kg, along with several samples with mercury concentrations greater than the PEC. A few locations in the other areas had concentrations that exceeded the TEC but were below the PEC.

- The greatest silver concentrations were located in Area 4, which had a maximum detection of 308 mg/kg, along with several samples with silver concentrations greater than the PEC. Area 1 also had several samples with silver concentrations that were greater than the PEC. Areas 3 and 5 each had one location with silver concentrations that were greater than the PEC. Finally, a few locations in Area 2 had concentrations that exceeded the TEC but were below the PEC.

- The greatest zinc concentration was located in Area 5, which had a maximum detection of 61,900 mg/kg (average of duplicate samples). Area 1 also had several samples with zinc concentrations that were greater than the PEC. Areas 2 through 4 had several locations with concentrations that exceeded the TEC but were below the PEC.

- Most of the total PAH concentrations were below the TEC, and none of the values were greater than the PEC.

In Area 1, the elevated metals detections (i.e., greater than the PEC) were bounded by samples with low copper concentrations (i.e., below the TEC) in the upstream and downstream directions. A few locations in Areas 2 and 3 had concentrations that exceeded the TEC but were below the PEC and were relatively well-bounded by samples with lower chemical concentrations (i.e., below the TEC). The chemical concentrations in Area 4 greater than the PEC were bounded by low chemical concentrations (i.e., below the PEC) in the upgradient and downgradient directions with the exception of silver in the downgradient direction. Finally, the location in Area 5 with the maximum metal concentrations (well above the PEC),

was bounded by samples with low chemical concentrations in the downgradient direction, but were not well-bounded in the upgradient direction.

5.6.1.6 Overall Risks to Benthic Invertebrates

As indicated in Section 5.6.1.4, sediments from five locations (MTCSD004, 015, 018, 019, and 023) were identified as having moderate risk, while the sediment from one location (MTCSD026) was identified as having high risk to benthic invertebrates. From Figures 4-12 through 4-19, it can be seen that MTCSD004 was collected in Area 1; MTCSD015 was collected in Area 2; MTCSD018 and 019 were collected in Area 4; while MTCSD023 and 026 were collected in Area 5.

No toxicity test or benthic community samples were collected in the location of the greatest chemical concentrations in Area 1, however, MTCSD004 was collected closest to the area with the greatest chemical concentrations. Therefore, based on the greater chemical concentrations near MTCSD004, it is possible that moderate or high risks would occur to benthic invertebrates inhabiting the shoreline immediately upgradient of MTCSD004.

Toxicity test and benthic community samples were conducted at four locations in Area 2. The chemical concentrations were relatively low in this area, as were the risks to benthic invertebrates. Therefore, risks to benthic invertebrates in locations in Area 2 where toxicity test and benthic community samples were not conducted are expected to be low as well.

The one location in Area 3 that had moderate risk to benthic invertebrates (MTCSD015) was the location with the greatest silver concentration in that area. The overall chemical concentrations in Area 3 were low for the other chemicals, and for silver in the other samples (the chemical concentrations of all the other detections were below the PEC). Therefore, although the location is not well-bounded, the low chemical concentrations in this area appear to indicate that the potential risk to the invertebrates are to the location with the elevated silver detection, and the risks to invertebrates are not an area-wide problem.

Two of the locations with moderate risks to benthic invertebrates were in Area 4 (MTCSD108 and 019). The samples were located in the areas that had the greatest mercury and silver concentrations in that area, although the samples for the toxicity tests were not collected in locations of the maximum detections. Therefore, other locations within Area 4 may have moderate risk to benthic invertebrates.

One location in Area 5 had moderate risks to benthic invertebrates (MTCSD023), while a second location had high risks (MTCSD026). The extent of the area with high risk is not known because the contamination is not well-bounded in the upgradient direction. At the location of MTCSD023, the

moderate risk was calculated in the duplicate sample, but a slight risk was calculated for the original sample, so there is some uncertainty regarding if the risks are actually slight or moderate. In either case, the portion of Area 5 near MTCSD023 is characterized as having relative low chemical concentrations (all detections are less than the PEC except for one silver detection), as can be seen from Figures 4-12 through 4-19. Therefore, the primary risks to benthic invertebrates in Area 5 appear to be focused near MTCSD026, which had high concentrations of several metals.

As discussed in Section 5.6.1.1, PAHS, arsenic, cadmium, copper, lead, mercury, silver, and zinc were the only chemicals that were retained as COCs for further evaluation for risks to benthic invertebrates. However, risks were not specifically linked to any one chemical because a mean quotient method was used in the lines of evidence approach as described in Section 5.6.1.1. Therefore, the PAHs and seven metals are considered COCs for benthic invertebrates across the areas within Mattawoman Creek. No attempt was made to determine which chemicals were causing the greatest risks in each area.

5.6.2 Risks to Wildlife

The food-chain models based on average input values are assumed to represent more realistic site exposure conditions to wildlife receptors compared to the conservative values. The following input parameters were used in the CDI equation for the semi-aquatic surrogate species:

- Average surface water or sediment concentrations
- Average receptor body weights (provided in Table 5-5)
- Average receptor ingestion rate (provided in Table 5-5)
- Contaminated area/home range equal to 1 (i.e., receptors ingest 100 percent of their food from the site)

Table 5-19 summarizes the results of the average food-chain model. Appendix C-3 contains calculation sheets for the food-chain model. Of the seven metals retained as COPCs from the conservative food-chain model, only three (arsenic, lead and zinc) had NOAEL EEQs greater than 1.0 in the average input food chain models. The LOAEL EEQs were less than 1.0 except for lead in the mallard model, which had a LOAEL EEQ of 2.3. As indicated from Table 5-8, lead was not detected in any of the hydrilla samples. Therefore, all of the exposure to lead for the mallard is being obtained from incidental ingestion of sediment and surface water with the exposure from sediment ingestion being much more significant. The elevated lead levels are isolated to a few small areas along the shoreline (see Figure 4-16). Therefore, it is not likely that mallards will ingest enough sediment to cause a risk, since they will be feeding throughout the creek, not just adjacent to the contaminated areas. Although this is somewhat taken into account in the average food-chain model, the extremely elevated lead detections in a few samples are resulting in an average lead concentration in the creek of 1,800 mg/kg. This value is greater than lead

concentrations in only two sediment samples from Mattawoman Creek, which indicates that the actual exposure to lead on an average basis would be much lower than 1,800 mg/kg. Thus, the EEQ would be less than 1 if this lower exposure was incorporated into the food-chain model. For these reasons, no chemicals are expected to cause risks to terrestrial wildlife and were not retained as COCs.

Approximately 10 pair of bald eagles nest and feed along Mattawoman Creek. Although risks to bald eagles were not specifically evaluated in this ERA, risks to piscivorous wildlife were evaluated as discussed above. However, there are some uncertainties regarding risks to bald eagles, which require a greater level of protection than most piscivorous birds because of their protected status. They also may be more sensitive than most piscivorous birds to some of the chemicals detected in the study area including pesticides such as DDT. The productivity of the nesting pairs is monitored by the facility. It is recommended that the productivity data be reviewed periodically to determine if thee are changes in productivity, beyond what would be expected naturally.

5.6.3 Risks to Fish

The following risk question was posed to evaluate risks to fish in Mattawoman Creek

- Do facility-related chemical concentrations in Mattawoman Creek present an unacceptable risk to fish (at different trophic levels)?

Tables 5-6 and 5-7 present the COPC screening tables, including the descriptive statistics for the whole body and fillet fish samples, respectively. There are no established fish tissue residue concentrations that can be used to evaluate risks to the fish. However, the following information sources provide a compilation of tissue residue data and effects to the fish:

- Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals (Ankley and Jarvinen, 1999).

- The U.S. Army Corps of Engineers (USACE)/EPA Environmental Residue-Effects Database (ERED): http://www.wes.army.mil/el/ered/index.html

These databases consist of the results of toxicity tests and associated tissue concentrations from the tested animals. The USACE database appears to have undergone less critical evaluation than the Jarvinen and Ankley data. For example, enzyme induction studies are included in the USACE data, while Jarvinen and Ankley limited their data to effects related to survival, growth, and reproduction. Enzyme induction is primarily a measure of exposure; therefore, the relationships of enzyme induction to biological effects are not clear. However, some type of response may be assumed from exposure. When an

organism commits resources to detoxifying chemicals, they are not available for other functions. For this investigation, enzyme induction studies were included, mainly because they did not appear to bias the data for the chemicals assessed, with the exception of PCBs (the fish tissue residue values (FTRVs) for PCBs are biased by enzyme induction data).

The data for each chemical were reduced and classified in order to develop meaningful statistics (see Appendix C-10). Within each study, the lowest value associated with an effect (LOAEL) and the highest value associated with no effect (NOAEL) were selected for each fish species. Tables were prepared that included entries for species, LOAEL (mg/kg wet weight (ww)), NOAEL (mg/kg ww), life stage of the fish, number of fish associated with the LOAEL/NOAEL, the specific effect (mortality, growth, etc.), exposure route, study reference, and data base source. The LOAELs were then examined to see if they were distributed normally or log-normally, by viewing plots of the data. Because the LOAEL distributions were all log-normal, logs were used to calculate a mean and a standard deviation (sd) in each case.

Standard techniques, including the use of *t* values based on the number of samples, were used to develop concentrations representing the following points in the distribution: the lower 5 percent and the midpoint (50 percent) of the data. Because logs were used, they were transformed back to normal units after the 5 and 50 percent points were calculated. Some of the LOAELs were ranges; a mean ("avg. range") of the two values indicating the range was used for calculating statistics. The means and sds of the logs are shown in the "FTRV calculation" portion of the following tables. The *t* value (one-tailed) associated with a probability of 0.05 and the applicable number of data points are multiplied by the sd and subtracted from the mean to yield the 5 percent level.

Table 5-20 summarizes the FTRVs that were developed using the above approach (for the chemicals that were retained as COCs), along with the maximum detections in the whole body and fillet fish tissue samples. Note that the FTRVs were based only on whole body fish tissue data. For some chemicals, the data were inadequate to develop 5 and 50 percent values, so the FTRVs were the lowest value associated with an effect (LOAEL) and the highest value associated with no effect (NOAEL). No FTRVs were available for some of the chemicals, especially the energetics.

None of the chemicals (except chromium) which had FTRVs were detected at concentrations in the whole body or fillet samples at concentrations that exceeded the 5 percent FTRVs. Therefore, risks to fish from these chemicals are expected to be negligible. Chromium, which was detected infrequently in the whole body samples (3/10) and in the fillet samples (3/16) was the only chemical that exceeded the 5 percent or 50 percent FTRV. The FTRV for chromium is based on very little data (two studies) (see Appendix C-10). Also, the 50 percent value is based on a cellular effect; the ecological significance is not known. The 5 percent value is based on mortality, and the same study had a LOAEL for mortality of 8.7 mg/kg, which

is greater then the maximum chromium detection in the fish samples. Finally, chromium was not retained as a COPC in sediment because its maximum concentration did not exceed the screening value. For those reasons, it is likely that risks to fish from chromium will be negligible.

Although no tissue residue data was available for energetics in fish tissue, the energetics were detected infrequently (4/10 and 1/10 detections in the whole body samples and 1/16 of 2/16 detections in the fillet samples). Therefore, the low frequency of detection makes it unlikely that significant populations of fish are being impacted.

5.6.4 Risks to Hydrilla

Table 5-8 presents the COPC screening table for hydrilla, which consisted of comparing the chemical concentrations in the site samples to the upgradient and reference samples. Metals were the only parameters that were detected in the hydrilla samples, and of those, zinc was the only chemical that was detected at greater concentrations in the site samples compared to the upgradient or reference samples. Its maximum detection of 21.6 mg/kg was just slightly greater than the maximum concentration in the upgradient or reference samples (18.3 mg/kg). However, no data exist to evaluate risks to aquatic vegetation based on tissue concentrations. Also, as can be observed from the aerial photographs of the site (Figure 3-1), hydrilla is abundant in Mattawoman Creek. Finally, Appendix C-11 contains a summary of the submerged aquatic vegetation (SAV) distribution and status of habitat for the Potomac River from the Maryland DNR web site. This document indicates that Mattawoman Creek has had a steady increase in SAV coverage since 1995, surpassing the Tier 1 goal in 1998, 1999, and 2000. Therefore, risks to hydrilla, and other aquatic vegetation in Mattawoman Creek from site chemicals are expected to be negligible.

5.6.5 Risks to Aquatic Organisms

This section evaluates risk to aquatic organisms from chemicals in the surface water only, because risks to aquatic organisms from chemicals in the sediment were addressed in Section 5.6.1.

Two VOCs (diethyl ether and methyl tert-butyl ether) and two SVOC parameters (low molecular weight PAHs and total PAHs) were retained as COPCs because no toxicity data were available for the chemicals.

Diethyl ether was only detected in one of 28 samples at a low concentration (6 µg/L). VOCs are typically not toxic to aquatic organisms as indicated by the screening values for the other VOCs. Therefore, diethyl ether is not retained as a COC. MTBE was retained as a COPC because no screening value was found for this VOC. The maximum concentration of MTBE was 1 µg/L. A chemical summary of MTBE

was prepared by the EPA in 1994 (EPA, August 1994). This summary indicates that MTBE has low acute toxicity to aquatic organisms with lethal concentrations generally greater than 100,000 µg/L. The document predicts a chronic value of 57,000 µg/L, which is much greater than the maximum detection in Mattawoman Creek. Therefore, risks to aquatic life from MTBE in groundwater are expected to be negligible.

The PAHs were detected in only one of 38 samples at a low concentration (4 µg/L). Therefore, risks to aquatic life from MTBE in groundwater are expected to be negligible.

Perchlorate and 4-nitrotoluene were retained as COPCs because no toxicity information was available for these chemicals. Perchlorate was only detected in three of 28 samples, and 4-nitrotoluene was only detected in one of 38 samples. Therefore, although screening values are not available for these chemicals, it is unlikely that they will cause a risk to aquatic organisms.

Although 10 total inorganic parameters (nine metals and cyanide) were retained as COPCs because the maximum detected concentrations exceeded the associated SWSVs, the discussion in this section will focus on the dissolved metals because they are the bioavailable fraction for aquatic life.

Eight filtered metals were retained as COPCs because the maximum detected concentrations exceeded the SWSVs. Chromium and zinc were only detected in one of 38 samples each, and were detected at concentrations below the EPA recommended water quality criteria (WQC) (EPA, April 1999) of 11 and 120 µg/L, respectively. Also, the maximum detections of iron and nickel were detected at concentrations below the EPA WQC of 1,000 and 52 µg/L, respectively. Therefore, these four metals are not retained as COCs.

The concentrations of copper and lead were detected at concentrations that exceeded their screening values in one and two of 38 samples, respectively. Therefore, this low frequency of criteria exceedence would limit potential risks to aquatic life so these chemicals are not retained as COCs. The maximum detection of manganese was below the secondary chronic value of 120 µg/L from Suter and Tsao (1996), so risks to aquatic receptors from manganese are expected to be low. Therefore, manganese is not retained as a COC.

Finally, cadmium exceeded the screening value in 12 of 38 samples with a maximum detection of 6.5 µg/L, so cadmium may be causing increased toxicity at a few locations. As discussed in Section 4.0, although cadmium was detected in 15 of the 38 filtered metals samples, it was only detected in three of the 44 total metals samples. Also, the cadmium concentrations in the dissolved samples were greater than their respective concentrations in the total samples. Finally, the maximum concentration of cadmium

in the whole body fish tissue sample was below the concentration in the upgradient/reference samples, and the maximum concentration of cadmium in the fillet fish tissue sample was just slightly greater than the concentration in the upgradient/reference samples. Therefore, cadmium does not appear to accumulating in the tissue samples. In summary, cadmium is retained as a COC because there may be risks to aquatic life from the concentrations detected in the surface water samples, but there is uncertainty in the analytical results.

5.7 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section presents some of the general uncertainties associated with ERAs. In the site-specific sections of the ERA, some of the uncertainties associated with the ERA process will be further evaluated for the chemicals that were retained as COPCs.

5.7.1 Uncertainty in Measurement and Assessment Endpoints

Measurement endpoints were used to evaluate the assessment endpoints that are selected for the ERA. For this ERA, some of the measurement endpoints were the same as the assessment endpoints. Therefore, the measures were used to predict effects to the assessment endpoints by selecting surrogate species that were evaluated. For example, mortality of a great blue heron was used to assess mortality of the piscivorous bird population. However, predicting mortality to a heron may either under or overprotect the piscivorous bird population, resulting from differences in ingestion rates, toxicity, food preferences, etc., between different species.

Several endpoints were not quantitatively evaluated in this ERA. For example, risks to reptiles and amphibians were not quantitatively evaluated because exposure factors are not established for most species, and toxicity data are very limited. However, because some chemicals in the sediment were detected at concentrations that exceed screening values, risks to amphibians are possible, using fish as surrogates for amphibians. Risks to reptiles are expected to be low using mammals and birds as surrogates for reptiles. Finally, although early life stages of fish were not evaluated in the ERA, because there were impacts to benthic invertebrates that live in the sediment, there may be potential impacts to the early life stages of fish that are directly exposed to the sediment where levels of chemicals are elevated.

Table 2-1 presents the list of protected species in or adjacent to Mattawoman Creek. Seven plant species are listed as state rare plants, and the least bittern is in Need of Conservation within the state. The bald eagle is the only federally protected species in the area. None of the protected plants are aquatic plants that live in Mattawoman Creek; the plants may live in moist/wet areas that are present along the edges of the creek. Therefore, impacts to the plants, from contaminants in the surface water

are expected to be minimal because their exposure will be minimal. Also, the ERA determined that there were no risks to aquatic vegetation that live in Mattawoman Creek. The least bittern consumes aquatic invertebrates, along with fish and insects. Because no risks were expected to piscivorous wildlife, no risks to the least bittern would be expected as well. Similarly, risks to bald eagles are not expected from consuming fish in Mattawoman Creek. Note, however, the bald eagles are being monitored by the facility.

5.7.2 Uncertainty in Exposure Characterization

The chemical dose to terrestrial wildlife was calculated using an equation that incorporates ingestion rates, body weights, bioaccumulation factors, and other exposure factors. These exposure factors were obtained from literature studies or predicted using various equations. Ingestion rates and body weights vary between species, especially between species inhabiting different areas.

The site-specific bioavailability of the chemicals in the surface water and/or sediment was determined by conducting sediment toxicity tests, conducting a benthic survey, and collecting fish and hydrilla samples for chemical analysis. These site-specific tests reduced the uncertainty in determining if the chemicals are causing risk to the ecological receptors, although there were uncertainties in the toxicity test data because low DO levels confounded the results of the tests.

Having chemical concentrations in tissue samples, the uncertainty via the food chain pathway is reduced, because actual concentrations wee sued to determine the exposure dose. However, all of the chemicals in the tissue samples were assumed to be 100 percent bioavailable to the wildlife consuming the food items, which is likely to be conservative and would tend to overestimate risks.

Uncertainty exists in the chemical data collected for the site. Measured levels of chemicals are only estimates of the true site chemical concentrations. Most of the samples were deliberately biased toward known or suspected high concentrations, thus causing the predicted doses to be higher than actual doses incurred by ecological receptors exposed to the entire site and surrounding area. On the other hand, since most of the samples were biased toward the north side of the creek, little information is known about the chemical concentrations in the southern side of the creek, where there may be more direct human contact with the sediment. However, based on the conceptual site model, it is unlikely that the south side of the creek will have greater chemical concentrations than the north side of the creek, since the source of the contamination is from IHDIV-NSWC.

Under the conservative exposure scenario, terrestrial wildlife are assumed to live and feed only at the site. These assumptions will tend to overpredict risk because it is unlikely that most receptors will obtain all their food from within the site boundaries. Less conservative exposure assumptions (i.e., average ingestion

rates, average chemical concentrations) were used in the Step 3a refinement to calculate and refine exposure estimates for potential ecological receptors. For chemicals that were retained as COPCs and exceeded background concentrations, an average CDI was calculated.

5.7.3 Uncertainty in Ecological Effects Data

Uncertainty exists in the ecological toxicity value comparison. The WQC developed by EPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species may be present at the site that are not protected by the use of these criteria. There also may be situations where the SWSVs are over-predictive of risk, if the sensitive species used to develop the criteria do not inhabit the site. Finally, with the exception of hardness for a few inorganics, the SWSVs do not account for site-specific factors, such as TOC or pH, which may affect toxicity.

Potential adverse impacts to aquatic receptors from constituents in the sediment are evaluated by comparing the COPC concentration to SSVs. The SSVs have more uncertainty associated with them than do the SWSVs for the following reasons: 1) the procedures for developing them are not as well established and fewer sediment toxicity data exist than surface water toxicity data, and 2) sediment characteristics (i.e., pH, acid volatile sulfides, total organic carbon) have a large impact on the actual bioavailability and toxicity of constituents.

The NOAELS that were selected for the wildlife endpoint species were based on species other than the endpoint species (i.e., rats, mice, mallards). Uncertainty exists in the application of toxicity data across species because the chemical may be more or less toxic to the endpoint species than it was to the test study species.

The toxicity of chemical mixtures is not well understood. All the toxicity information used in the ERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms differently than the individual chemicals because of synergistic or antagonistic effects. This was partially evaluated by using the TEC and PEC quotients; however, there is still uncertainty associated with effects from chemical mixtures.

5.7.4 Uncertainty in Risk Characterization

The potential for adverse risks may be anticipated if an EEQ is greater than or equal to 1.0 regardless of the magnitude of the EEQ. Although the relationship between the magnitude of an EEQ and toxicity is not necessarily linear, the magnitude of an EEQ can be used as rough approximation of the extent of potential risks, especially if there is sufficient confidence in the screening value used. Finally, uncertainty exists in how the predicted risks to a species at the site translate into risk to the population in the area as a whole.

The lower bound of the threshold effects is based on consistently conservative assumptions and NOAEL toxicity values (EPA, June 1997). This bound will present the highest potential risks. The upper bound is based on observed impacts or predictions that ecological effects could occur and is developed using consistent assumptions, site-specific data, LOAEL toxicity values, or an impact evaluation (EPA, June 1997). This bound will present the average potential risk. Both the upper and lower bounds were evaluated in this ERA to provide the overall range of potential risks.

To select the chemicals that were retained as COPCs, conservative exposure assumptions were used to calculate the CDI, and the NOAEL was used to calculate the EEQ. However, to determine which chemicals should be carried through and evaluated in the BERA, less conservative exposure assumptions were used to calculate the CDI, and the EEQ was calculated using a LOAEL.

Finally, there was some uncertainty with the results of the toxicity tests because the DO concentrations dropped below the recommended level of 2.5 mg/l for a few days. The percent survival in the toxicity test correlated to the DO levels. However, based on data in the literature it does not appear that the low DO was the sole cause of the toxicity (see Section 5.6.1.2 for a more detailed discussion). Therefore, because of the uncertainties in the results of the toxicity tests, the toxicity tests were given less weight than the sediment chemistry data or the benthic invertebrate data.

5.8 CONCLUSIONS

As presented in Section 5.2 and Table 5-1, this ERA focused on evaluating risks to several assessment endpoints. This sections summarize the risks to these endpoints.

5.8.1 Risks to Benthic Invertebrates

As indicated in Section 5.6.1.4, sediment locations from five locations (MTCSD004, 015, 018, 019, and 023) were identified as having moderate risk, while the sediment from one location (MTCSD026) was identified as having high risk to benthic invertebrates. Sediment samples from the remaining 14 locations had negligible to slight risks to benthic invertebrates. The locations that appear to have the greatest risks are Areas 1, 4, and 5. As discussed in Section 5.6.1.6, it was not possible to identify a specific chemical that was causing the risks to the benthic invertebrates in these samples. However, seven metals (arsenic, cadmium, copper, lead, mercury, silver, and zinc) and PAHs were detected at elevated (i.e., greater than PECs) levels in these areas. No other chemicals were detected in these samples at concentrations that appear to have the potential to cause toxicity based on data in the literature. Therefore, it is likely that the seven metals and PAHs are impacting the benthic community in Areas 1, 4, and 5, although the spatial extent of the impacts has not been determined.

5.8.2 Risks to Wildlife

Risk to piscivorous birds and mammals are expected to be low from consuming fish, sediment, and surface water from Mattawoman Creek. Risk to herbivorous birds and mammals are expected to be low from consuming vegetation, sediment, and surface water from Mattawoman Creek. Therefore, no chemicals were retained as final COCs for risks to wildlife.

5.8.3 Risks to Fish

None of the chemicals (except chromium) which had FTRVs were detected at concentrations in the whole body or fillet samples at concentrations that exceeded the 5 percent FTRVs. Therefore, risks to fish from these chemicals are expected to be negligible. It is likely that risks to fish from chromium will be negligible because chromium was detected infrequently in the tissue samples and the maximum chromium detection was lower than the LOAEL based on mortality.

Although no tissue residue data was available for energetics in fish tissue, the energetics were detected infrequently. Therefore, the low frequency of detection makes it unlikely that significant populations of fish are being impacted. In summary, no chemicals were retained as final COCs for risks to fish.

5.8.4 Risks to Aquatic Vegetation

Metals were the only parameters that were detected in the hydrilla samples, and of those, zinc was the only chemical that was detected at greater concentrations in the site samples compared to the upgradient or reference samples. Its maximum detection was just slightly greater than the maximum concentration in the upgradient or reference samples. However, no data exist that serve as a guide for evaluating risks to aquatic vegetation based on tissue concentrations. Also, hydrilla is abundant in Mattawoman Creek, and it has been reported that Mattawoman Creek has had a steady increase in SAV coverage since 1995, surpassing the Tier 1 goal in 1998, 1999, and 2000. Therefore, risks to hydrilla and other aquatic vegetation in Mattawoman Creek from site chemicals are expected to be negligible. Therefore, no chemicals were retained as final COCs for risks to aquatic vegetation.

5.8.5 Risks to Aquatic Organisms

Cadmium was the only chemical detected in the surface water samples that may be causing an increased risk to aquatic organisms at a few locations. Cadmium was detected less frequently and at lower concentrations in the non-filtered surface water samples than the filtered surface water samples. Therefore, although cadmium is retained as a COC because there may be risks to aquatic life from the concentrations detected in the surface water samples, there is uncertainty in the analytical results.

TABLE 5-1

RISK QUESTIONS AND ASSESSMENT ENDPOINTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Risk Question	Assessment Endpoint(s)	Measurement Endpoint (Measure of Effects)
Do base-related chemical concentrations in the surface water and sediment in Mattawoman Creek present an unacceptable risk to benthic macroinvertebrates?	Survival and growth of healthy benthic macroinvertebrate populations.	1. *Hyalella azteca* 10-day survival and growth toxicity tests. 2. Community analysis metrics and indices (as an indicator of reproduction). 3. Comparison of sediment chemical concentrations to sediment screening guidelines (e.g., ER-Ls, ER-Ms).
Do base-related concentrations of bioaccumulatable chemicals in the fish, surface water, and sediment in Mattawoman Creek present an unacceptable risk to piscivorous birds and mammals?	Survival, growth, and reproduction of healthy piscivorous bird populations.	Model potential risks (doses) to the great blue heron and mink using site-specific prey concentrations.
Do base-related concentrations of bioaccumulatable chemicals in the vegetation, surface water, and sediment in Mattawoman Creek present an unacceptable risk to herbivorous birds?	Survival, growth, and reproduction of healthy herbivorous bird populations.	Model potential risks (doses) to the mallard using site-specific forage concentrations.
Do base-related concentrations of inorganics and pesticides/PCBs in the surface water and sediment in Mattawoman Creek present an unacceptable risk to aquatic vegetation?	Survival, growth, and reproduction of healthy emergent vegetation communities.	1. Compare tissue concentrations of hydrilla to upgradient/reference locations.[1] 2. Qualitatively evaluate the health of the vegetation.
Do base-related concentrations of chemicals in the surface water in Mattawoman Creek present an unacceptable risk to aquatic organisms?	Survival, growth, and reproduction of aquatic organisms.	Compare Mattawoman Creek surface water chemical concentrations to screening guidelines (e.g., AWQCs)
Do base-related chemical concentrations in the surface water and sediment in Mattawoman Creek present an unacceptable risk to fish (at different trophic levels)?	Survival, growth, and reproduction of fish communities.	1. Compare Mattawoman Creek surface water chemical concentrations to screening guidelines (e.g., AWQCs). [1] 2. Compare body burdens of chemicals in fish tissue to upgradient/reference locations and tissue-effects levels.

1 Although it is recognized that a comparison of tissue concentrations/body burdens does not provide direct information regarding potential risk to receptors, it was used as one measure of exposure to determine if the receptors were accumulating chemicals from Mattawoman Creek.

TABLE 5-2

TOXICITY REFERENCE VALUES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	Mammal		Bird	
	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)
SEMIVOLATILES				
Acenaphthene	17.5	35	2	20
Acenaphthylene	70	700	2	20
Anthracene	100	1000	2	20
Benzo(a)anthracene	0.17	1.7	2	20
Benzo(a)pyrene	1	10	2	20
Benzo(b)fluoranthene	4	40	2	20
Benzo(g,h,i)perylene	7.2	72	2	20
Benzo(k)fluoranthene	7.2	72	2	20
Chrysene	0.17	1.7	2	20
Dibenzo(a,h)anthracene	1.33	13.3	2	20
Fluoranthene	12.5	25	2	20
Fluorene	12.5	25	2	20
Indeno(1,2,3-cd)pyrene	7.2	72	2	20
Phenanthrene	1	10	2	20
Pyrene	7.5	12.5	2	20
PESTICIDES/PCBs				
4,4'-DDD	0.8	4	0.0028	0.028
4,4'-DDE	0.8	4	0.0028	0.028
alpha-BHC	0.014	0.14	0.56	2.25
Aroclor-1248	0.01	0.1	NV	NV
INORGANICS				
Arsenic	0.126	1.26	2.46	7.38
Cadmium	1	10	1.45	20
Chromium	3.28	13.14	1	5
Copper	11.71	15.4	46.97	61.72
Lead	8	80	1.13	11.3
Mercury	0.015	0.025	0.0064	0.064
Silver	2.38	23.8	5.44	54.4
Zinc	160	320	14.49	130.9

See Appendix C-3 for the sources of these TRVs.

TABLE 5-3

COPC SELECTION-SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	SURFACE WATER COPC SCREENING LEVEL[3]	NUMBER OF EXCEEDANCES OF SURFACE WATER SCREENING LEVEL	ECOLOGICAL EFFECTS QUOTIENT	RETAIN AS A COPC?	RATIONALE FOR COPC SELECTION OR DELETION[4]
VOLATILE ORGANICS (UG/L)													
ACETONE	1/5	5 J	5 J	MTCSW00801	5	5	ND	1	9000000	0	6E-07	NO	BSL
BENZENE	5/38	0.7 J	8	MTCSW01001	3.1	1	ND	5	700	0	0.01	NO	BSL
BROMOFORM	1/38	0.5 J	0.5 J	MTCSW00301	0.5	1	ND	1	1000	0	0.001	NO	BSL
CIS-1,2-DICHLOROETHENE	1/38	4	4	MTCSW02101	4	1	ND	1	11600	0	0.0003	NO	BSL
DIETHYL ETHER	1/28	6 J	6 J	MTCSW02101	6	0.9	ND	1	NA	0	NA	YES	NTX
ETHYLBENZENE	5/38	0.6 J	7	MTCSW01001	3	1	ND	5	430	0	0.02	NO	BSL
METHYL TERT-BUTYL ETHER	1/4	1 J	1 J	IS11SW01	1	4	NA	1	NA	0	NA	YES	NTX
TOLUENE	8/38	0.6 J	30	MTCSW01501	9	3	ND	8	1050	0	0.03	NO	BSL
TOTAL XYLENES	7/38	1	48	MTCSW01001	15	4	ND	7	6000	0	0.01	NO	BSL
TRICHLOROETHENE	2/38	1	6	MTCSW02101	4	1	ND	2	2000	0	0.003	NO	BSL
SEMIVOLATILE ORGANICS (UG/L)													
2-METHYLNAPHTHALENE	1/38	2 J	2 J	MTCSW01001	2	3	ND	1	300	0	0.007	NO	BSL
BIS(2-ETHYLHEXYL)PHTHALATE	7/38	1 J	1 J	IS11SW01, MTCSW00501, MTCSW02301-D, MTCSW02601, S39SW0020001, S39SW0040001, MTCSW02401	1	2	ND	7	30	0	0.03	NO	BSL
NAPHTHALENE	1/38	2 J	2 J	MTCSW01001	2	3	ND	1	100	0	0.02	NO	BSL
LOW MOLECULAR WEIGHT PAHS	1/1	4	4	MTCSW01001	4	4	ND	1	NA	0	NA	YES	NTX
TOTAL PAHS	1/1	4	4	MTCSW01001	4	4	ND	1	NA	0	NA	YES	NTX
EXPLOSIVES (UG/L)													
1,3-DINITROBENZENE	1/38	0.075 J	0.075 J	IS11SW01	0.08	0.06	ND	1	1200	0	0.0001	NO	BSL
4-NITROTOLUENE	1/38	0.11 J	0.11 J	IS17SW02	0.11	0.21	ND	1	NA	0	NA	YES	NTX
HMX	1/38	0.15 J	0.15 J	MTCSW01001	0.15	0.11	ND	1	330	0	0.0005	NO	BSL
INORGANICS (UG/L)													
ALUMINUM	23/44	124	918	S39SW0020001-D	292	174	587	2	25	23	37	YES	ASL
ARSENIC	7/44	4.2 K	8.3 K	MTCSW02101	5.5	2.5	ND	7	10	0	0.8	NO	BSL
BARIUM	44/44	19 J	76.8	S39SW0050001	33.5	33.5	57	6	10000	0	0.01	NO	BSL
BERYLLIUM	1/44	0.12	0.12	MTCSW00601	0.12	0.07	ND	1	5.3	0	0.02	NO	BSL
CADMIUM	3/44	0.11 K	0.21 K	MTCSW02301-D	0.13	0.10	0.17	0	0.27	0	0.8	NO	BSL
CALCIUM	44/44	9490	34400	S39SW0030001	14754	14754	50300	0	NA	0	NA	NO	NT
CHROMIUM	2/44	0.57 K	3.4 K	MTCSW00401	2.1	0.64	1.8	1	2	1	1.7	YES	ASL
COBALT	1/44	6.3	6.3	S39SW0020001-D	4.3	0.74	ND	0	35000	0	0.0002	NO	BSL
COPPER	8/44	2.4 J	28.1 K	MTCSW02101	7.3	2.7	ND	8	2.9	7	9.7	YES	ASL
CYANIDE	5/44	1.1 L	10	MTCSW00501, IS17SW02	5.9	2.2	36.8	0	1	5	10	YES	ASL
IRON	44/44	84.8	1620 K	S39SW0020001-D	389	389	577	8	320	22	5.1	YES	ASL
LEAD	9/44	1.3 J	38.4	IS11SW01	7.1	2.0	ND	9	2.5	4	15	YES	ASL
MAGNESIUM	44/44	5140	34300	S39SW0030001	10876	10876	153000	0	NA	0	NA	NO	NT
MANGANESE	44/44	9.3 K	202	S39SW0020001-D	66.6	66.6	1190	0	10	43	20	YES	ASL
NICKEL	11/44	1.9	4	S39SW0020001-D	2.7	1.8	ND	11	8.2	0	0.5	NO	BSL
POTASSIUM	44/44	2630 J	12400	S39SW0010001, S39SW0030001, S39SW0040001	4516	4516	64400	0	NA	0	NA	NO	NT
SELENIUM	1/44	5.8	5.8	IS17SW05	5.8	16.7	ND	1	5	1	1.2	YES	ASL
SILVER	1/44	1.1	6	S39SW0020001-D	3.6	0.69	ND	1	0.0001	1	60000	YES	ASL
SODIUM	44/44	11900	211000 J	S39SW0030001	43386	43386	1230000	0	NA	0	NA	NO	NT
VANADIUM	36/44	0.73 K	7.4	MTCSW02101	1.5	1.4	ND	36	10000	0	0.001	NO	BSL
ZINC	6/44	16	90.4	S39SW0050001	37.7	10.6	ND	6	19	5	4.8	YES	ASL
INORGANICS - FILTERED (UG/L)													
ARSENIC	4/38	3.75 K	5.4 K	MTCSW01201-F	4.5	2.3	ND	4	10	0	0.5	NO	BSL
BARIUM	36/38	17 J	62.3	MTCSW01901-F	27.8	27.7	ND	36	10000	0	0.01	NO	BSL
BERYLLIUM	1/38	0.31 J	0.31 J	IS17SW01	0.2	0.1	ND	0	5.3	0	0.06	NO	BSL
CADMIUM	16/38	0.11 K	6.5 K	MTCSW02501-F	1.4	0.66	ND	16	0.27	12	24	YES	ASL
CALCIUM	38/38	9120	16300	MTCSW02101-F	11804	11804	49700	0	NA	0	NA	NO	NT
CHROMIUM	1/38	9.7 K	9.7 K	MTCSW00201-F-D	5.1	0.73	ND	1	2	0	4.9	YES	ASL
COPPER	5/38	2.2 J	69.1	MTCSW02101-F	15.9	4.3	ND	5	2.9	1	24	YES	ASL
IRON	10/38	28.2 J	456	IS17SW01	104.0	42.0	ND	10	320	0	1.4	YES	ASL
LEAD	4/38	1.3	66.9	MTCSW02401-F	25.7	3.3	ND	4	2.5	2	26.8	YES	ASL
MAGNESIUM	36/38	4840 J	8780	MTCSW00401-F	7483	7247	149000	0	NA	0	NA	NO	NT
MANGANESE	14/38	1.7 J	86.7	IS17SW01	13.7	6.0	249	0	10	6	8.7	YES	ASL
NICKEL	5/38	3.1 J	17.9 J	IS17SW01	5.7	2.0	ND	5	8.2	2	2.2	YES	ASL
POTASSIUM	38/38	2400 J	3980	MTCSW00401-F, MTCSW02101-F	3295	3295	64800	0	NA	0	NA	NO	NT
SELENIUM	1/38	4.9 J	4.9 J	IS17SW04	4.9	2.2	ND	1	5	0	0.98	NO	BSL
SODIUM	38/38	11300	26500	MTCSW01001-F	18795	18795	1150000	0	NA	0	NA	NO	NT
VANADIUM	26/38	0.48	3.4	MTCSW02101-F	1.0	0.86	ND	26	10000	0	0.0003	NO	BSL
ZINC	1/38	29.9	29.9	IS17SW04	29.9	9.0	ND	1	19	1	1.6	YES	ASL
MISCELLANEOUS PARAMETERS													
CHLORIDE(MG/L)	28/28	29.5	44.5	MTCSW02301	39.6	39.6	2420	0	230000	0	NA	NO	BSL
DIESEL RANGE ORGANICS (UG/L)	4/4	100	160	IS11SW01, IS11SW02	135	135	NA	4	NA	0	NA	NO	NZ
FLUORIDE(MG/L)	28/28	0.17	0.31	MTCSW01301, MTCSW01401, MTCSW02101, MTCSW02301, MTCSW02301-D	0.24	0.24	0.19	20	2000	0	0.0002	NO	BSL
HARDNESS(MG/L)	33/34	36	75	MTCSW00101	60.2	59.4	760	0	NA	0	NA	NO	NZ
NITRATE(MG/L)	5/23	0.047 J	0.19 J	MTCSW02101	0.10	0.04	0.5	0	NA	0	NA	NO	NZ
PERCHLORATE (UG/L)	3/38	1.36 J	3.05 J	IS11SW04	2.3	2.3	ND	3	NA	0	NA	YES	NTX
PH (S.U.)	56/56	5.43	11.17	MTCSW00601	8.7	8.7	7.88	36	NA	0	NA	NO	NZ
SULFATE(MG/L)	28/28	23.2	32.2	MTCSW01201	29.1	29.1	299	0	NA	0	NA	NO	NZ

TABLE 5-3

COPC SELECTION-SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SURFACE WATER CONCENTRATION	SURFACE WATER COPC SCREENING LEVEL[3]	NUMBER OF EXCEEDANCES OF SURFACE WATER SCREENING LEVEL	ECOLOGICAL EFFECTS QUOTIENT	RETAIN AS A COPC?	RATIONALE FOR COPC SELECTION OR DELETION[4]
TOTAL DISSOLVED SOLIDS(MG/L)	27/27	110	510	MTCSW00401	161	161	4000	0	NA	0	NA	NO	NZ
TOTAL ORGANIC CARBON(MG/L)	27/27	6	11	MTCSW00901	7.1	7.1	8	2	NA	0	NA	NO	NZ
TOTAL SUSPENDED SOLIDS(MG/L)	9/27	10	48	MTCSW00501	19.7	9.9	38	2	NA	0	NA	NO	NZ
DISSOLVED OXYGEN (MG/L)	28/28	8.07	26.41	MTCSW02601	12.7	12.7	25.95	0	NA	0	NA	NO	NZ
SPECIFIC CONDUCTANCE (MS/CM)	28/28	0.227	0.305	MTCSW00701	0.26	0.26	8.91	0	NA	0	NA	NO	NZ
TEMPERATURE (C)	28/28	11.4	31.04	MTCSW00701	26.6	26.6	28.04	6	NA	0	NA	NO	NZ

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average.
Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Source of data is Table 4-8
4 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level
BIO = Bioaccumulative Chemical
NTX = No Toxicity Information Available
For Elimination as a COPC:
BSL = Below COPC Screening Level
NT = Nontoxic
NZ = Not applicable because these parameters are used to characterize the sediments and/or cannot be used to evaluate ecological risks

Acronyms/Abbreviations:
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons

Shaded chemical name indicates the chemical was selected as a COPC.

ASSOCIATED SAMPLES:

IS11SW01	MTCSW01401
IS11SW02	MTCSW01401-F
IS11SW03	MTCSW01501
IS11SW04	MTCSW01501-F
IS17SW01	MTCSW01601
IS17SW01-AVG	MTCSW01601-F
IS17SW01P	MTCSW01701
IS17SW02	MTCSW01701-F
IS17SW03	MTCSW01801
IS17SW04	MTCSW01801-F
IS17SW05	MTCSW01901
IS17SW06	MTCSW01901-F
MTCSW00101	MTCSW02001
MTCSW00101-F	MTCSW02001-F
MTCSW00201	MTCSW02101
MTCSW00201-AVG	MTCSW02101-F
MTCSW00201-D	MTCSW02201
MTCSW00201-F	MTCSW02201-F
MTCSW00201-F-A	MTCSW02301
MTCSW00201-F-D	MTCSW02301-AVG
MTCSW00301	MTCSW02301-D
MTCSW00301-F	MTCSW02301-F
MTCSW00401	MTCSW02301-F-AVG
MTCSW00401-F	MTCSW02301-F-D
MTCSW00501	MTCSW02401
MTCSW00501-F	MTCSW02401-F
MTCSW00601	MTCSW02501
MTCSW00601-F	MTCSW02501-F
MTCSW00701	MTCSW02601
MTCSW00701-F	MTCSW02601-AVG
MTCSW00801	MTCSW02601-D
MTCSW00801-F	MTCSW02601-F
MTCSW00901	MTCSW02601-F-AVG
MTCSW00901-F	MTCSW02601-F-D
MTCSW01001	MTCSW02901
MTCSW01001-F	MTCSW02901-F
MTCSW01101	MTCSW03001
MTCSW01101-F	MTCSW03001-F
MTCSW01201	S39SW0010001
MTCSW01201-AVG	S39SW0020001
MTCSW01201-D	S39SW0020001-AVG
MTCSW01201-F	S39SW0020001-D
MTCSW01201-F-A	S39SW0030001
MTCSW01201-F-D	S39SW0040001
MTCSW01301	S39SW0050001
MTCSW01301-F	S39SW0060001

TABLE 5-4

COPC SELECTION-SEDIMENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATIONS	SEDIMENT COPC SCREENING LEVEL[3]	NUMBER OF EXCEEDANCES OF ECOLOGICAL SEDIMENT SCREENING LEVEL	ECOLOGICAL EFFECTS QUOTIENT	RETAIN AS A COPC?	RATIONALE FOR COPC SELECTION OR DELETION[5]
VOLATILE ORGANICS (UG/KG)													
2-BUTANONE	3/40	14 J	390	S39SD0070001	201	23	ND	3	9330	0	0.04	NO	BSL
ACETONE	26/40	7 J	2400 J	S39SD0070001	210	141	210	2	1000	2	2.4	YES	ASL
CARBON DISULFIDE	26/40	2 J	45 J	MTCSD00901	16	13	ND	0	1.9	26	24	YES	ASL
CHLOROFORM	2/40	10 J	12 J	MTCSD02301-D	11	9	ND	2	62.9	0	0.2	NO	BSL
CHLOROMETHANE	1/40	14 J	14 J	IS11SD010001	14	9	ND	1	NA	0	NA	YES	NTX
CIS-1,2-DICHLOROETHENE	1/32	2 J	2 J	MTCSD02101	2	9	ND	1	1030	0	0.002	NO	BSL
DIETHYL ETHER	2/28	6 J	57 J	MTCSD02101	32	11	ND	2	NA	0	NA	YES	NTX
METHYL TERT-BUTYL ETHER	1/32	3 J	3 J	MTCSD02201	3	9	ND	1	NA	0	NA	YES	NTX
TOLUENE	4/40	0.8 J	4 J	MTCSD01901	3	8	ND	4	123	0	0.03	NO	BSL
TRICHLOROETHENE	1/40	5 J	5 J	MTCSD02101	5	9	ND	1	450	0	0.01	NO	BSL
SEMIVOLATILE ORGANICS (UG/KG)													
2-METHYLNAPHTHALENE	2/40	48 J	85 J	MTCSD02101	67	361	ND	2	70	1	1.2	YES	ASL
4-METHYLPHENOL	1/40	80 J	80 J	MTCSD01201-D	80	366	ND	1	670	0	0.1	NO	BSL
ACENAPHTHENE	2/40	50 J	120 J	MTCSD02101	85	362	ND	2	16	2	7.5	YES	ASL
ACENAPHTHYLENE	2/40	52 J	340 J	MTCSD01201-D	140	364	ND	2	44	2	7.7	YES	ASL
ANTHRACENE	4/40	69 J	540 J	MTCSD01201-D	255	371	ND	4	85.3	3	6.3	YES	ASL
BENZO(A)ANTHRACENE	11/40	70 J	1700 J	MTCSD01201-D	381	397	ND	11	261	3	6.5	YES	ASL
BENZO(A)PYRENE	11/40	77 J	1800 J	MTCSD01201-D	335	384	ND	11	430	3	4.2	YES	ASL
BENZO(B)FLUORANTHENE	21/40	51 J	2000 J	MTCSD01201-D	315	346	ND	21	3200	0	0.6	NO	BSL
BENZO(G,H,I)PERYLENE	6/40	51 J	1100 J	MTCSD01201-D	246	372	ND	6	670	0	1.6	YES	ASL
BENZO(K)FLUORANTHENE	7/40	50 J	1500 J	MTCSD02101	385	396	ND	7	240	3	6.3	YES	ASL
BIS(2-ETHYLHEXYL)PHTHALATE	6/40	48 J	410 J	S39SD0040001	142	169	ND	6	1300	0	0.3	NO	BSL
CARBAZOLE	3/40	96 J	140 J	MTCSD02101	115	360	ND	3	NA	0	NA	YES	NTX
CHRYSENE	17/40	46 J	1700 J	MTCSD01201-D	312	362	ND	17	384	3	4.4	YES	ASL
DI-N-BUTYL PHTHALATE	4/40	470 J	640 J	S39SD0080001	590	393	ND	4	1400	0	0.5	NO	BSL
DIBENZO(A,H)ANTHRACENE	4/40	55 J	220 J	MTCSD01201-D	122	358	ND	4	63.4	3	3.5	YES	ASL
DIBENZOFURAN	2/40	80 J	94 J	MTCSD02101	87	361	ND	2	540	0	0.2	NO	BSL
DIETHYL PHTHALATE	3/40	65 J	840	MTCSD01501	335	376	ND	3	200	1	4.2	YES	ASL
FLUORANTHENE	21/40	56 J	4000 J	MTCSD01201-D	422	402	ND	21	600	3	6.7	YES	ASL
FLUORENE	3/40	64 J	200 J	MTCSD02101	148	363	ND	3	19	3	11	YES	ASL
HIGH MOLECULAR WEIGHT PAHS	22/40	130	18350	MTCSD01201-D	1978	1978	NA	22	1700	5	11	YES	ASL
INDENO(1,2,3-CD)PYRENE	7/40	55 J	1100 J	MTCSD01201-D	241	371	ND	7	600	1	1.8	YES	ASL
LOW MOLECULAR WEIGHT PAHS	10/40	77	3660	MTCSD01201-D	646	646	NA	10	552	3	6.6	YES	ASL
N-NITROSODIPHENYLAMINE	10/40	42 J	4800 J	MTCSD02101	1139	559	ND	10	28	10	171	YES	ASL
NAPHTHALENE	2/40	50 J	71 J	MTCSD02101	61	361	ND	2	160	0	0.4	NO	BSL
PHENANTHRENE	10/40	77 J	2600 J	MTCSD01201-D	439	400	ND	10	240	4	11	YES	ASL
PYRENE	22/40	48 J	4000 J	MTCSD01201-D	394	382	ND	22	665	3	6	YES	ASL
TOTAL PAHS	22/40	130	22010	MTCSD01201-D	2273	2273	NA	22	4022	3	5.5	YES	ASL
PESTICIDES/PCBS (UG/KG)													
4,4'-DDD	2/36	6 J	7.7 J	S39SD0070001	6.9	4.0	ND	2	16	0	0.5	NO	BSL
4,4'-DDE	2/36	4.1 J	6 J	S39SD0070001	5.1	3.9	ND	2	2.2	2	2.7	YES	ASL
ALPHA-BHC	1/36	0.7 J	0.7 J	S39SD0030001	0.70	2.0	ND	1	NA	0	NA	YES	NTX
AROCLOR-1248	1/36	170	170	MTCSD00401	170	43.2	ND	1	22.7	1	7.5	YES	ASL
EXPLOSIVES (MG/KG)													
1,3,5-TRINITROBENZENE	1/46	0.094 J	0.094 J	IS17SD020001	0.09	3.6	ND	1	0.002	1	47	YES	ASL
1,3-DINITROBENZENE	1/46	0.069 J	0.069 J	IS17SD020001	0.07	0.11	ND	1	0.007	1	9.9	YES	ASL
2,4,6-TRINITROTOLUENE	2/46	0.066 J	0.1 J	IS17SD020001	0.08	0.10	ND	2	0.09	1	1.1	YES	ASL
2,6-DINITROTOLUENE	1/54	0.1 J	0.1 J	IS17SD030001	0.1	42.3	ND	1	0.294	0	0.3401	NO	BSL
2-AMINO-4,6-DINITROTOLUENE	1/46	0.22 J	0.22 J	IS17SD050001	0.22	0.11	ND	1	NA	0	NA	YES	NTX
3-NITROTOLUENE	2/46	0.18 J	0.22 J	IS17SD020001	0.2	0.11	ND	2	NA	0	NA	YES	NTX
4-NITROTOLUENE	1/46	0.14 J	0.14 J	IS11SD040001	0.14	0.11	ND	1	NA	0	NA	YES	NTX
HMX	1/46	0.1 J	0.1 J	MTCSD02401	0.1	0.14	0.17	0	0.005	1	20	YES	ASL
NITROCELLULOSE	30/36	2 J	4780	MTCSD02101	326	272	56	13	NA	0	NA	YES	NTX
INORGANICS (MG/KG)													
ALUMINUM	46/46	245	19600	S39SD0070001	6277	6277	11400	9	18000	1	1.1	YES	ASL
ANTIMONY	8/46	0.69 L	63.9 L	IS11SD020001	20.4	4.1	ND	8	150	0	0.4	NO	BSL
ARSENIC	36/46	1.1 K	70.7 J	MTCSD02601	10.4	8.7	4.1	24	8.2	14	8.6	YES	ASL
BARIUM	46/46	5.5	169	IS11SD010001	76.7	76.7	112	13	48	29	3.5	YES	ASL
BERYLLIUM	40/46	0.061 J	1.6 J	MTCSD01901	0.69	0.61	1.3	3	NA	0	NA	YES	NTX
CADMIUM	38/46	0.074 K	116 J	MTCSD02601	4.15	3.45	3.5	7	1.2	17	97	YES	ASL
CALCIUM	44/46	85	22100 J	IS11SD020001	1964	1882	1490	22	NA	0	NA	NO	NT
CHROMIUM	46/46	1.8 K	69.7 L	IS11SD040001	20.1	20.1	25	15	81	0	0.9	NO	BSL
COBALT	44/46	1.5	34.7	S39SD0020001	11.9	11.4	19.8	7	10	25	3.5	YES	ASL
COPPER	43/46	3 J	757 L	IS11SD010001	87.0	81.4	22.7	25	34	14	22	YES	ASL
CYANIDE	4/46	0.12 J	4.7 J	MTCSD00201	1.17	0.34	ND	4	0.667	2	7	YES	ASL
IRON	46/46	1710	134000 J	IS11SD030001	25970	25970	27900	11	20000	25	6.7	YES	ASL
LEAD	46/46	1.7	76400 J	IS11SD010001	1832	1832	30.7	26	46.7	17	1636	YES	ASL

TABLE 5-4

COPC SELECTION-SEDIMENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MINIMUM CONCENTRATION	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND SEDIMENT CONCENTRATION	NUMBER OF EXCEEDANCES OF MAXIMUM BACKGROUND SEDIMENT CONCENTRATIONS	SEDIMENT COPC SCREENING LEVEL[3]	NUMBER OF EXCEEDANCES OF ECOLOGICAL SEDIMENT SCREENING LEVEL	ECOLOGICAL EFFECTS QUOTIENT	RETAIN AS A COPC?	RATIONALE FOR COPC SELECTION OR DELETION[5]
MAGNESIUM	43/46	108 J	3190 J	IS11SD020001	1434	1344	3590	0	NA	0	NA	NO	NT
MANGANESE	46/46	28.2	1470 J	MTCSD01901	428	428	876	6	260	27	5.7	YES	ASL
MERCURY	32/45	0.02	8.7	S39SD0070001	0.55	0.54	ND	32	0.15	20	58	YES	ASL
NICKEL	44/46	1.3 K	46.4 L	IS11SD040001	18.7	17.9	22.5	17	20.9	20	2.2	YES	ASL
POTASSIUM	45/46	74.7	1530 J	MTCSD00901	590	578	1460	1	NA	0	NA	NO	NT
SELENIUM	1/45	1.7 L	1.7 L	IS11SD030001	1.7	0.81	ND	1	1	1	1.7	YES	ASL
SILVER	33/46	0.12 L	308	S39SD0040001	14.7	10.6	0.76	26	1	26	308	YES	ASL
SODIUM	4/46	372 J	23000 J	MTCSD02601	5274	592	3760	1	NA	0	NA	NO	NT
THALLIUM	9/46	1.1 K	4.2	IS11SD010001	2.4	1.1	ND	9	NA	0	NA	YES	NTX
VANADIUM	46/46	3.5 K	53.4	MTCSD02101	22.9	22.9	32.9	15	57	0	0.9	NO	BSL
ZINC	40/46	8.8 J	71000 J	MTCSD02601	1793	1562	142	19	150	16	473	YES	ASL
AVS/SEM PARAMETERS (UMO/G)													
ACID VOLATILE SULFIDE	31/36	0.00945	39	S39SD0080001	2.5	2.2	7.878	2	NA	0	NA	NO	NZ
CADMIUM-SEM	6/36	0.00365 J	0.68 J	MTCSD02601	0.12	0.02	ND	6	NA	0	NA	NO	NZ
COPPER-SEM	33/36	0.01888	7.7 J	MTCSD02601	0.89	0.82	1.992	5	NA	0	NA	NO	NZ
LEAD-SEM	35/36	0.01264	10.0	MTCSD02601-D	0.37	0.36	0.218	6	NA	0	NA	NO	NZ
NICKEL-SEM	25/36	0.02896 K	12.9 J	MTCSD01001	1.9	1.3	2.281	6	NA	0	NA	NO	NZ
ZINC-SEM	29/36	0.10858	946	MTCSD02601-D	30.1	24.3	8.064	1	NA	0	NA	NO	NZ
TOTAL SEM[4]-AVS	35/35	-37.5003	963	MTCSD02601-D	25.2	25.2	9.986	2	NA	0	NA	NO	NZ
MISCELLANEOUS PARAMETERS													
PH (S.U.)	14/14	5.4	7.5	IS17SD060001	6.72	6.72	NA	14	NA	0	NA	NO	NZ
TOTAL ORGANIC CARBON(MG/KG)	39/42	550	74200 J	MTCSD00801	26382	24502	69200	2	NA	0	NA	NO	NZ
PERCENT CLAY(%)	21/21	0.2	35.6	MTCSD01401	12.6	12.6	27.1	2	NA	0	NA	NO	NZ
PERCENT GRAVEL(%)	21/21	0	44.3	MTCSD01701	6.1	6.1	0.6	9	NA	0	NA	NO	NZ
PERCENT SAND(%)	21/21	4	92.6	MTCSD02001	48.9	48.9	79.4	4	NA	0	NA	NO	NZ
PERCENT SILT(%)	21/21	1.2	78	MTCSD00901	32.4	32.4	65.2	4	NA	0	NA	NO	NZ

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations
However, duplicates are considered separate samples for purposes of identifying the range of concentrations
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average.
Nondetected results were assinged a concentration equal to 1/2 the sample with the exception of the total PAHs values; They were calculated using only postive detections.
quantitation limit
3 Source of data is Table 4-9
4 Total SEM is the sum of the concentrations of the SEM metals (Cd, Cu, Pb, Ni, Zn).
5 Rationale Codes:
For Selection as a COPC:
ASL = Above COPC Screening Level
BIO = Bioaccumulative Chemical
NTX = No Toxicity Information Available
For Elimination as a COPC:
BSL = Below COPC Screening Level
NT = Nontoxic
NZ = Not applicable because these parameters are used to characterize the sediments
and/or cannot be used to evaluate ecological risks

Acronyms/Abbreviations:
AVS/SEM = Acid-volatile sulfide/simultaneously extrated metals
NA = Not Available
ND = Not Detected
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls

Shaded chemical name indicates the chemical was selected as a COPC.

ASSOCIATED SAMPLES:

IS11SD010001	MTCSD01601
IS11SD020001	MTCSD01701
IS11SD030001	MTCSD01801
IS11SD040001	MTCSD01901
IS17SD010001	MTCSD02001
IS17SD020001	MTCSD02101
IS17SD030001	MTCSD02201
IS17SD040001	MTCSD02301
IS17SD050001	MTCSD02301-AVG
IS17SD060001	MTCSD02301-D
MTCSD00101	MTCSD02401
MTCSD00201	MTCSD02501
MTCSD00201-AVG	MTCSD02601
MTCSD00201-D	MTCSD02601-A
MTCSD00301	MTCSD02601-A-AVG
MTCSD00401	MTCSD02601-A-D
MTCSD00501	MTCSD02601-AVG
MTCSD00601	MTCSD02601-D
MTCSD00701	MTCSD02901
MTCSD00801	MTCSD03001
MTCSD00901	S39SD0010001
MTCSD01001	S39SD0020001
MTCSD01101	S39SD0030001
MTCSD01201	S39SD0040001
MTCSD01201-AVG	S39SD0050001
MTCSD01201-D	S39SD0060001
MTCSD01301	S39SD0070001
MTCSD01401	S39SD0080001
MTCSD01501	

TABLE 5-5

EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
MATTAWOMAN CREEK
INDIANHEAD, MARYLAND

Species/Exposure Inputs	Conservative Inputs		Average Inputs		Source
	Values	Units	Values	Units	
Great Blue Heron					
Body Weight = BW	2.200E+00	kg	2.310E+00	kg	USEPA, 1993
Food Ingestion Rate = If	4.640E-01	kg/day	4.160E-01	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	1.160E-01	L/day	1.040E-01	L/day	USEPA, 1993
Sediment Ingestion Rate - Is	1.531E-02	kg/day	1.373E-02	kg/day	Beyer, 1994
Home Range = HR	Assume 100% on site		1.100E+01	acres	USEPA, 1993
Mallard Duck					
Body Weight = BW	1.043E+00	kg	1.166E+00	kg	USEPA, 1993
Food Ingestion Rate = If	5.170E-01	kg/day	4.950E-01	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	6.800E-02	L/day	6.600E-02	L/day	USEPA, 1993
Sediment Ingestion Rate - Is	1.706E-02	kg/day	1.634E-02	kg/day	Beyer, 1994
Home Range = HR	Assume 100% on site		1.433E+03	acres	USEPA, 1993
Mink					
Body Weight = BW	5.500E-01	kg	1.103E+00	kg	USEPA, 1993
Food Ingestion Rate = If	2.430E-01	kg/day	1.800E-01	kg/day	USEPA, 1993
Water Ingestion Rate = Iw	1.210E-01	L/day	7.300E-02	L/day	USEPA, 1993
Sediment Ingestion Rate - Is	8.019E-03	kg/day	5.940E-03	kg/day	Beyer, 1994
Home Range = HR	Assume 100% on site		5.040E+01	acres	USEPA, 1993

Calculations of these exposure parameters are presented in Appendix C-2

TABLE 5-6

COPC SELECTION-WHOLE BODY FISH TISSUE SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND CONCENTRATION-SHINER, MUMMICHOG, PUMPKINSEED GROUP	RETAIN AS A COPC?	RATIONALE FOR CONTAMINANT SELECTION OR ELIMINATION[3]
SEMIVOLATILE ORGANICS (UG/KG)								
2-METHYLPHENOL	2/10	170	MTCGS003	122	470	ND	YES	ABKG
4-METHYLPHENOL	9/10	39000	MTCFS004	11362	10242	660	YES	ABKG
BENZALDEHYDE	3/10	53	MTCFS005	44	442	410	NO	BKG
BIS(2-ETHYLHEXYL)PHTHALATE	6/10	1900	MTCFS001	855	808	ND	YES	ABKG
PHENOL	3/10	140	MTCFS003	118	464	98	YES	ABKG
PESTICIDES/PCBS (UG/KG)								
4,4'-DDD	1/10	3.9	MTCSS004	3.9	2.0	ND	YES	BIO/ABKG
4,4'-DDE	7/10	17	MTCSS004	7	5.6	6.8	YES	BIO/ABKG
AROCLOR-1260	6/10	130	MTCSS004	59	44	59	YES	BIO/ABKG
EXPLOSIVES (MG/KG)								
NITROGLYCERIN	4/10	0.22	MTCSS005	0.15	0.25	ND	YES	ABKG
NITROGUANIDINE	1/10	0.068	MTCSS005	0.07	0.29	ND	YES	ABKG
INORGANICS (MG/KG)								
ALUMINUM	8/10	20.6	MTCSS005	10.8	9.1	15.9	NO	NON-BIO
ARSENIC	10/10	2	MTCFS003	1.4	1.4	1.5	YES	BIO/ABKG
BARIUM	10/10	4.8	MTCSS005	1.7	1.7	6.2	NO	BKG
CADMIUM	6/10	0.025	MTCFS004, MTCSS001	0.02	0.02	ND	YES	BIO/ABKG
CALCIUM	10/10	10800	MTCFS002	5669	5669	7990	NO	NUT
CHROMIUM	3/10	6.6	MTCGS002	2.6	0.89	1.2	YES	BIO/ABKG
CYANIDE	2/10	0.45	MTCGS003	0.43	0.22	ND	NO	NON-BIO
IRON	10/10	166	MTCGS002	34.8	34.8	35.2	NO	NON-BIO
LEAD	2/10	0.41	MTCFS003	0.31	0.17	ND	YES	BIO/ABKG
MAGNESIUM	10/10	293	MTCFS002	198	198	308	NO	NUT
MANGANESE	10/10	8.2	MTCFS003	6.0	6.0	21.5	NO	BKG
POTASSIUM	10/10	1620	MTCSS005	1180	1180	2050	NO	NUT
SODIUM	10/10	493	MTCFS003	363	363	655	NO	NUT
VANADIUM	5/10	0.38	MTCGS002	0.17	0.10	0.1	NO	NON-BIO
ZINC	10/10	24.9	MTCSS005	15.6	15.6	35.1	NO	BKG
MISCELLANEOUS PARAMETERS								
LIPIDS (%)	10/10	2.38	MTCGS003	1.0	1.0	0.94	NO	NZ

TABLE 5-6

COPC SELECTION-WHOLE BODY FISH TISSUE SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Shaded chemical name indicates the chemical was selected as a COPC.

ASSOCIATED SAMPLES

MTCFS001	MTCGS002
MTCFS002	MTCGS003
MTCFS003	MTCSS001
MTCFS004	MTCSS004
MTCFS005	MTCSS005

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Rationale Codes:
For Selection as a COPC:
ABKG = Maximum concentration is above the maximum background concentration.
BIO = Bioaccumulative Chemical
For Elimination as a COPC:
NON-BIO = Non-Bioaccumulative Chemical
NUT = Essential nutrient that can be tolerated by living organisms at high concentrations.
NZ = Not applicable because the parameter is used to characterize the sediments and/or cannot be used to evaluate ecological risks.
BKG = Maximum concentration is below the maximum background concentration.

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

TABLE 5-7

COPC SELECTION-FILLET FISH TISSUE SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MAXIMUM CONCENTRATION	LOCATION OF MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE DETECTIONS	AVERAGE OF ALL ANALYTICAL RESULTS[2]	MAXIMUM BACKGROUND FILET CONCENTRATION	RETAIN AS A COPC?	RATIONALE FOR CONTAMINANT SELECTION OR ELIMINATION[3]
SEMIVOLATILE ORGANICS (UG/KG)								
4-METHYLPHENOL	11/16	64000	MTCCT00302	12641	8742	45000	NO	NON-BIO/MED
BENZALDEHYDE	5/16	91	MTCLB005	65.8	523	500	NO	BKG
BIS(2-ETHYLHEXYL)PHTHALATE	14/16	2200	MTCCT00403	1008	903	800	NO	NON-BIO/MED
PHENOL	3/16	150	MTCCT005	91.7	540	46	NO	NON-BIO/MED
PESTICIDES/PCBS (UG/KG)								
4,4'-DDE	12/16	110	MTCCT00301	28	21	8.7	YES	BIO/ABKG
AROCLOR-1260	12/16	380	MTCCT00301	146	114	73	YES	BIO/ABKG
DIELDRIN	1/15	7.3	MTCCT00301	7.3	2.0	ND	YES	BIO/ABKG
ENDOSULFAN I	1/16	2.1	MTCCT00102	2.1	0.93	ND	YES	BIO/ABKG
ENDRIN	1/16	5	MTCCT00402	5.0	1.9	ND	YES	BIO/ABKG
GAMMA-CHLORDANE	3/14	8.5	MTCCT00301	6.2	2.0	ND	YES	BIO/ABKG
EXPLOSIVES (MG/KG)								
1,3-DINITROBENZENE	1/16	0.057	MTCCT005	0.06	0.12	ND	YES	ABKG
2-AMINO-4,6-DINITROTOLUENE	1/16	0.096	MTCCT00402	0.10	0.12	ND	YES	ABKG
HMX	1/16	0.083	MTCCT005	0.08	0.12	ND	YES	ABKG
NITROCELLULOSE	1/16	5.7	MTCCT00402	5.7	1.2	ND	YES	ABKG
NITROGUANIDINE	2/16	0.19	MTCLB00401	0.16	0.13	ND	YES	ABKG
INORGANICS (MG/KG)								
ALUMINUM	8/16	22.4	MTCCT00102	8.3	4.9	20.1	NO	NON-BIO
ARSENIC	8/16	1.6	MTCLB00202	1.1	0.72	2.2	NO	BKG
BARIUM	4/16	0.74	MTCLB005	0.52	0.20	1.3	NO	BKG
CADMIUM	9/16	0.034	MTCCT00101	0.03	0.02	0.024	YES	BIO/ABKG
CALCIUM	16/16	16900	MTCLB005	3135	3135	21900	NO	NUT
CHROMIUM	3/16	6.2	MTCLB00202	2.84	0.63	0.59	YES	BIO/ABKG
COPPER	1/16	3.6	MTCCT005	3.6	0.50	ND	YES	BIO/ABKG
CYANIDE	2/16	5.5	MTCLB00201	3.0	0.53	ND	NO	NON-BIO
IRON	8/16	48	MTCLB00202	18.0	10.3	47.3	NO	NON-BIO
LEAD	4/16	1.1	MTCLB00202	0.45	0.22	ND	YES	BIO/ABKG
MAGNESIUM	16/16	611	MTCLB005	227	227	674	NO	NUT
MANGANESE	15/16	4	MTCCT00302	1.4	1.37	7.8	NO	BKG
MERCURY	2/16	0.098	MTCLB005	0.08	0.03	0.17	NO	BKG
POTASSIUM	16/16	3680	MTCLB005	2234	2234	3250	NO	NUT
SODIUM	16/16	880	MTCCT005	415	415	969	NO	NUT
ZINC	9/16	11.9	MTCLB00201	8.9	6.3	17.3	NO	BKG
MISCELLANEOUS PARAMETERS								
LIPIDS (%)	16/16	7.23	MTCCT00101	2.0	2.0	0.74	NO	NZ
PERCHLORATE (UG/KG)	1/16	10200	MTCLB00201	10200	2591	ND	NO	NZ

TABLE 5-7

COPC SELECTION-FILLET FISH TISSUE SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Shaded chemical name indicates the chemical was selected as a COPC.

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Rationale Codes:
For Selection as a COPC:
ABKG = Maximum concentration is above the maximum background concentration.
BIO = Bioaccumulative Chemical
For Elimination as a COPC:
NON-BIO = Non-Bioaccumulative Chemical
NUT = Essential nutrient that can be tolerated by living organisms at high concentrations.
NZ = Not applicable because the parameter is used to characterize the sediments and/or cannot be used to evaluate ecological risks.
BKG = Maximum concentration is below the maximum background concentration.
MED = Detected in fish tissue samples only and not (or infrequently) in any other media.

ASSOCIATED SAMPLES:

MTCCT00101	MTCLB00202
MTCCT00102	MTCLB00203
MTCCT00301	MTCLB003
MTCCT00302	MTCLB00401
MTCCT00401	MTCLB00402
MTCCT00402	MTCLB005
MTCCT00403	
MTCCT005	
MTCLB001	
MTCLB00201	

Acronyms/Abbreviations:
ND = Not Detected
PCB = Polychlorinated Biphenyl

TABLE 5-8

COPC SELECTION-HYDRILLA SAMPLES
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

PARAMETER	FREQUENCY OF DETECTION[1]	MAXIMUM CONCENTRATION	LOCATION OF MAXIMIM CONCENTRATION	AVERAGE OF POSITIVE DETECTIONS	AVERAGE OF ALL ANALTICAL RESULTS[2]	MAXIMUM BACKGROUND HYDRILLA CONCENTRATION	RETAIN AS A COPC?	RATIONALE FOR CONTAMINANT SELECTION OR ELIMINATION[3]
INORGANICS (MG/KG)								
ALUMINUM	5/5	275	MTCVG003	136	136	286	NO	BKG
BARIUM	5/5	18.4	MTCVG004	14.1	14.1	35.1	NO	BKG
BERYLLIUM	3/5	0.032	MTCVG003	0.03	0.02	0.044	NO	BKG
CADMIUM	1/5	0.13	MTCVG003	0.13	0.07	0.39	NO	BKG
CALCIUM	5/5	960	MTCVG005	798	798	616	NO	NUT
CHROMIUM	1/5	0.9	MTCVG003	0.90	0.40	0.98	NO	BKG
IRON	5/5	684	MTCVG003	344	344	2260	NO	BKG
MAGNESIUM	5/5	394	MTCVG003	362	362	427	NO	NUT
MANGANESE	5/5	354	MTCVG004	283	283	1970	NO	BKG
NICKEL	3/5	1.7	MTCVG004	1.6	1.2	2.1	NO	BKG
POTASSIUM	5/5	3580	MTCVG001	3068	3068	2560	NO	NUT
SODIUM	2/5	499	MTCVG001	402	271	1420	NO	NUT
VANADIUM	5/5	0.99	MTCVG003	0.55	0.55	1.2	NO	BKG
ZINC	1/5	21.6	MTCVG005	21.6	8.1	18.3	YES	BIO/ABKG

Shaded chemical name indicates the chemical was selected as a COPC.

ASSOCIATED SAMPLES
MTCVG001
MTCVG002
MTCVG003
MTCVG004
MTCVG005

Footnotes:
1 Duplicates are considered one sample for purposes of calculating frequency of detection. However, duplicates are considered separate samples for purposes of identifying the range of concentrations detected.
2 Analytical results for duplicate samples were averaged prior to the calculation of this statistic. Rejected results are not included in the calculation of the average. Nondetect results were assigned a concentration equal to 1/2 the sample quantitation limit prior to calculation of this statistic.
3 Rationale Codes:
For Selection as a COPC:
BIO = Bioaccumulative Chemical
ABKG = Maximum concentration is above the maximum background concentration.
For Elimination as a COPC:
NUT = Essential nutrient that can be tolerated by living organisms at high concentrations.
BKG = Maximum concentration is below the maximum background concentration.

TABLE 5-9

TERRESTRIAL WILDLIFE MODEL EEQS-MAXIMUM INPUTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARLYAND

Parameter	Great Blue Heron NOAEL EEQs	Great Blue Heron LOAEL EEQs	Mallard Duck NOAEL EEQs	Mallard Duck LOAEL EEQs	Mink NOAEL EEQs	Mink LOAEL EEQs
SEMIVOLATILES						
Acenaphthene	4.2E-04	4.2E-05	9.8E-04	9.8E-05	1.0E-04	5.0E-05
Acenaphthylene	1.2E-03	1.2E-04	2.8E-03	2.8E-04	7.1E-05	7.1E-06
Anthracene	1.9E-03	1.9E-04	4.4E-03	4.4E-04	7.9E-05	7.9E-06
Benzo(a)anthracene	5.9E-03	5.9E-04	1.4E-02	1.4E-03	1.5E-01	1.5E-02
Benzo(a)pyrene	6.3E-03	6.3E-04	1.5E-02	1.5E-03	2.6E-02	2.6E-03
Benzo(b)fluoranthene	7.0E-03	7.0E-04	1.6E-02	1.6E-03	7.3E-03	7.3E-04
Benzo(g,h,i)perylene	3.8E-03	3.8E-04	9.0E-03	9.0E-04	2.2E-03	2.2E-04
Benzo(k)fluoranthene	5.2E-03	5.2E-04	1.2E-02	1.2E-03	3.0E-03	3.0E-04
Chrysene	5.9E-03	5.9E-04	1.4E-02	1.4E-03	1.5E-01	1.5E-02
Dibenzo(a,h)anthracene	7.7E-04	7.7E-05	1.8E-03	1.8E-04	2.4E-03	2.4E-04
Fluoranthene	1.4E-02	1.4E-03	3.3E-02	3.3E-03	4.7E-03	2.3E-03
Fluorene	7.0E-04	7.0E-05	1.6E-03	1.6E-04	2.3E-04	1.2E-04
Indeno(1,2,3-cd)pyrene	3.8E-03	3.8E-04	9.0E-03	9.0E-04	2.2E-03	2.2E-04
Phenanthrene	9.0E-03	9.0E-04	2.1E-02	2.1E-03	3.8E-02	3.8E-03
Pyrene	1.4E-02	1.4E-03	3.3E-02	3.3E-03	7.8E-03	4.7E-03
PESTICIDES/PCBS						
4,4'-DDD	3.1E-01	3.1E-02	4.5E-02	4.5E-03	2.3E-03	4.6E-04
4,4'-DDE	1.3E+00	1.3E-01	3.5E-02	3.5E-03	9.5E-03	1.9E-03
Alpha-BHC	8.7E-06	2.2E-06	2.0E-05	5.1E-06	7.3E-04	7.3E-05
Aroclor-1248	6.6E-03	6.6E-04	1.5E-02	1.5E-03	2.5E-01	2.5E-02
INORGANICS						
Arsenic	3.7E-01	1.2E-01	4.7E-01	1.6E-01	1.5E+01	1.5E+00
Cadmium	5.6E-01	4.1E-02	1.4E+00	9.8E-02	1.7E+00	1.7E-01
Chromium	1.9E+00	3.8E-01	1.6E+00	3.2E-01	1.2E+00	3.0E-01
Copper	1.1E-01	8.5E-02	2.6E-01	2.0E-01	9.4E-01	7.2E-01
Lead	4.7E+02	4.7E+01	1.1E+03	1.1E+02	1.4E+02	1.4E+01
Mercury	9.5E+00	9.5E-01	2.2E+01	2.2E+00	8.5E+00	5.1E+00
Silver	3.9E-01	3.9E-02	9.3E-01	9.3E-02	1.9E+00	1.9E-01
Zinc	3.4E+01	3.8E+00	8.1E+01	9.0E+00	6.5E+00	3.3E+00

Notes:
Cells are shaded if the EEQ is greater than 1.0.
EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD00101		MTCSD00201		MTCSD00201-D		MTCSD00301		MTCSD00401	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	0.307	0.191	0.616	0.383	ND	NA	ND	NA	2.396	1.488
Arsenic	9.79	7.1	0.725	6.6	0.674	4.2	0.429	1.1	0.112	20	2.043
Cadmium	0.99	0.79	0.798	0.62	0.626	0.64	0.646	1	1.010	0.77	0.778
Copper	31.6	37.4	1.184	29.8	0.943	25.7	0.813	8.6	0.272	18.4	0.582
Lead	35.8	60.5	1.690	43.4	1.212	38.3	1.070	15.8	0.441	53.4	1.492
Mercury	0.18	0.2	1.111	0.16	0.889	0.07	0.389	0.0345	0.192	0.13	0.722
Silver	1	1.3	1.300	1.4	1.400	1.2	1.200	0.34	0.340	3.2	3.200
Zinc	121	89.7	0.741	74.3	0.614	72.2	0.597	3.9	0.032	37.1	0.307
MEAN HQ[3]		**0.97**		**0.84**		**0.73**		**0.34**		**1.3**	

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD00901		MTCSD01001		MTCSD01101		MTCSD01201		MTCSD01201-D	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	ND	NA	0.41	0.255	ND	NA	3.121	1.939	22.01	13.671
Arsenic	9.79	6.8	0.695	14.6	1.491	5	0.511	5.6	0.572	3.6	0.368
Cadmium	0.99	4.1	4.141	1.1	1.111	1.1	1.111	0.074	0.075	0.084	0.085
Copper	31.6	36.3	1.149	27.7	0.877	30.2	0.956	4.4	0.139	5.1	0.161
Lead	35.8	47.2	1.318	54.2	1.514	43.5	1.215	10.3	0.288	12.9	0.360
Mercury	0.18	0.24	1.333	0.54	3.000	0.085	0.472	0.0355	0.197	0.0355	0.197
Silver	1	1.4	1.400	0.76	0.760	1.3	1.300	0.075	0.075	0.08	0.080
Zinc	121	143	1.182	107	0.884	19.65	0.162	9.6	0.079	46.1	0.381
MEAN HQ[3]		**1.6**		**1.2**		**0.82**		**0.42**		**1.9**	

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD01301		MTCSD01401		MTCSD01501		MTCSD01601		MTCSD01701	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	ND	NA	0.48	0.298	0.676	0.420	0.13	0.081	1.241	0.771
Arsenic	9.79	9.6	0.981	2.85	0.291	0.85	0.087	3.75	0.383	0.485	0.050
Cadmium	0.99	0.075	0.076	0.93	0.939	1.4	1.414	1.5	1.515	0.42	0.424
Copper	31.6	15	0.475	28.7	0.908	9.9	0.313	37.1	1.174	6.8	0.215
Lead	35.8	19.3	0.539	36.5	1.020	13.4	0.374	45.8	1.279	10.5	0.293
Mercury	0.18	0.041	0.228	0.24	1.333	0.038	0.211	0.22	1.222	0.025	0.139
Silver	1	0.07	0.070	2	2.000	4.8	4.800	2.7	2.700	0.05	0.050
Zinc	121	36.5	0.302	149	1.231	59.7	0.493	204	1.686	13.3	0.110
MEAN HQ[3]		**0.38**		**1.003**		**1.01**		**1.3**		**0.26**	

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD01801		MTCSD01901		MTCSD02001		MTCSD02301		MTCSD02301-D	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	ND	NA	0.82	0.509	7.345	4.562	ND	NA	0.855	0.531
Arsenic	9.79	2.7	0.276	5.15	0.526	13.9	1.420	3.55	0.363	4.8	0.490
Cadmium	0.99	1.3	1.313	1.7	1.717	0.35	0.354	1.3	1.313	1.4	1.414
Copper	31.6	25.7	0.813	35.2	1.114	15.6	0.494	24.1	0.763	25.9	0.820
Lead	35.8	34.4	0.961	46.5	1.299	16.3	0.455	43.5	1.215	47.2	1.318
Mercury	0.18	0.37	2.056	0.26	1.444	0.13	0.722	0.12	0.667	0.21	1.167
Silver	1	1.5	1.500	1.6	1.600	0.07	0.070	3.3	3.300	5.9	5.900
Zinc	121	158	1.306	210	1.736	59.4	0.491	117	0.967	128	1.058
MEAN HQ[3]		**1.2**		**1.2**		**1.1**		**1.2**		**1.6**	

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD02401		MTCSD02501		MTCSD02601		MTCSD02601-D		MTCSD02701	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	ND	NA	0.759	0.471	ND	NA	ND	NA	ND	NA
Arsenic	9.79	1.4	0.143	13.8	1.410	70.7	7.2	45.5	4.65	2.7	0.276
Cadmium	0.99	2.3	2.323	0.4	0.404	116	117	43.8	44	2.6	2.63
Copper	31.6	12.7	0.402	0.8	0.025	229	7.2	92.4	2.92	13.8	0.437
Lead	35.8	18.7	0.522	16	0.447	3010	84	1330	37.2	19.4	0.542
Mercury	0.18	0.12	0.667	0.0295	0.164	0.03	0.167	0.024	0.133	0.075	0.417
Silver	1	0.43	0.430	0.075	0.075	0.4	0.400	0.12	0.120	0.76	0.760
Zinc	121	74.2	0.613	35.3	0.292	71000	587	52800	436	108	0.893
MEAN HQ[3]		**0.73**		**0.41**		**115**		**75**		**0.85**	

TABLE 5-10

CALCULATION OF TEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	TEC[1]	MTCSD02801		NJCSD00101		NJCSD00201	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	1.61	ND	NA	ND	NA	ND	NA
Arsenic	9.79	1.25	0.128	4.1	0.419	1.3	0.133
Cadmium	0.99	2.3	2.32	3.5	3.54	0.47	0.475
Copper	31.6	11.1	0.351	22.7	0.718	1.4	0.044
Lead	35.8	14.6	0.408	30.7	0.858	4.9	0.137
Mercury	0.18	0.06	0.333	0.105	0.583	0.028	0.156
Silver	1	0.18	0.180	0.22	0.220	0.07	0.070
Zinc	121	69.9	0.578	142	1.17	19	0.157
MEAN HQ[3]		**0.61**		**1.1**		**0.17**	

Notes:
Grey-shaded values are one-half non-detect result.
Black-shaded values are EEQs greater than 1.0
1 - MacDonald et al., 2000
2 - EEQ = Concentration (mg/kg) / TEC (mg/kg)
3 - Mean HQ calculated by averaging the HQs for the individual chemicals
EEQ - Ecological Effects Quotient
TEC - Threshold Effect Concentration

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD00101		MTCSD00201		MTCSD00201-D		MTCSD00301		MTCSD00401	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	0.307	0.013	0.616	0.027	ND	NA	ND	NA	2.396	0.105
Arsenic	33	7.1	0.215	6.6	0.200	4.2	0.127	1.1	0.033	20	0.606
Cadmium	4.98	0.79	0.159	0.62	0.124	0.64	0.129	1	0.201	0.77	0.155
Copper	149	37.4	0.251	29.8	0.200	25.7	0.172	8.6	0.058	18.4	0.123
Lead	128	60.5	0.473	43.4	0.339	38.3	0.299	15.8	0.123	53.4	0.417
Mercury	1.06	0.2	0.189	0.16	0.151	0.07	0.066	0.0345	0.033	0.13	0.123
Silver	3.7	1.3	0.351	1.4	0.378	1.2	0.324	0.34	0.092	3.2	0.865
Zinc	459	89.7	0.195	74.3	0.162	72.2	0.157	3.9	0.008	37.1	0.081
MEAN HQ[3]		**0.23**		**0.20**		**0.18**		**0.078**		**0.31**	

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD00901		MTCSD01001		MTCSD01101		MTCSD01201		MTCSD01201-D	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	ND	NA	0.41	0.018	ND	NA	3.121	0.137	22.01	0.965
Arsenic	33	6.8	0.206	14.6	0.442	5	0.152	5.6	0.170	3.6	0.109
Cadmium	4.98	4.1	0.823	1.1	0.221	1.1	0.221	0.074	0.015	0.084	0.017
Copper	149	36.3	0.244	27.7	0.186	30.2	0.203	4.4	0.030	5.1	0.034
Lead	128	47.2	0.369	54.2	0.423	43.5	0.340	10.3	0.080	12.9	0.101
Mercury	1.06	0.24	0.226	0.54	0.509	0.085	0.080	0.0355	0.033	0.0355	0.033
Silver	3.7	1.4	0.378	0.76	0.205	1.3	0.351	0.075	0.020	0.08	0.022
Zinc	459	143	0.312	107	0.233	19.65	0.043	9.6	0.021	46.1	0.100
MEAN HQ[3]		**0.37**		**0.28**		**0.20**		**0.063**		**0.17**	

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD01301		MTCSD01401		MTCSD01501		MTCSD01601		MTCSD01701	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	ND	NA	0.48	0.021	0.676	0.030	0.13	0.006	1.241	0.054
Arsenic	33	9.6	0.291	2.85	0.086	0.85	0.026	3.75	0.114	0.485	0.015
Cadmium	4.98	0.075	0.015	0.93	0.187	1.4	0.281	1.5	0.301	0.42	0.084
Copper	149	15	0.101	28.7	0.193	9.9	0.066	37.1	0.249	6.8	0.046
Lead	128	19.3	0.151	36.5	0.285	13.4	0.105	45.8	0.358	10.5	0.082
Mercury	1.06	0.041	0.039	0.24	0.226	0.038	0.036	0.22	0.208	0.025	0.024
Silver	3.7	0.07	0.019	2	0.541	4.8	1.30	2.7	0.730	0.05	0.014
Zinc	459	36.5	0.080	149	0.325	59.7	0.130	204	0.444	13.3	0.029
MEAN HQ[3]		**0.099**		**0.233**		**0.25**		**0.30**		**0.043**	

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD01801		MTCSD01901		MTCSD02001		MTCSD02301		MTCSD02301-D	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	ND	NA	0.82	0.036	7.345	0.322	ND	NA	0.855	0.038
Arsenic	33	2.7	0.082	5.15	0.156	13.9	0.421	3.55	0.108	4.8	0.145
Cadmium	4.98	1.3	0.261	1.7	0.341	0.35	0.070	1.3	0.261	1.4	0.281
Copper	149	25.7	0.172	35.2	0.236	15.6	0.105	24.1	0.162	25.9	0.174
Lead	128	34.4	0.269	46.5	0.363	16.3	0.127	43.5	0.340	47.2	0.369
Mercury	1.06	0.37	0.349	0.26	0.245	0.13	0.123	0.12	0.113	0.21	0.198
Silver	3.7	1.5	0.405	1.6	0.432	0.07	0.019	3.3	0.892	5.9	1.59
Zinc	459	158	0.344	210	0.458	59.4	0.129	117	0.255	128	0.279
MEAN HQ[3]		**0.27**		**0.28**		**0.16**		**0.30**		**0.38**	

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD02401		MTCSD02501		MTCSD02601		MTCSD02601-D		MTCSD02701	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	ND	NA	0.759	0.033	ND	NA	ND	NA	ND	NA
Arsenic	33	1.4	0.042	13.8	0.418	70.7	2.1	45.5	1.38	2.7	0.082
Cadmium	4.98	2.3	0.462	0.4	0.080	116	23	43.8	8.80	2.6	0.522
Copper	149	12.7	0.085	0.8	0.005	229	1.5	92.4	0.62	13.8	0.093
Lead	128	18.7	0.146	16	0.125	3010	24	1330	10.4	19.4	0.152
Mercury	1.06	0.12	0.113	0.0295	0.028	0.03	0.028	0.024	0.02	0.075	0.071
Silver	3.7	0.43	0.116	0.075	0.020	0.4	0.108	0.12	0.03	0.76	0.205
Zinc	459	74.2	0.162	35.3	0.077	71000	155	52800	115	108	0.235
MEAN HQ[3]		**0.16**		**0.098**		**29**		**19**		**0.19**	

TABLE 5-11

CALCULATION OF PEC HAZARD QUOTIENT AND MEAN QUOTIENT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Parameter	PEC[1]	MTCSD02801		NJCSD00101		NJCSD00201	
	(mg/kg)	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]	Concentration (mg/kg)	EEQ[2]
Total PAHs	22.8	ND	NA	ND	NA	ND	NA
Arsenic	33	1.25	0.038	4.1	0.124	1.3	0.039
Cadmium	4.98	2.3	0.462	3.5	0.703	0.47	0.094
Copper	149	11.1	0.074	22.7	0.152	1.4	0.009
Lead	128	14.6	0.114	30.7	0.240	4.9	0.038
Mercury	1.06	0.06	0.057	0.105	0.099	0.028	0.026
Silver	3.7	0.18	0.049	0.22	0.059	0.07	0.019
Zinc	459	69.9	0.152	142	0.309	19	0.041
MEAN HQ[3]		**0.14**		**0.24**		**0.038**	

Notes:
Grey-shaded values are one-half non-detect result.
Black-shaded values are EEQs greater than 1.0
1 - MacDonald et al., 2000
2 - EEQ = Concentration (mg/kg) / PEC (mg/kg)
3 - Mean HQ calculated be averaging the HQs for the individual chemicals
EEQ - Ecological Effects Quotient
PEC - Probable Effect Concentration

TABLE 5-12

SUMMARY OF SEDIMENT CHEMISTRY WEIGHT OF EVIDENCE EVALUATION
MATTAWOMAN CREEK INVESTIGATION
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Threshold Effect Concentration (TEC)		Probable Effect Concentration (PEC)		Overall Weight of Evidence Score
	Number of Metals > TEC[1]	Mean TEC Quotient[1]	Number of Metals > PEC[1]	Mean PEC Quotient[1]	
MTCSD001	4	0.97	0	0.23	0
MTCSD002	2	0.84	0	0.20	0
MTCSD002D	2	0.73	0	0.18	0
MTCSD003	1	0.34	0	0.078	0
MTCSD004	4	1.3	0	0.31	2
MTCSD009	6	1.6	0	0.37	2
MTCSD010	4	1.2	0	0.28	2
MTCSD011	3	0.82	0	0.20	0
MTCSD012	1	0.42	0	0.063	0
MTCSD012D	1	1.9	0	0.17	2
MTCSD013	0	0.38	0	0.099	0
MTCSD014	4	1.00	0	0.23	0
MTCSD015	2	1.01	1	0.25	4
MTCSD016	6	1.3	0	0.30	2
MTCSD017	0	0.26	0	0.043	0
MTCSD018	4	1.2	0	0.27	2
MTCSD019	6	1.2	0	0.28	2
MTCSD020	2	1.1	0	0.16	0
MTCSD023	3	1.2	0	0.30	2
MTCSD023D	5	1.6	1	0.38	4
MTCSD024	1	0.73	0	0.16	0
MTCSD025	1	0.41	0	0.10	0
MTCSD026	5	115	5	29	6
MTCSD026D	5	75	4	19	6
MTCSD027	1	0.85	0	0.19	Not Applicable-Upgradient Sample
MTCSD028	1	0.61	0	0.14	Not Applicable-Upgradient Sample
NJCSD001	2	1.1	0	0.24	Not Applicable-Reference Sample
NJCSD002	0	0.17	0	0.038	Not Applicable-Reference Sample

Notes:
1 - See Table 5-10 and 5-11 for the comparison of the chemicals to the sediment guidelines and the calculation of the quotients.

Overall Weight of Evidence Score
0 - The concentrations of no chemicals exceed the TEC
2 - The concentrations of no chemicals exceed the PEC, but mean TEC EEQ is greater than maximum reference/upgradient TEC EEQ (1.1)
4 - The concentration of one chemical exceeds the PEC
6 - The concentrations of more than one chemical exceeds the PEC

TABLE 5-13

SUMMARY OF TOXICITY TEST RESULTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample	Mean Number of Survivors Per Replicate[1]	Mean Mass Per Survivor (grams)	Ammonia		Dissolved Oxygen		
			Beginning	End	Minimum	Average	Number of Days With Low DO[2]
Site Samples							
MTCSD001	2.38	0.25	1.28	0.25	2	4.4	1
MTCSD002	8.00	0.22	0	0.25	2.7	4.4	0
MTCSD002D	8.50	0.23	0.25	0.5	2.9	4.6	0
MTCSD003	1.38	0.32	1	0.5	0.7	4.0	1
MTCSD004	4.63	0.20	0	0.5	3.1	4.8	0
MTCSD009	1.88	0.06	1.75	0.25	0.9	3.7	3
MTCSD010	1.00	0.33	2.5	0.5	1	3.8	3
MTCSD011	2.00	0.06	2	0.25	1	4.3	2
MTCSD012	7.50	0.28	0.5	0.25	3.4	5.0	0
MTCSD012D	8.13	0.35	0.25	0.25	2.4	4.3	1
MTCSD013	7.50	0.43	0	0.25	4.2	6.2	0
MTCSD014	3.63	0.28	2.25	0.25	2.1	4.0	1
MTCSD015	2.00	0.26	1.5	0.25	2	4.0	1
MTCSD016	2.63	0.31	3.75	0	1.6	3.8	3
MTCSD017	0.00	0.00	0.5	NR	3.5	4.5	0
MTCSD018	2.75	0.20	7	0.25	0.8	3.5	3
MTCSD019	1.63	0.14	10	0.75	1	3.4	2
MTCSD020	5.00	0.24	0.5	0.75	2.8	4.6	0
MTCSD023	4.00	0.28	4	0	1.6	3.7	2
MTCSD023D	5.13	0.16	3	0	1.5	3.6	3
MTCSD024	3.13	0.25	2.5	0	1.3	3.9	2
MTCSD025	2.25	0.48	0.5	0	2.3	3.8	1
MTCSD026	0.00	0.00	0.75	0	3.9	5.5	0
MTCSD026D	0.00	0.00	0.25	0.25	4.3	5.2	0
Upgradient/Reference Samples							
MTCSD027	3.13	0.39	2.25	0	2.8	3.9	0
MTCSD028	4.00	0.28	1.75	0	2.7	4.3	0
NJCSD001	6.13	0.20	1.25	0.75	3	4.1	0
NJCSD002	5.00	0.48	1.5	0.25	3.4	4.9	0
Laboratory Control Samples							
9/18 Control	8.63	0.59	7	0.25	3.8	4.7	0
9/22 Control	8.63	0.67	1.5	0.25	4.4	6.3	0

NR - Not recorded
1 - The toxicity tests were started with 10 organisms per replicate
2 - Low dissolved oxygen is less than 2.5 mg/L.

TABLE 5-14

SUMMARY OF CORRELATION COEFFICIENTS (R^2) FOR MEAN SURVIVAL AND MASS VERSUS PARAMETERS - AMPHIPOD TOXICITY TESTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

	Including all Samples		Without MTCSD026	
Parameter	**Versus Survival**	**Versus Mass**	**Versus Survival**	**Versus Mass**
Arsenic	0.12	0.19	0.019	0.010
Cadmium	0.38	0.33	0.36	0.19
Copper	0.15	0.46	0.063	0.50
Lead	0.17	0.37	0.064	0.38
Mercury	0.10	0.046	0.19	0.21
Silver	0.015	0.040	0.13	0.14
Zinc	0.16	0.25	0.08	0.13
Percent Fines	0.055	0.067	0.06	0.14
Maximum Ammonia Concentration	0.042	0.02	0.21	0.0067
Minimum Dissolved Oxygen Concentration	0.19	0.06	0.63	0.41
SEM-AVS	0.16	0.25	0.017	0.0036
LMW PAH	0.12	0.74	0.12	0.74
HMW PAH	0.30	0.041	0.32	0.04
Total PAH	0.32	0.043	0.32	0.04
PEC Quotient	0.16	0.33	0.09	0.41

Notes:
R^2 values are presented on the correlation plots in Appendix C-7

Common ranking used to determine the strength of association based on the R^2 value:
0.64-1.00 Strong Association between Variables
0.36-0.63 Strong to Moderate Association
0.16-0.35 Moderate Association
0.09-0.15 Moderate to Weak Association
0.04-0.08 Weak Association
0.00-0.039 Little, if any association

TABLE 5-15

SUMMARY OF TOXICITY TEST STATISTICAL COMPARISONS AND WEIGHT OF EVIDENCE SCORE
MATTAWOMAN CREEK INVESTIGATION
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Versus Reference Stations[1]		Versus Upgradient Stations[1]		Versus Combined Ref/Up Stations		Versus Control Samples		Overall Weight of Evidence Score
	Lower Mean Survival	Lower Mean Growth	Lower Mean Survival	Lower Mean Growth	Lower Mean Survival	Lower Mean Growth	Lower Mean Survival	Lower Mean Growth	
MTCSD001	*						*		1
MTCSD002									0
MTCSD002D									0
MTCSD003	*				*		*		2
MTCSD004							*		1
MTCSD009	*						*		1
MTCSD010	*				*		*		2
MTCSD011	*						*		1
MTCSD012									0
MTCSD012D									0
MTCSD013									0
MTCSD014							*		1
MTCSD015	*						*		1
MTCSD016							*		1
MTCSD017	*	*	*	*	*	*	*	*	3
MTCSD018							*		1
MTCSD019	*						*		1
MTCSD020							*		1
MTCSD023							*		1
MTCSD023D							*	*	1
MTCSD024							*		1
MTCSD025	*						*		1
MTCSD026	*	*	*	*	*	*	*	*	3
MTCSD026D	*	*	*	*	*	*	*	*	3

Notes:
Statistical comparisons are presented in Appendix C-6
* Indicates that the results in the site sample are statistically lower than the results in the samples to which they are being compared
1 - These values are not used in the weight of evidence scoring; They are presented for informational purposes only.
The upgradient stations consist of samples MTCSD027 and 028; The reference stations consist of samples NJCSD001 and 002

Overall Weight of Evidence Score
0 - Survival or growth in site samples are similar to or greater than in control samples
1 - Survival or growth in site samples are lower than in control samples, but survival and growth in site samples is similar to or greater than in combined reference/upgradient samples.
2 - Survival or growth in site samples are lower than in control samples, and survival (but not growth) in site samples is lower than in combined reference/upgradient samples.
3 - Survival and growth in site samples are lower than in control samples, and survival and growth in site samples are lower than in combined reference/upgradient samples.

TABLE 5-16

SUMMARY OF BENTHIC COMMUNITY METRICS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Area	Total Number of Organisms	Total Number of Taxa	Biotic Index	Shannon Diversity Index	Percent Dominant Taxon
Site Samples						
MTCSD00101	1	38	7	6.0	1.55	71.1
MTCSD00201		25	2	5.3	0.24	96.0
MTCSD00201D		19	4	5.2	1.06	78.9
MTCSD00301		133	16	7.0	2.84	45.1
MTCSD00401		13	5	7.2	1.70	61.5
MTCSD00901	2	25	10	5.4	2.38	32.0
MTCSD01001		118	18	5.4	2.73	46.6
MTCSD01101		33	10	6.4	2.38	36.4
MTCSD01201		241	14	7.8	1.77	52.7
MTCSD01201D		307	22	7.8	2.52	41.0
MTCSD01301	3	90	19	7.3	3.20	34.4
MTCSD01401		13	6	5.6	1.85	61.5
MTCSD01501		20	6	6.7	2.09	50.0
MTCSD01601		26	13	7.6	3.43	19.2
MTCSD01701	4	237	12	4.4	1.05	84.8
MTCSD01801		10	7	6.7	2.65	30.0
MTCSD01901		7	4	7.7	1.84	42.9
MTCSD02001		31	8	6.8	2.55	38.7
MTCSD02301	5	89	23	7.5	4.05	19.1
MTCSD02301D		18	5	6.9	1.39	72.2
MTCSD02401		33	7	7.9	2.44	33.3
MTCSD02501		95	13	6.3	2.59	27.4
MTCSD02601		1	1	7.1	0.00	100.0
MTCSD02601D		1	1	6.9	0.00	100.0
Upgradient/Reference Samples						
MTCSD02701	6	40	7	6.7	1.77	60.0
MTCSD02801		25	10	7.6	2.88	32.0
NJCSD00101	7	86	14	8.1	2.09	66.3
NJCSD00201		15	4	N/A	1.04	80.0

These indices were calculated as described in Section 5.6.1.3 of this report.
N/A - A biotic index could not be calculated for this sample because none of the organisms identified in this sample had an established tolerance index (see Appendix C-8)

TABLE 5-17

SUMMARY OF BIOLOGICAL CONDITION AT EACH STATION BASED ON BENTHIC COMMUNITY DATA
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Comparison to Which Area	Number of Organisms	*Score*	Number of Taxa	*Score*	Biotic Index	*Score*	Diversity Index	*Score*	Composite Score (%)	New Biological Condition	Overall Biological Condition	Overall Biological Condition
MTCSD00101	Upgradient(1)	117	***6***	82	***6***	120	***6***	149.8	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	75	***4***	78	***4***	67	***2***	100.6	***6***	67	Slightly impaired		
	Combined(3)	92	***6***	80	***4***	94	***6***	125.2	***6***	92	Non-impaired		
MTCSD00201	Upgradient(1)	77	***4***	24	***0***	134	***6***	961.8	***6***	67	Slightly impaired	Slightly impaired	2
	Reference(2)	50	***2***	22	***0***	75	***4***	645.9	***6***	50	Moderately impaired		
	Combined(3)	60	***4***	23	***0***	105	***6***	803.8	***6***	67	Slightly impaired		
MTCSD00201D	Upgradient(1)	58	***2***	47	***2***	139	***6***	220.0	***6***	67	Slightly impaired	Slightly impaired	2
	Reference(2)	38	***0***	44	***2***	78	***4***	147.7	***6***	50	Moderately impaired		
	Combined(3)	46	***2***	46	***2***	108	***6***	183.9	***6***	67	Slightly impaired		
MTCSD00301	Upgradient(1)	409	***6***	188	***6***	103	***6***	81.8	***4***	92	Non-impaired	Slightly impaired	2
	Reference(2)	263	***6***	178	***6***	58	***2***	55.0	***2***	67	Slightly impaired		
	Combined(3)	320	***6***	183	***6***	80	***4***	68.4	***2***	75	Slightly impaired		
MTCSD00401	Upgradient(1)	40	***2***	59	***2***	100	***6***	136.9	***6***	67	Slightly impaired	Moderately impaired	4
	Reference(2)	26	***0***	56	***2***	56	***2***	91.9	***6***	42	Moderately impaired		
	Combined(3)	31	***0***	57	***2***	78	***4***	114.4	***6***	50	Moderately impaired		
MTCSD00901	Upgradient(1)	77	***4***	118	***6***	134	***6***	97.9	***6***	92	Non-impaired	Non-impaired	0
	Reference(2)	50	***2***	111	***6***	75	***4***	65.7	***2***	58	Slightly impaired		
	Combined(3)	60	***4***	114	***6***	104	***6***	81.8	***4***	83	Non-impaired		
MTCSD01001	Upgradient(1)	363	***6***	212	***6***	133	***6***	85.2	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	234	***6***	200	***6***	75	***4***	57.2	***2***	75	Slightly impaired		
	Combined(3)	284	***6***	206	***6***	104	***6***	71.2	***4***	92	Non-impaired		
MTCSD01101	Upgradient(1)	102	***6***	118	***6***	112	***6***	97.9	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	65	***4***	111	***6***	63	***2***	65.8	***2***	58	Slightly impaired		
	Combined(3)	80	***4***	114	***6***	87	***6***	81.8	***4***	83	Non-impaired		
MTCSD01201	Upgradient(1)	742	***6***	165	***6***	92	***6***	131.3	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	477	***6***	156	***6***	51	***2***	88.2	***6***	83	Non-impaired		
	Combined(3)	581	***6***	160	***6***	71	***4***	109.8	***6***	92	Non-impaired		

TABLE 5-17

SUMMARY OF BIOLOGICAL CONDITION AT EACH STATION BASED ON BENTHIC COMMUNITY DATA
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Comparison to Which Area	Number of Organisms	*Score*	Number of Taxa	*Score*	Biotic Index	*Score*	Diversity Index	*Score*	Composite Score (%)	New Biological Condition	Overall Biological Condition	Overall Biological Condition
MTCSD01201D	Upgradient(1)	945	***6***	259	***6***	92	***6***	92.5	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	608	***6***	244	***6***	52	***2***	62.1	***2***	67	Slightly impaired		
	Combined(3)	740	***6***	251	***6***	72	***4***	77.3	***4***	83	Non-impaired		
MTCSD01301	Upgradient(1)	277	***6***	224	***6***	99	***6***	72.8	***4***	92	Non-impaired	Slightly impaired	2
	Reference(2)	178	***6***	211	***6***	56	***2***	48.9	***0***	58	Slightly impaired		
	Combined(3)	217	***6***	217	***6***	77	***4***	60.8	***2***	75	Slightly impaired		
MTCSD01401	Upgradient(1)	40	***2***	71	***4***	127	***6***	125.5	***6***	75	Slightly impaired	Slightly impaired	2
	Reference(2)	26	***0***	67	***4***	71	***4***	84.3	***4***	50	Moderately impaired		
	Combined(3)	31	***0***	69	***4***	99	***6***	104.9	***6***	67	Slightly impaired		
MTCSD01501	Upgradient(1)	62	***4***	71	***4***	107	***6***	111.6	***6***	83	Non-impaired	Slightly impaired	2
	Reference(2)	40	***0***	67	***4***	60	***2***	75.0	***4***	42	Moderately impaired		
	Combined(3)	48	***2***	69	***4***	83	***4***	93.3	***6***	67	Slightly impaired		
MTCSD01601	Upgradient(1)	80	***4***	153	***6***	95	***6***	67.9	***2***	75	Slightly impaired	Slightly impaired	2
	Reference(2)	51	***2***	144	***6***	53	***2***	45.6	***0***	42	Moderately impaired		
	Combined(3)	63	***4***	149	***6***	74	***4***	56.8	***2***	67	Slightly impaired		
MTCSD01701	Upgradient(1)	729	***6***	141	***6***	161	***6***	221.2	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	469	***6***	133	***6***	91	***6***	148.6	***6***	100	Non-impaired		
	Combined(3)	571	***6***	137	***6***	126	***6***	184.9	***6***	100	Non-impaired		
MTCSD01801	Upgradient(1)	31	***0***	82	***6***	106	***6***	88.0	***6***	75	Slightly impaired	Moderately impaired	4
	Reference(2)	20	***0***	78	***4***	60	***2***	59.1	***2***	33	Moderately impaired		
	Combined(3)	24	***0***	80	***4***	83	***4***	73.5	***4***	50	Moderately impaired		
MTCSD01901	Upgradient(1)	22	***0***	47	***2***	93	***6***	126.4	***6***	58	Slightly impaired	Moderately impaired	4
	Reference(2)	14	***0***	44	***2***	52	***2***	84.9	***4***	33	Moderately impaired		
	Combined(3)	17	***0***	46	***2***	72	***4***	105.6	***6***	50	Moderately impaired		
MTCSD02001	Upgradient(1)	95	***6***	94	***6***	106	***6***	91.4	***6***	100	Non-impaired	Slightly impaired	2
	Reference(2)	61	***4***	89	***6***	60	***2***	61.4	***2***	58	Slightly impaired		
	Combined(3)	75	***4***	91	***6***	83	***4***	76.4	***4***	75	Slightly impaired		

TABLE 5-17

SUMMARY OF BIOLOGICAL CONDITION AT EACH STATION BASED ON BENTHIC COMMUNITY DATA
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Comparison to Which Area	Number of Organisms	*Score*	Number of Taxa	*Score*	Biotic Index	*Score*	Diversity Index	*Score*	Composite Score (%)	New Biological Condition	Overall Biological Condition	Overall Biological Condition
MTCSD02301	Upgradient(1)	274	***6***	271	***6***	96	***6***	57.4	***2***	83	Non-impaired	Slightly impaired	2
	Reference(2)	176	***6***	256	***6***	54	***2***	38.6	***0***	58	Slightly impaired		
	Combined(3)	214	***6***	263	***6***	75	***4***	48.0	***0***	67	Slightly impaired		
MTCSD02301D	Upgradient(1)	55	***2***	59	***2***	105	***6***	167.9	***6***	67	Slightly impaired	Slightly impaired	2
	Reference(2)	36	***0***	56	***2***	59	***2***	112.8	***6***	42	Moderately impaired		
	Combined(3)	43	***2***	57	***2***	82	***4***	140.3	***6***	58	Slightly impaired		
MTCSD02401	Upgradient(1)	102	***6***	82	***6***	91	***6***	95.5	***6***	100	Non-impaired	Slightly impaired	2
	Reference(2)	65	***4***	78	***4***	51	***2***	64.1	***2***	50	Moderately impaired		
	Combined(3)	80	***4***	80	***4***	71	***4***	79.8	***4***	67	Slightly impaired		
MTCSD02501	Upgradient(1)	292	***6***	153	***6***	113	***6***	90.0	***6***	100	Non-impaired	Non-impaired	0
	Reference(2)	188	***6***	144	***6***	64	***2***	60.4	***2***	67	Slightly impaired		
	Combined(3)	229	***6***	149	***6***	88	***6***	75.2	***4***	92	Non-impaired		
MTCSD02601	Upgradient(1)	3	***0***	12	***0***	101	***6***	NA	***0***	25	Moderately impaired	Severely impaired	6
	Reference(2)	2	***0***	11	***0***	57	***2***	NA	***0***	8	Severely impaired		
	Combined(3)	2	***0***	11	***0***	79	***4***	NA	***0***	17	Severely impaired		
MTCSD02601D	Upgradient(1)	3	***0***	12	***0***	104	***6***	NA	***0***	25	Moderately impaired	Severely impaired	6
	Reference(2)	2	***0***	11	***0***	59	***2***	NA	***0***	8	Severely impaired		
	Combined(3)	2	***0***	11	***0***	82	***4***	NA	***0***	17	Severely impaired		

1 - Upgradient samples are MTCSD02701 and -02801
2 - Reference samples are NJCSD00101 and -00201
3 - Combined data set included 4 upgradient samples and reference samples

TABLE 5-18

OVERALL BENTHIC MACROINVERTEBRATE BOLOGICAL SCORE
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Sample Number	Weight of Evidence Score For Each Benthic Invertebrate Measurement Endpoint			Overall Score[4]	Potential Risks to Benthic Invertebrates[5]
	Sediment Chemistry[1]	Sediment Toxicity Test[2]	Benthic Community[3]		
MTCSD00101	0	1	0	0.3	Negligable Risk
MTCSD00201	0	0	2	0.7	Negligable Risk
MTCSD00201D	0	0	2	0.7	Negligable Risk
MTCSD00301	0	2	2	1.3	Slight Risk
MTCSD00401	2	1	4	2.3	Moderate Risk
MTCSD00901	2	1	0	1.0	Negligable Risk
MTCSD01001	2	2	0	1.3	Slight Risk
MTCSD01101	0	1	0	0.3	Negligable Risk
MTCSD01201	0	0	0	0.0	Negligable Risk
MTCSD01201D	2	0	0	0.7	Negligable Risk
MTCSD01301	0	0	2	0.7	Negligable Risk
MTCSD01401	0	1	2	1.0	Negligable Risk
MTCSD01501	4	1	2	2.3	Moderate Risk
MTCSD01601	2	1	2	1.7	Slight Risk
MTCSD01701	0	3	0	1.0	Negligable Risk
MTCSD01801	2	1	4	2.3	Moderate Risk
MTCSD01901	2	1	4	2.3	Moderate Risk
MTCSD02001	0	1	2	1.0	Negligable Risk
MTCSD02301	2	1	2	1.7	Slight Risk
MTCSD02301D	4	1	2	2.3	Moderate Risk
MTCSD02401	0	1	2	1.0	Negligable Risk
MTCSD02501	0	1	0	0.3	Negligable Risk
MTCSD02601	6	3	6	5.0	High Risk
MTCSD02601D	6	3	6	5.0	High Risk

Notes:
1 - See Table 5-12 for calculation of sediment chemistry score
2 - See Table 5-15 for calculation of sediment toxicity test score
3 - See Table 5-17 for calculation of benthic communty score
4 - Calculated by averaging scores for individual measurement endpoints
5 - Risks to benthic macroinvertebrates were classified as follows:
- 0 to 1 = Negligable risk
- 1.1 to 2 = Slight risk
- 2.1 to 4 = Moderate risk
- 4.1 to 5 = High risk

TABLE 5-19

TERRESTRIAL WILDLIFE MODEL EEQS-AVERAGE INPUTS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARLYAND

Parameter	Great Blue Heron NOAEL EEQs	Great Blue Heron LOAEL EEQs	Mallard Duck NOAEL EEQs	Mallard Duck LOAEL EEQs	Mink NOAEL EEQs	Mink LOAEL EEQs
PESTICIDES/PCBS						
4,4'-DDE	3.7E-01	3.7E-02	2.0E-02	2.0E-03	1.2E-03	2.3E-04
INORGANICS						
Arsenic	1.2E-01	4.1E-02	5.0E-02	1.7E-02	2.2E+00	2.2E-01
Cadmium	1.7E-02	1.2E-03	5.4E-02	3.9E-03	2.2E-02	2.2E-03
Chromium	2.8E-01	5.6E-02	4.5E-01	9.0E-02	7.7E-02	1.9E-02
Lead	4.2E+00	4.2E-01	2.3E+01	2.3E+00	5.4E-01	5.4E-02
Mercury	3.6E-01	3.6E-02	8.5E-01	8.5E-02	1.4E-01	8.4E-02
Silver	1.2E-02	1.2E-03	2.7E-02	2.7E-03	2.4E-02	2.4E-03
Zinc	9.5E-01	1.1E-01	1.7E+00	1.9E-01	6.8E-02	3.4E-02

Notes:
Cells are shaded if the EEQ is greater than 1.0.
This table only presents the chemicals that had EEQs greater than 1.0 using the conservative inputs (Table 5-9)
EEQ - Ecological Effects Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

TABLE 5-20

SUMMARY OF FISH TISSUE TRVS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Chemical	Maximum Whole Body Concentration (mg/kg)	Maximum Fillet Concentration (mg/kg)	5% FTRV (mg/kg)	50% FTRV (mg/kg)
1,3-Dinitrobenzene	ND	0.057	4.6[(1)]	22.9[(1)]
2-Amino-4,6-dinitrotoluene	ND	0.096	NA	NA
HMX	ND	0.093	NA	NA
Nitrocellulose	ND	5.7	NA	NA
Nitroglycerin	0.22	ND	NA	NA
Nitroguanidine	0.068	0.19	NA	NA
4,4'-DDD	0.0039	ND	0.44	13.2
4,4'-DDE	0.017	0.11	0.44	13.2
Dieldrin	ND	0.0073	0.548[(1)]	3.7[(1)]
Endosulfan I	ND	0.0021	0.014	0.21
Endrin	ND	0.005	0.051	0.72
Gamma-chlordane	ND	0.0085	1.38[(1)]	3.18[(1)]
Aroclor-1260	0.13	0.38	1.45	48.6
Arsenic	2	Not a COPC	2.4	5.8
Cadmium	0.025	0.034	0.044	1.2
Chromium	6.6	6.2	5.5[(1)]	1[(1)]
Copper	ND	3.6	0.76	7.5
Lead	0.41	1.1	2.5[(1)]	4[(1)]

The calculation of FTRVs is presented in Appendix C-10

NA - Not available
ND - Not detected
FTRV - Fish Tissue Reference Value

1 - Values are NOAEL (in 5% FTRV column) and LOAEL (in 50% FTRV column) because there was not enough data to generate a TRV

Navy Ecological Risk Assessment Tiered Approach

RPM Input and Risk Management Consideration[3]

Step 8: Risk Management

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to bench marks.

Step 1: Site visit; Pathway Identification/Problem Formulation; Toxicity Evaluation

Step 2: Exposure Estimate; Risk Calculation (SMDP)[1]

Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment: Decision for exiting or continuing the ecological risk assessment.

1) Site passes screening risk assessment. A determination is made that the site poses acceptable risk and shall be closed out for ecological concerns.

2) Site fails screening risk assessment: The site must have both complete pathway and unacceptable risk. As a result the site will either have an interim cleanup or moves to the second tier.

Tier 2. Baseline Ecological Risk Assessment (BERA): Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site specific values that are protective of the environment.

Step 3a: Refinement of Conservative Exposure Assumptions[2] (SRA)----**Proceed to Exit Criteria for Step 3a**

Step 3b: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)

Step 4: Study Design/DQO - Line of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)

Step 5: Verification of Field Sampling Design (SMDP)

Step 6: Site Investigation and Data Analysis (SMDP)

Step 7: Risk Characterization

Proceed to Exit Criteria for BERA

Exit Criteria Step 3 a Refinement

1) If re-evaluation of the conservative exposure assumptions (SRA) support an acceptable risk determination then the site exits the ecological risk assessment process.

2) If re-evaluation of the conservative exposure assumptions (SRA) do not support an acceptable risk determination then the site continues in the Baseline Ecological Risk Assessment process. **Proceed to Step 3b.**

Exit Criteria Baseline Risk Assessment

1) If the site poses acceptable risk then no further evaluation and no remediation from an ecological perspective is warranted.

2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to third tier.

Tier 3. Evaluation of Remedial Alternative (RAGs C)

a. Develop site specific risk based cleanup values.

B. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short term) impacts and estimate risk reduction provided by each (long-term) impacts; provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA 9 Evaluation Criteria. Plan for monitoring and site closeout.

Notes: 1) See EPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).

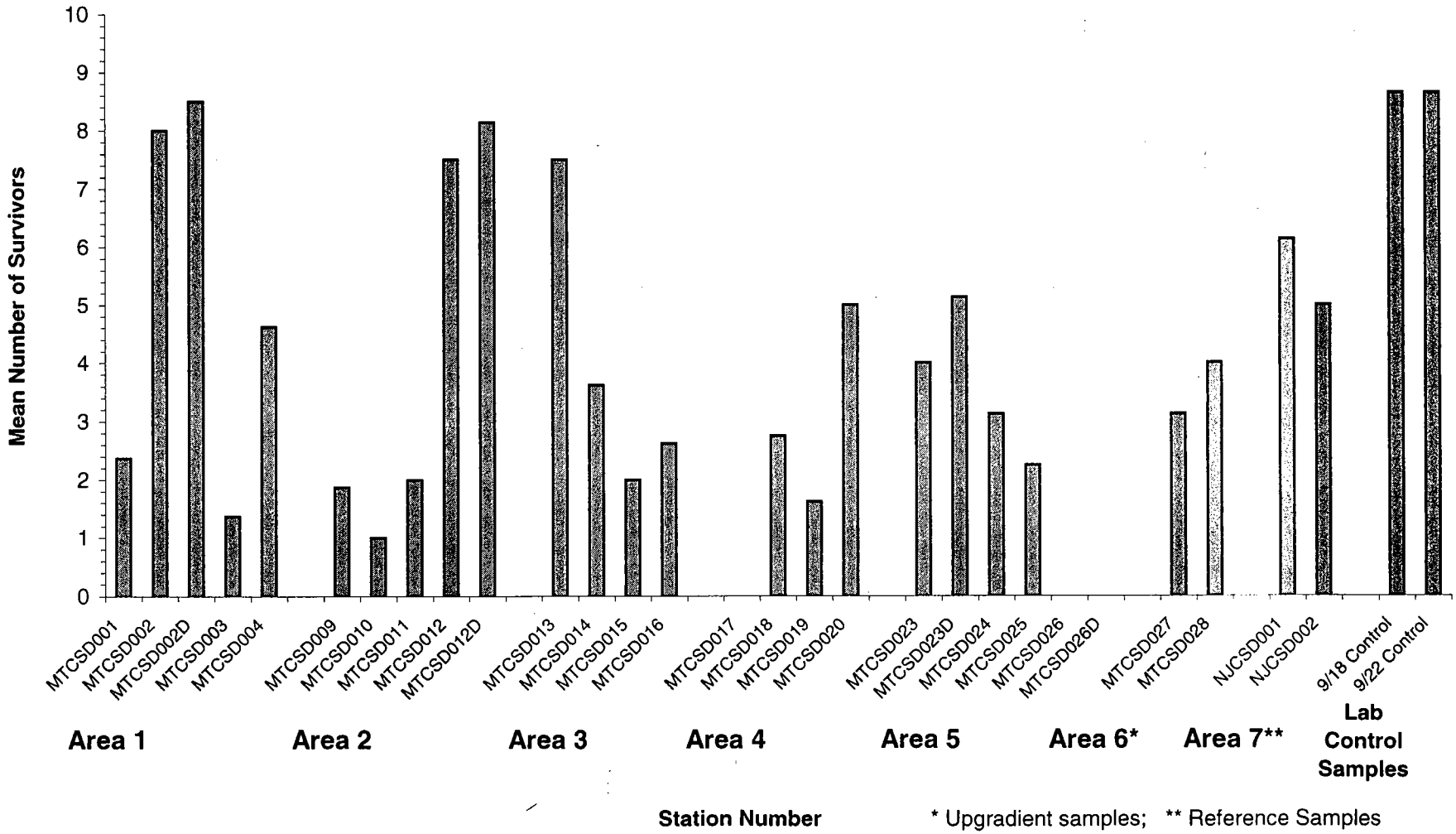
2) Refinement Includes but is not limited to background, bioavailability, detection frequency. Etc.

3) Risk Management is incorporated throughout the tiered approach.

FIGURE 5-1
NAVY TIERED APPROACH
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

FIGURE 5-2

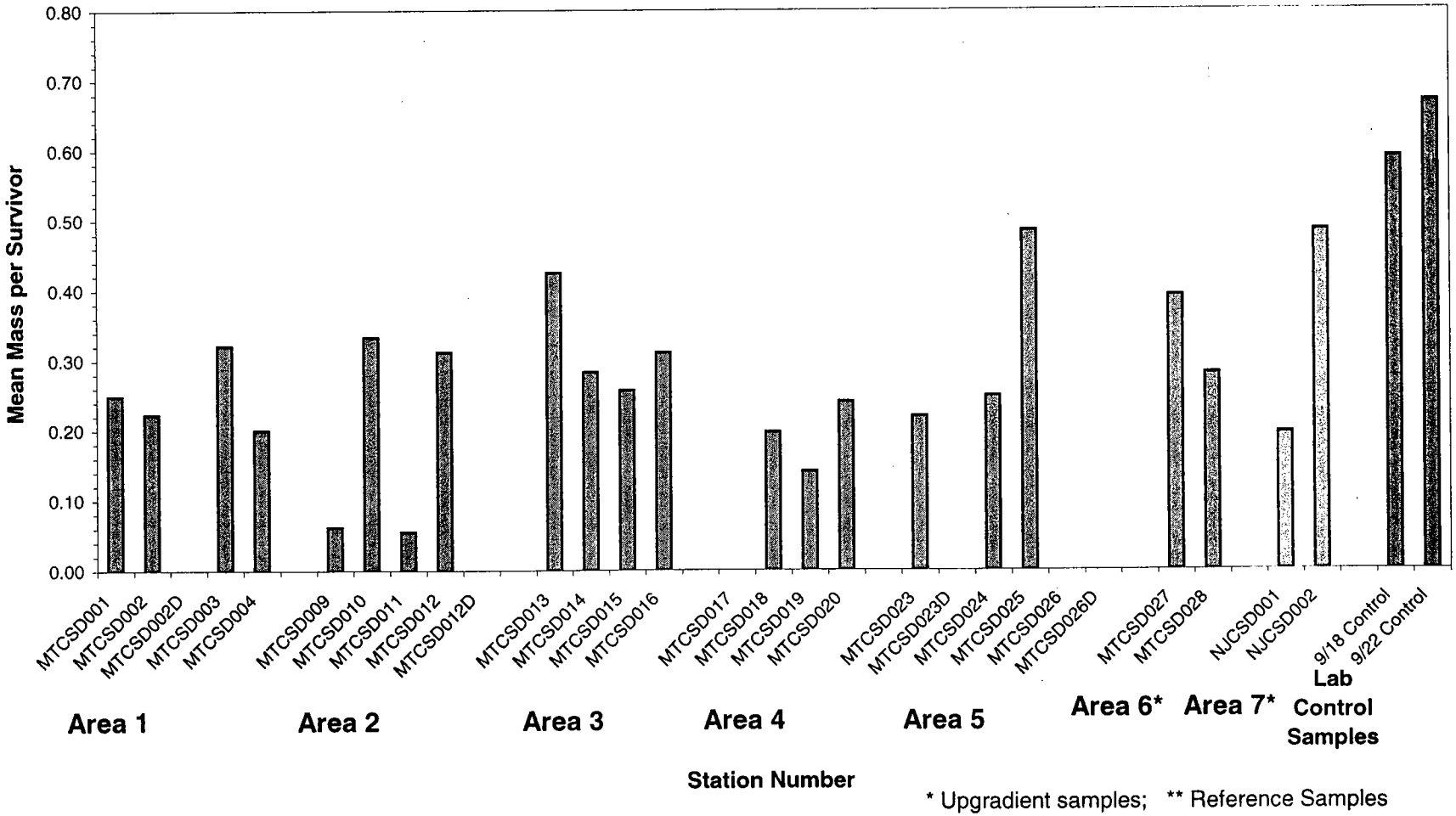
MEAN NUMBER OF SURVIVORS AT EACH STATION-AMPHIPOD TOXICITY TEST
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples

FIGURE 5-3

MEAN MASS PER SURVIVOR AT EACH STATION-AMPHIPOD TOXICITY TEST
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples

FIGURE 5-4

MEAN NUMBER OF SURVIVORS VS. PERCENT FINES-AMPHIPOD TOXICITY TEST
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

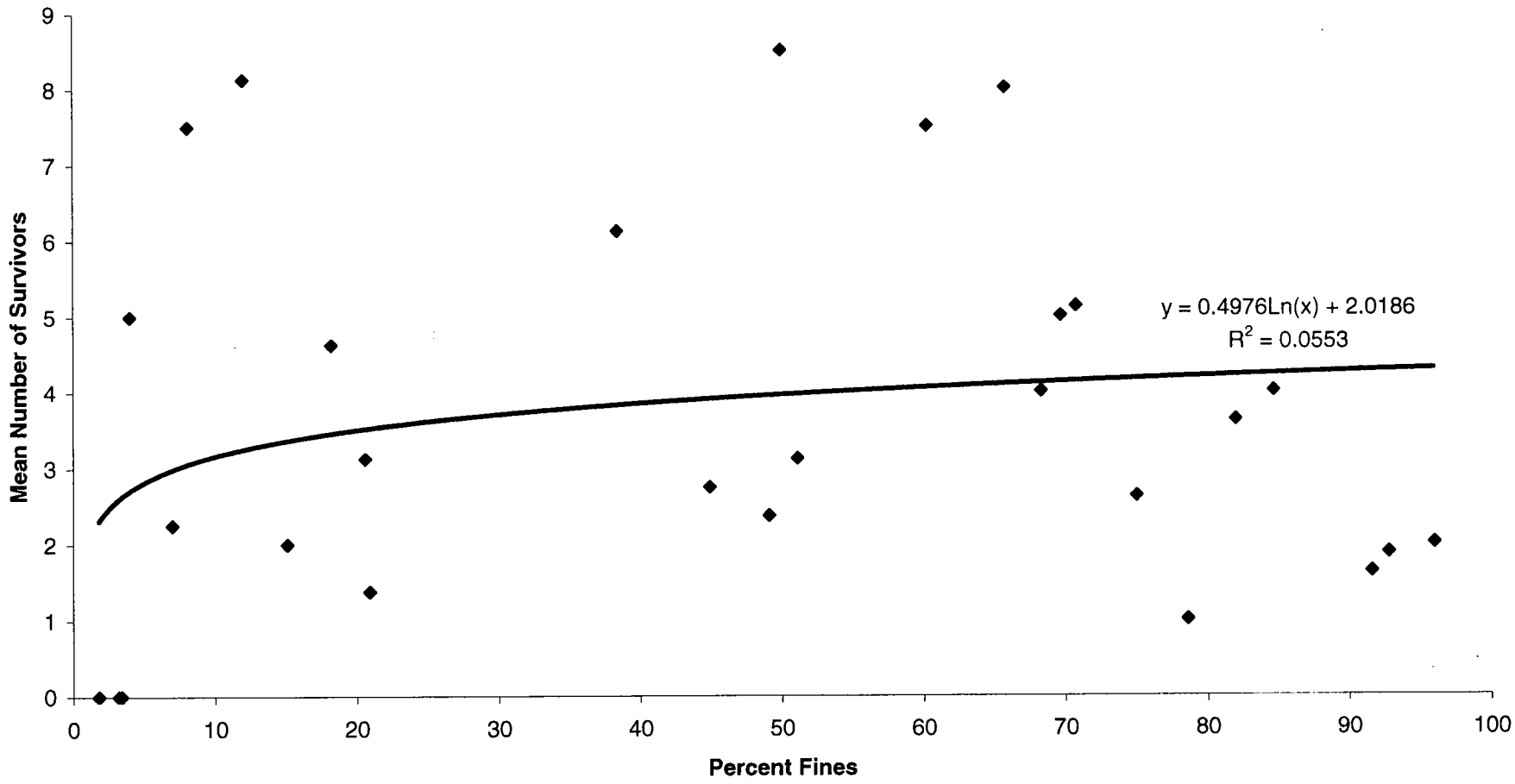


FIGURE 5-5

MEAN NUMBER OF SURVIVORS VS. MAXIMUM AMMONIA CONCENTRATION-
AMPHIPOD TOXICITY TEST
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

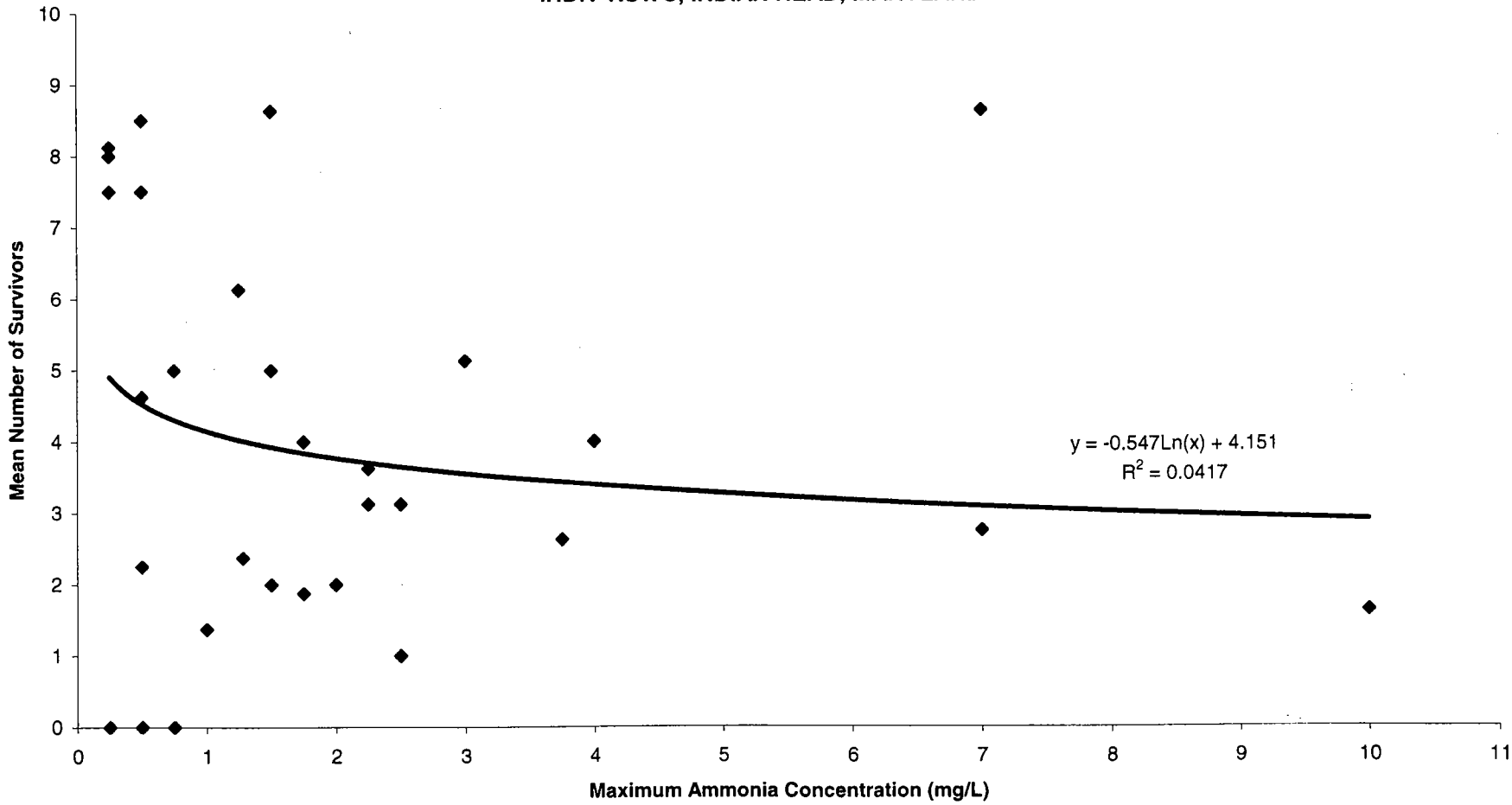


FIGURE 5-6

MEAN NUMBER OF SURVIVORS VS. MINIMUM DISSOLVED OXYGEN CONCENTRATION-
AMPHIPOD TOXICITY TEST
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

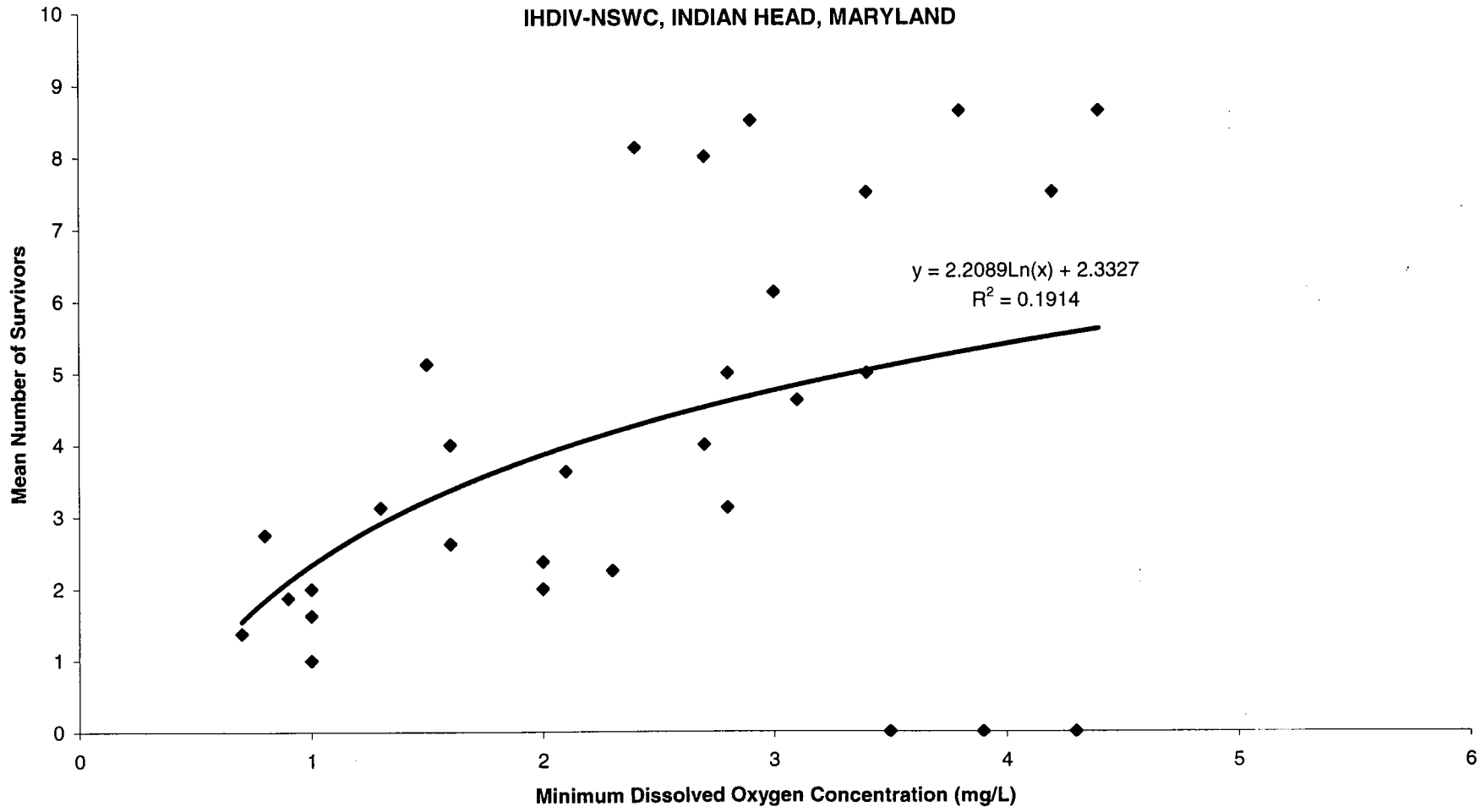


FIGURE 5-7

MEAN NUMBER OF SURVIVORS VS. PERCENT FINES
-AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

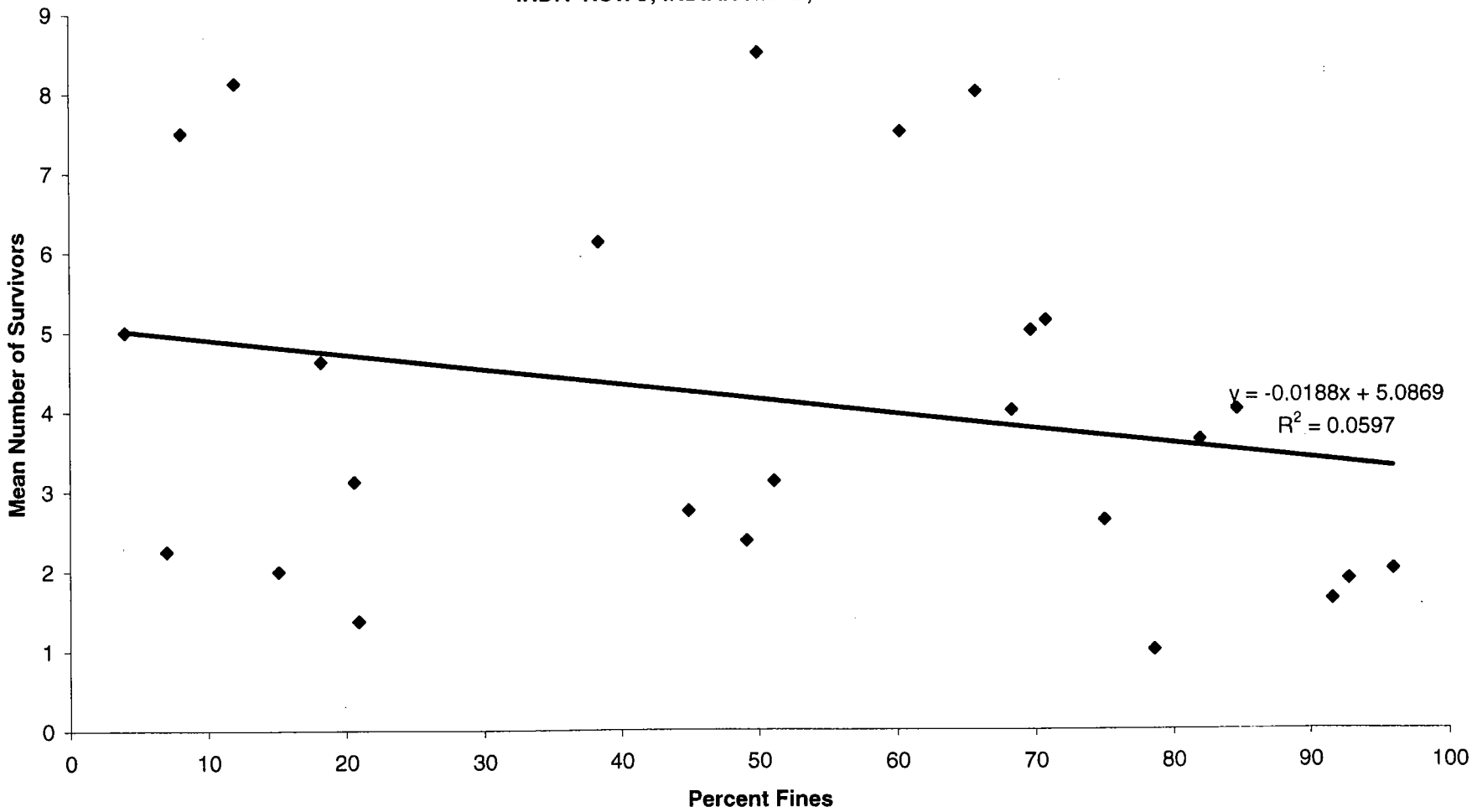


FIGURE 5-8

MEAN NUMBER OF SURVIVORS VS. MAXIMUM AMMONIA CONCENTRATION-
AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

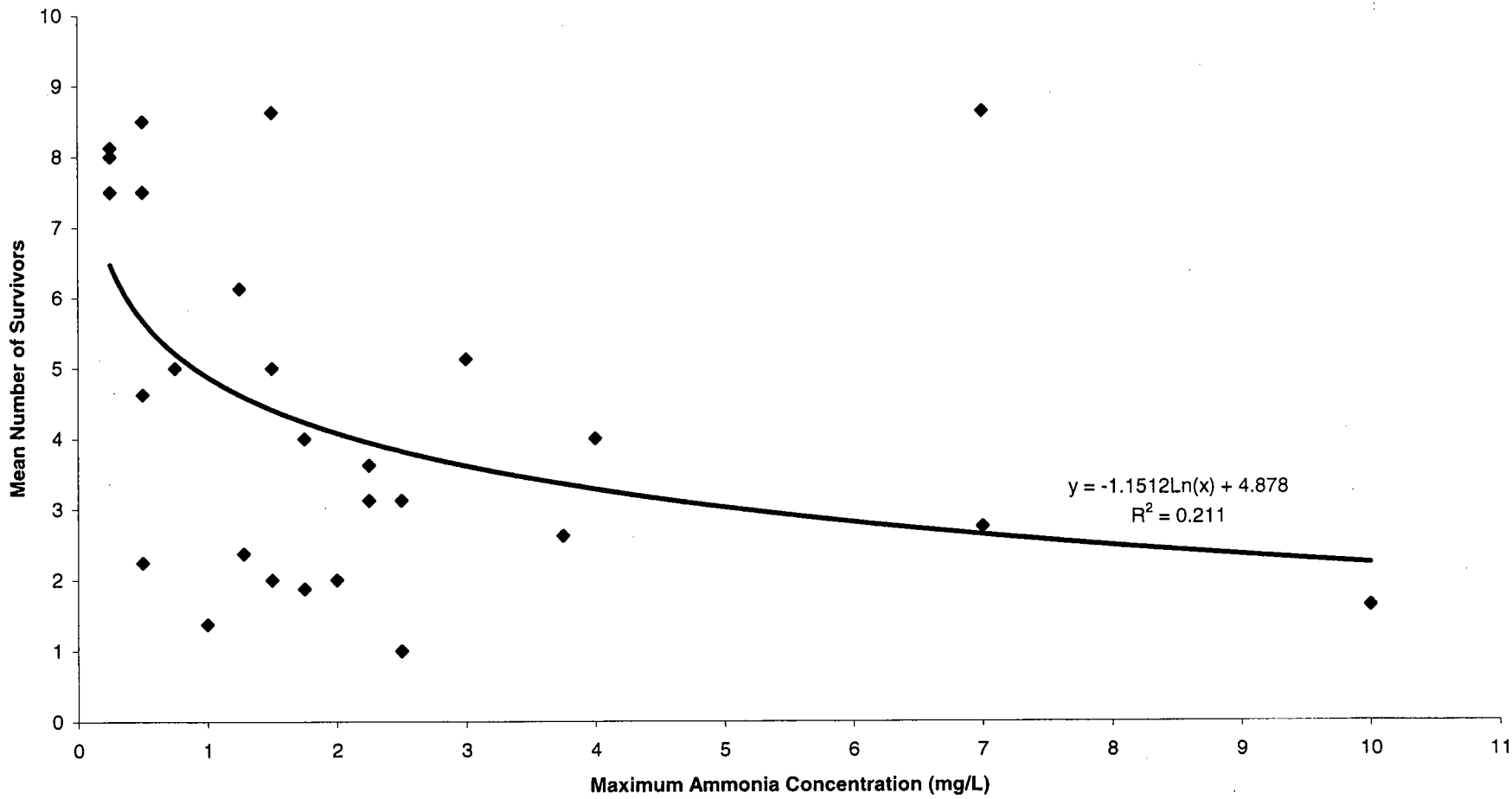


FIGURE 5-9

MEAN NUMBER OF SURVIVORS VS. MINIMUM DISSOLVED OXYGEN CONCENTRATION-AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

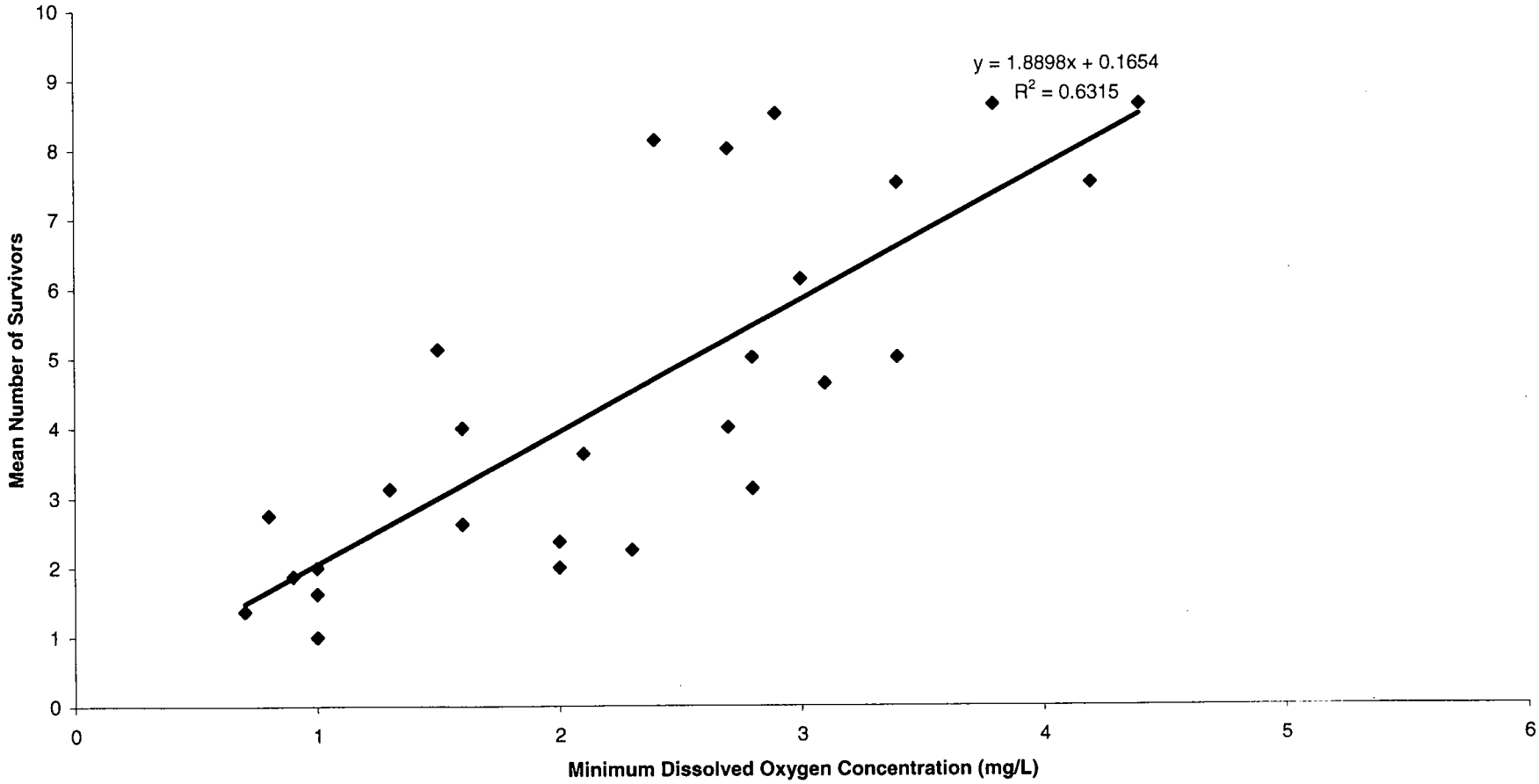


FIGURE 5-10

MEAN MASS PER SURVIVOR VS. PERCENT FINES-AMPHIPOD TOXICITY TEST
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

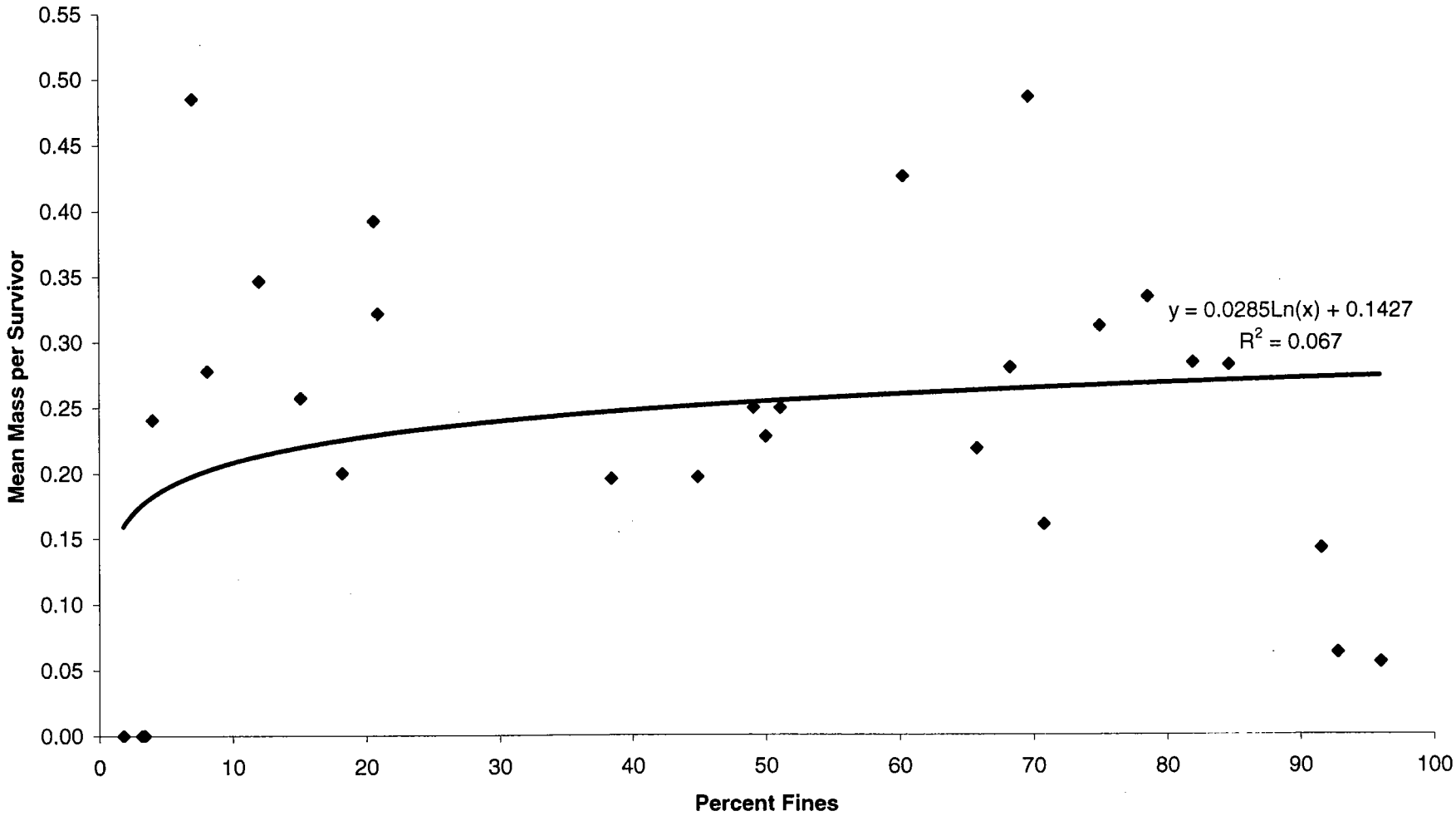


FIGURE 5-11

MEAN MASS PER SURVIVOR VS. MAXIMUM AMMONIA CONCENTRATION-
AMPHIPOD TOXICITY TEST
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

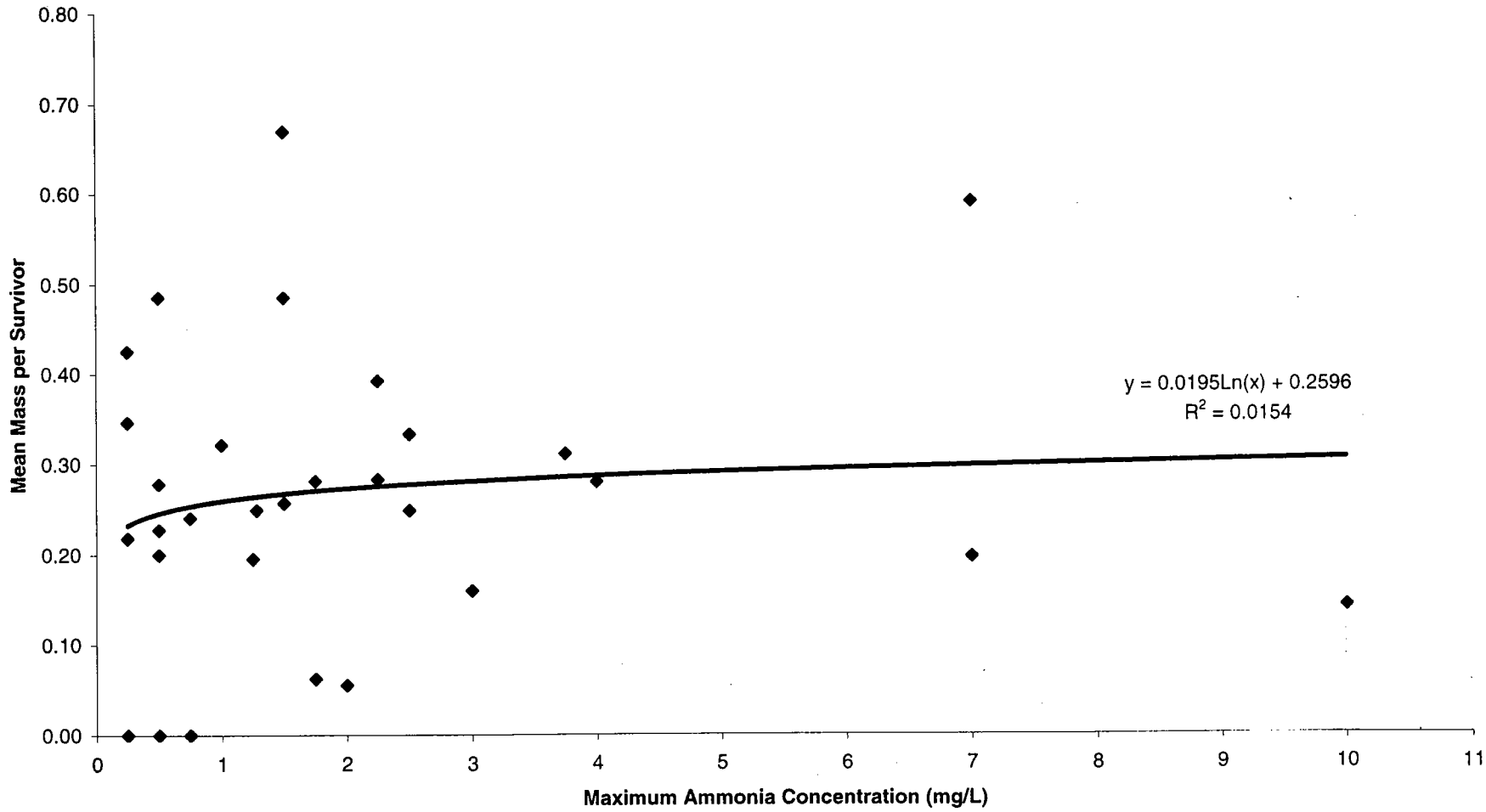


FIGURE 5-12

MEAN MASS PER SURVIVOR VS. MINIMUM DISSOLVED OXYGEN CONCENTRATION-AMPHIPOD TOXICITY TEST
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

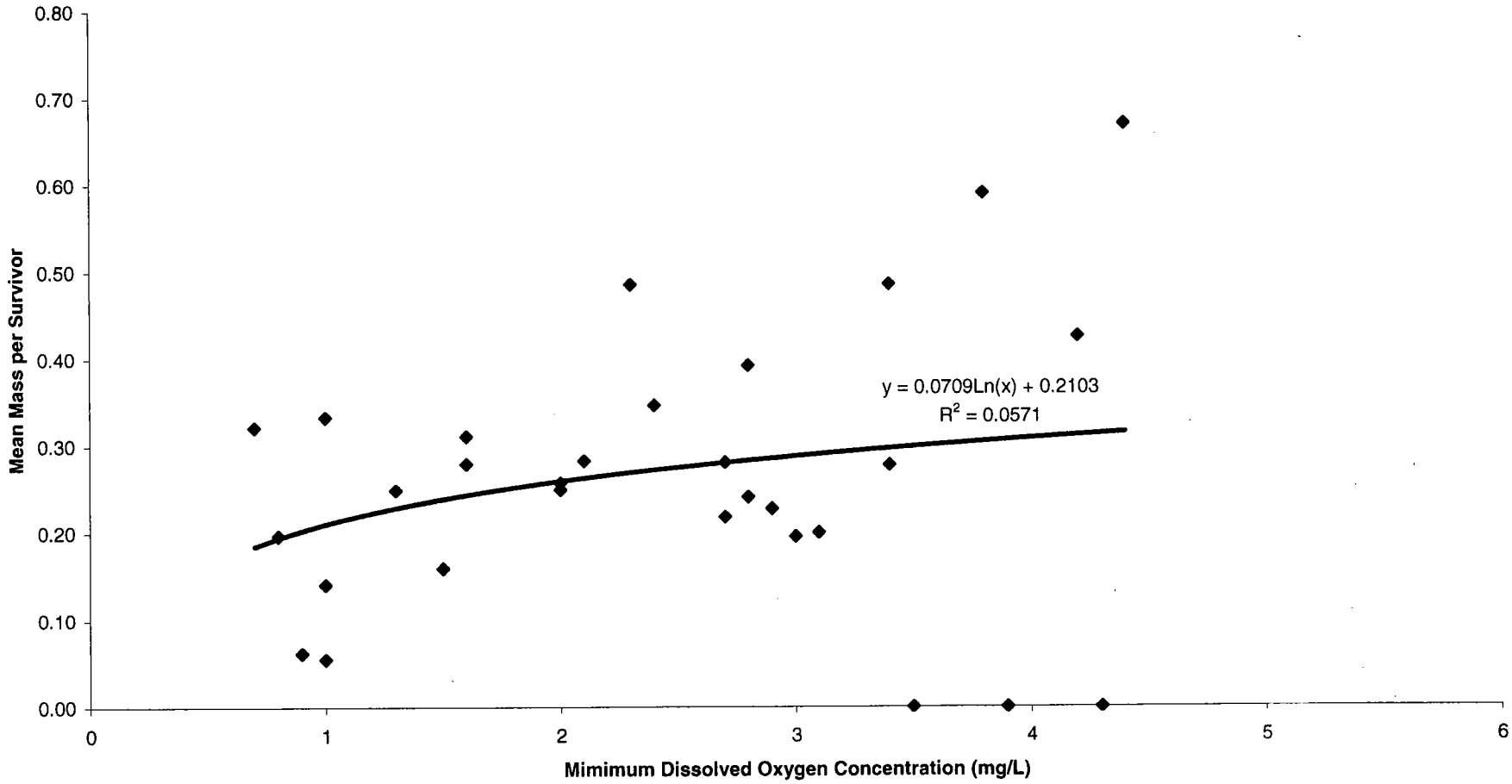


FIGURE 5-13

MEAN MASS PER SURVIVOR VS. PERCENT FINES-
AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

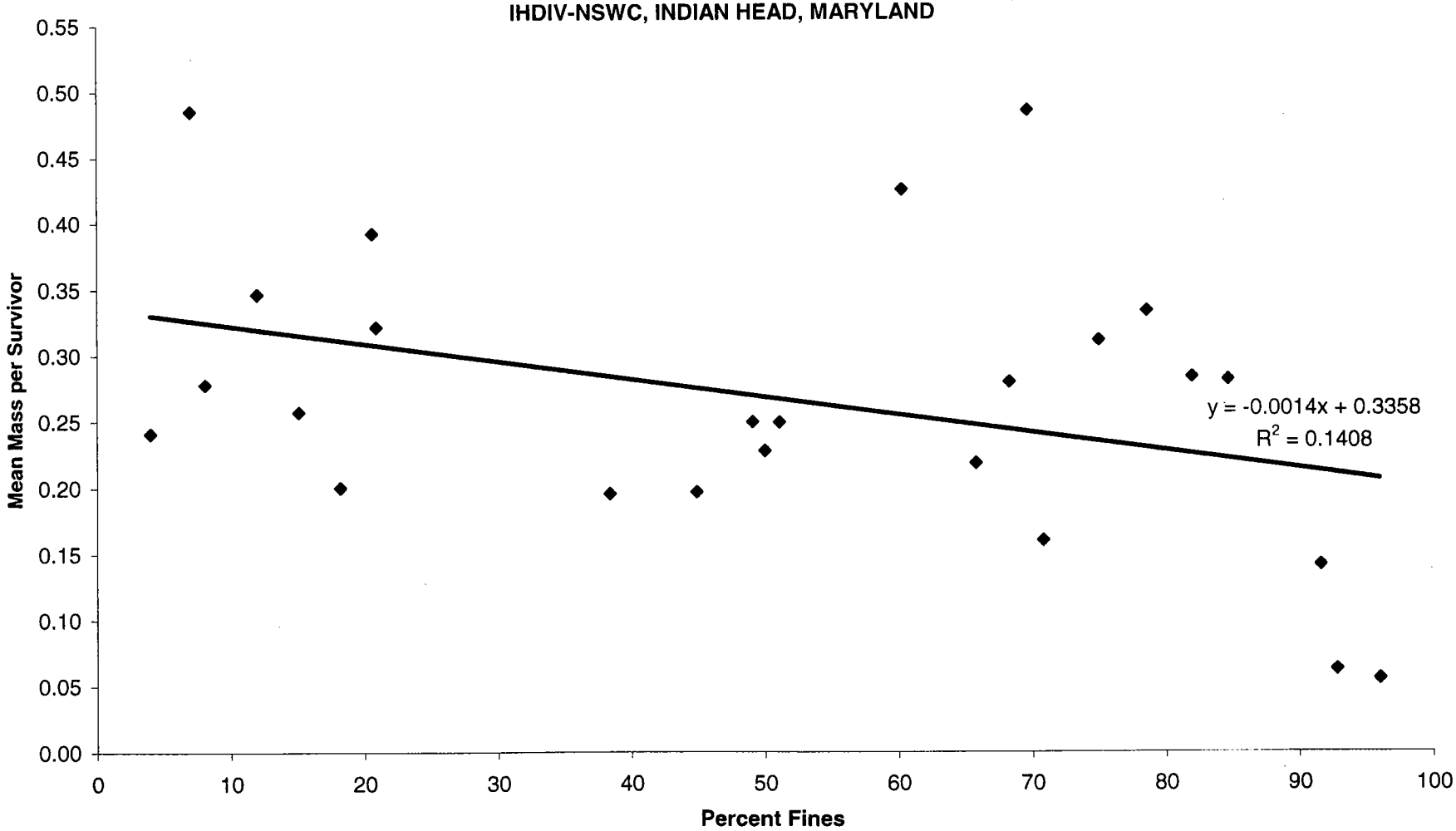


FIGURE 5-14

MEAN MASS PER SURVIVOR VS. MAXIMUM AMMONIA CONCENTRATION-
AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

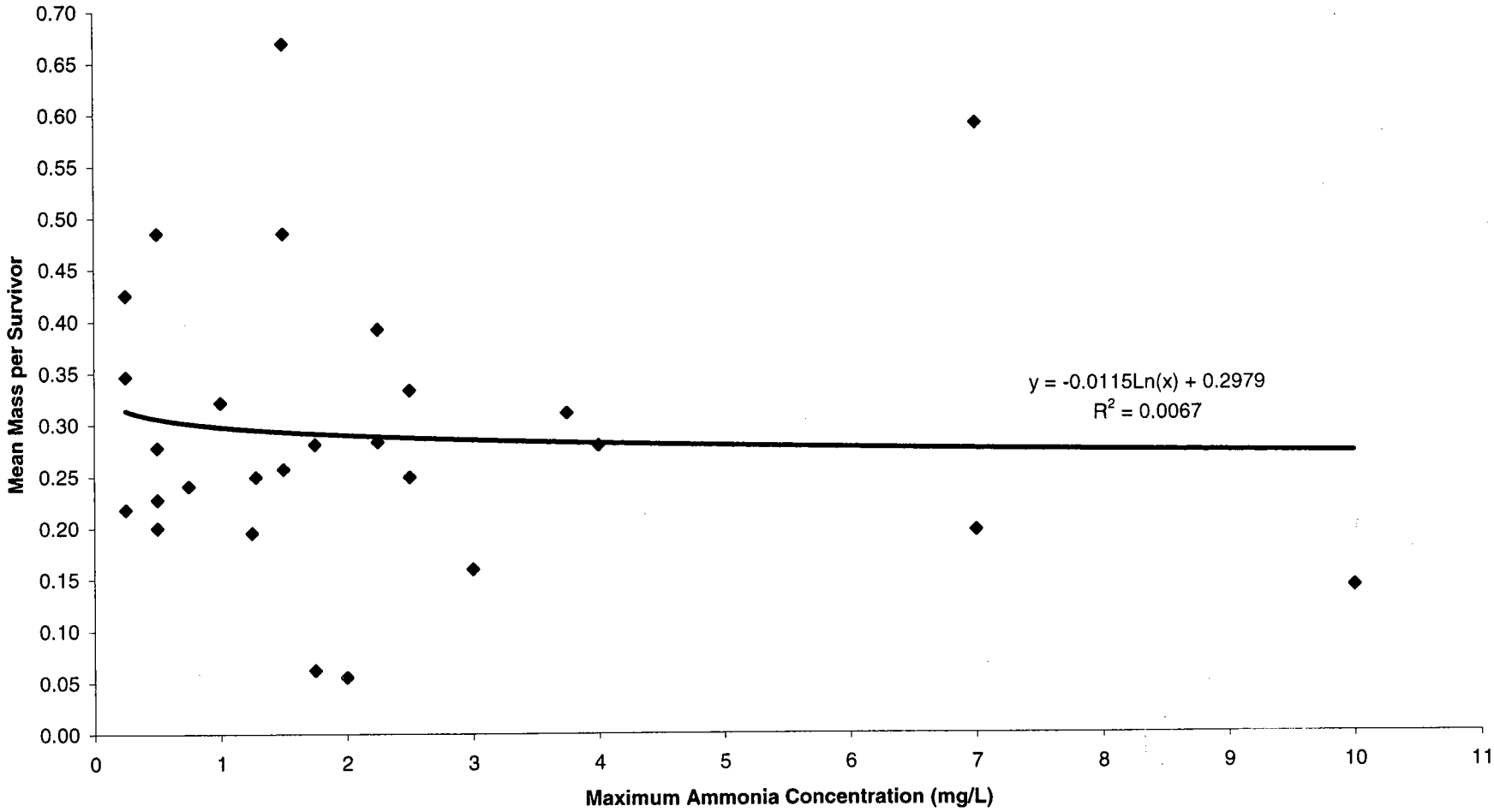


FIGURE 5-15

MEAN MASS PER SURVIVOR VS. MINIMUM DISSOLVED OXYGEN CONCENTRATION-
AMPHIPOD TOXICITY TEST (WITH MTCSD017 AND 026 REMOVED)
MATTAWOMEN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

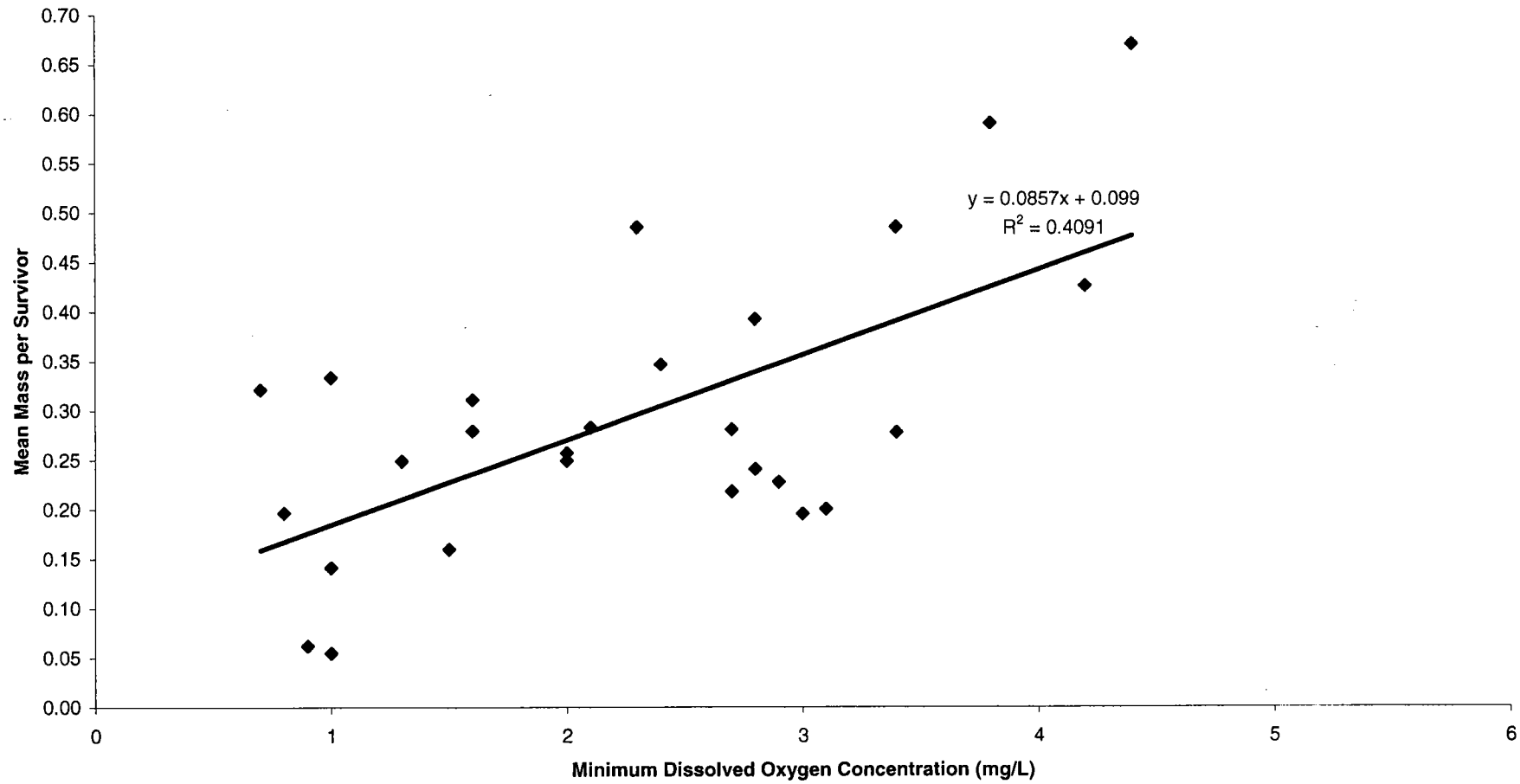
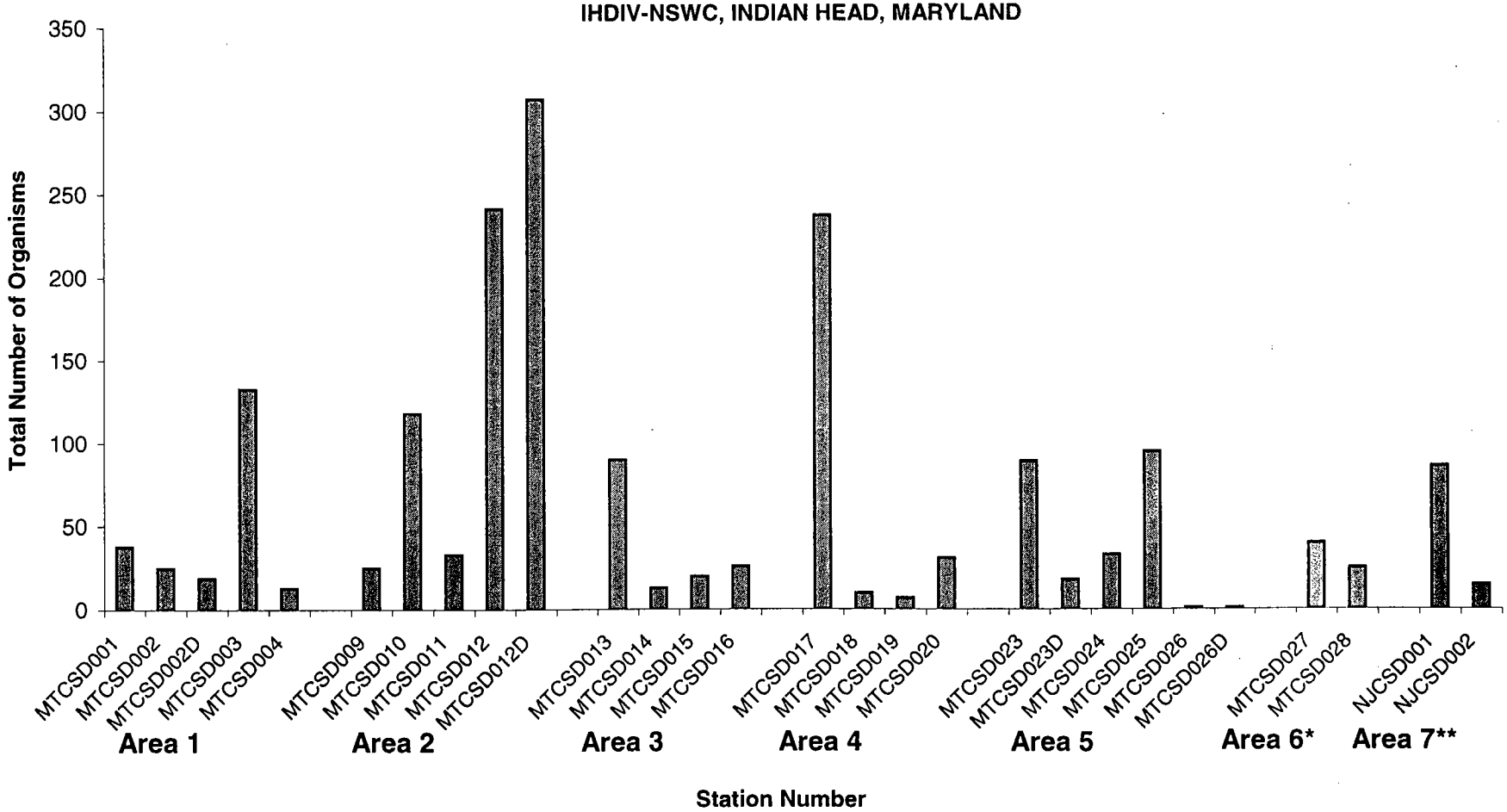


FIGURE 5-16

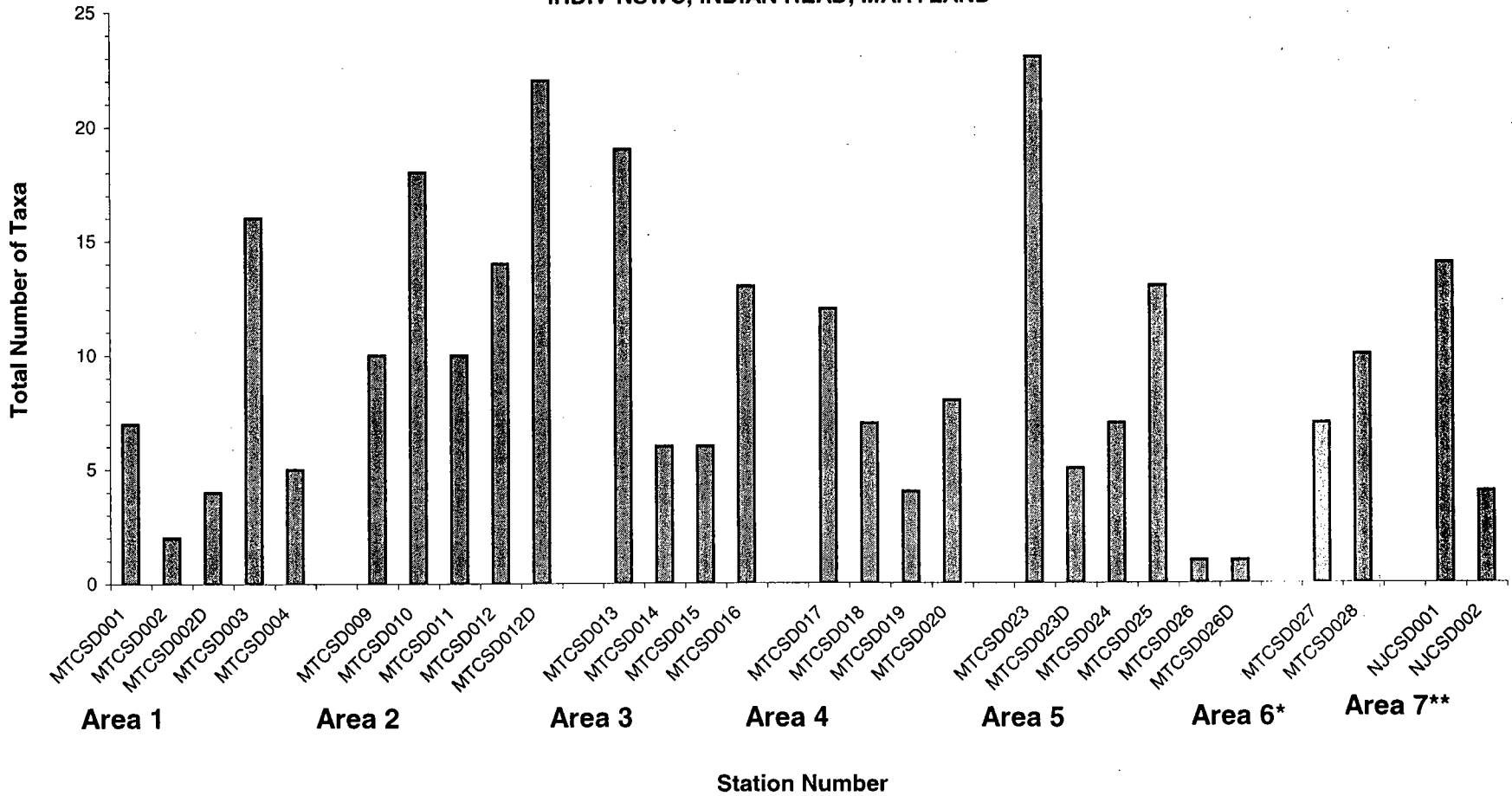
TOTAL NUMBER OF ORGANISMS AT EACH STATION-BENTHIC COMMUNITY STUDY
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples

FIGURE 5-17

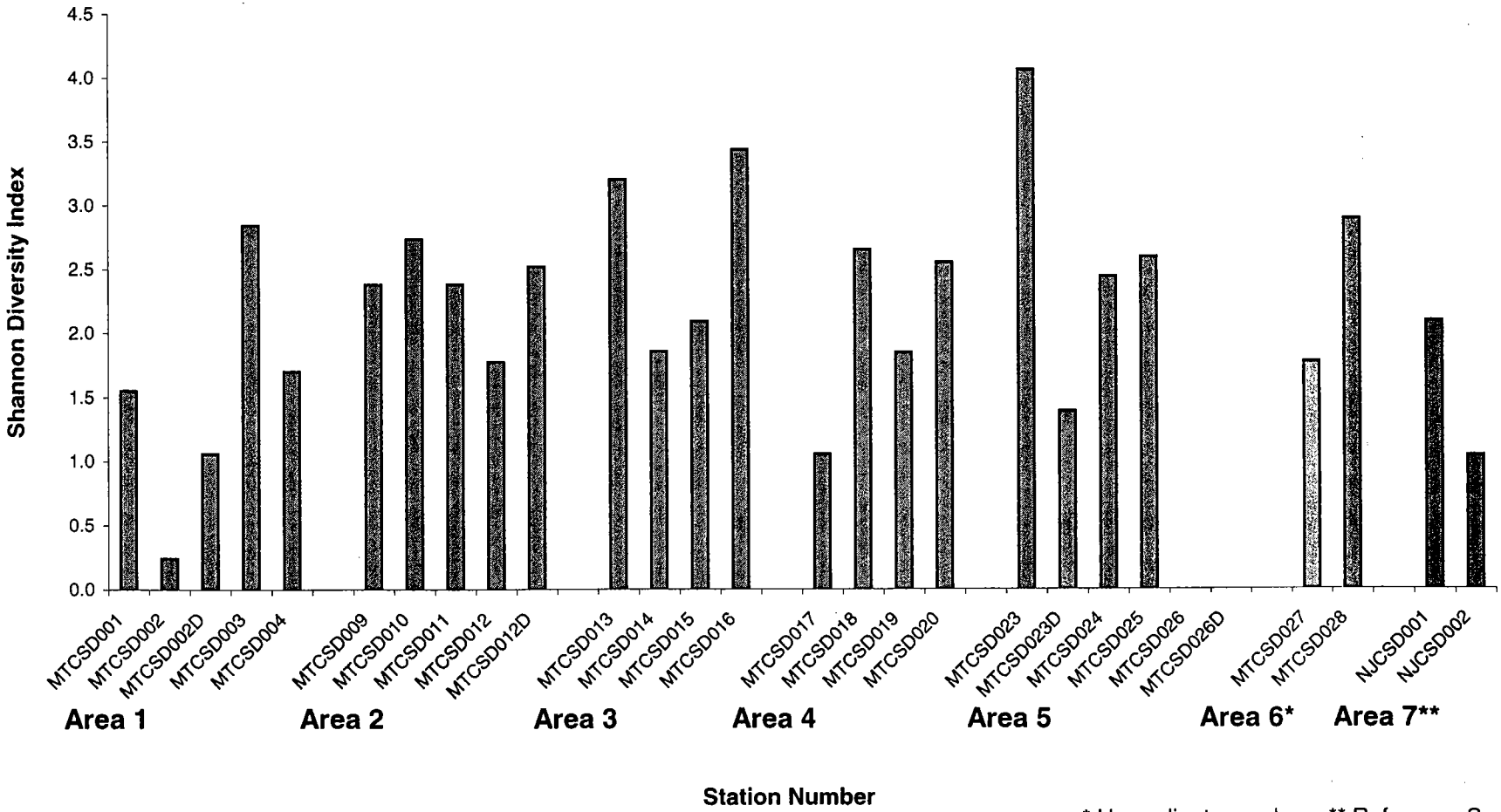
TOTAL NUMBER OF TAXA AT EACH STATION-BENTHIC COMMUNITY STUDY
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples

FIGURE 5-18

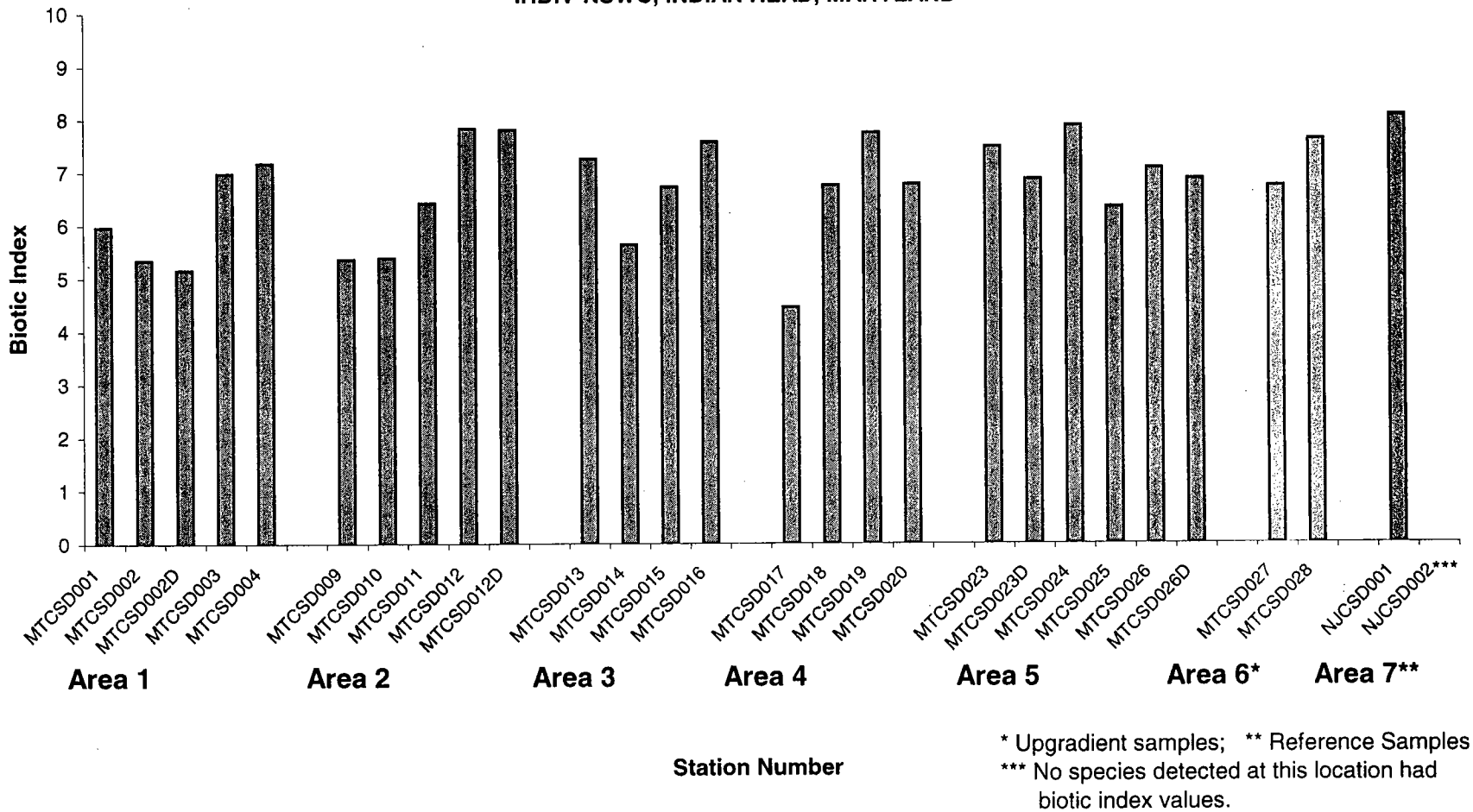
SHANNON DIVERSITY INDEX AT EACH STATION-BENTHIC COMMUNITY STUDY
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Sample

FIGURE 5-19

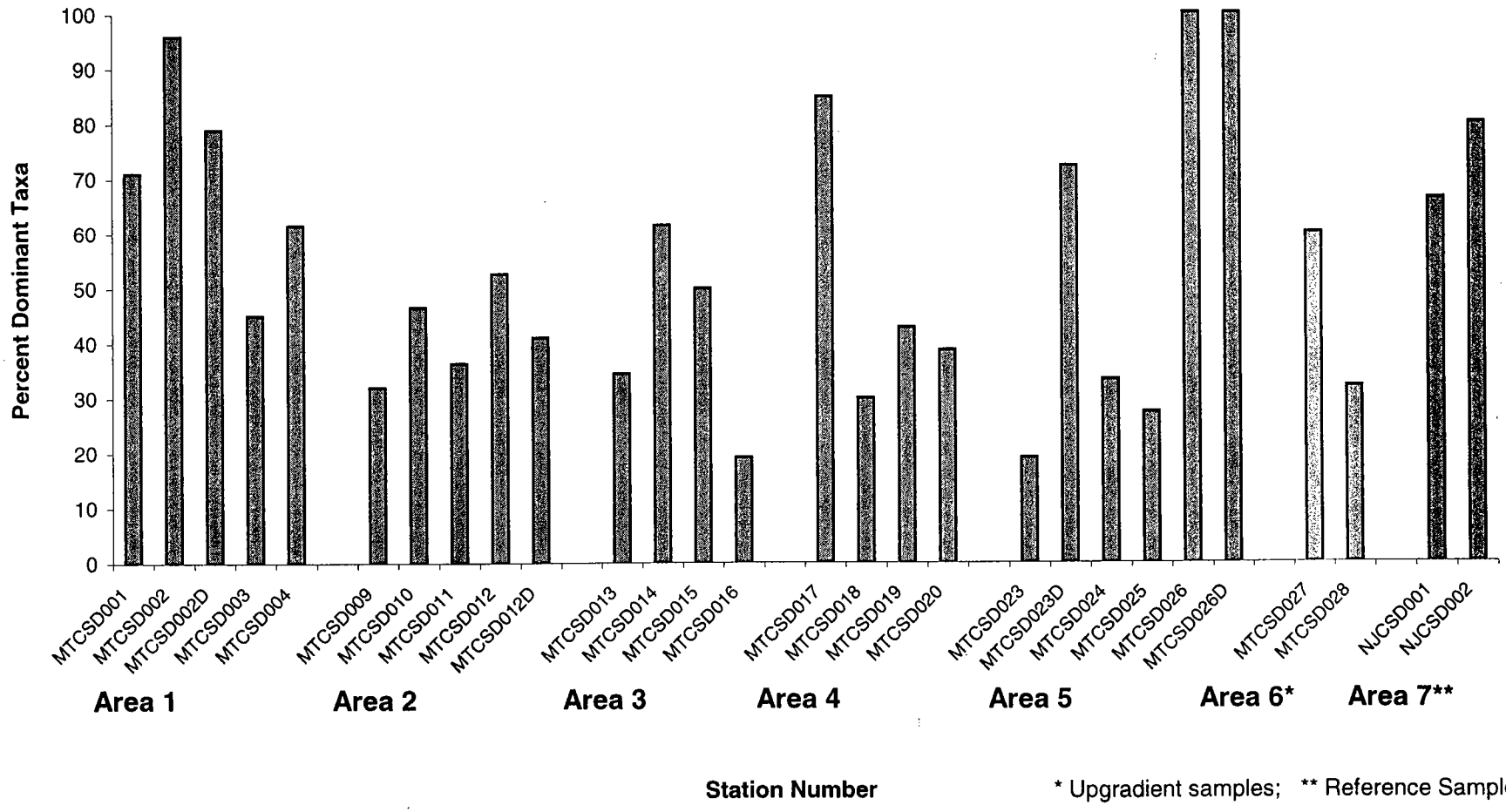
BIOTIC INDEX AT EACH STATION-BENTHIC COMMUNITY STUDY
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples
*** No species detected at this location had biotic index values.

FIGURE 5-20

PERCENT DOMINANT TAXA AT EACH STATION-BENTHIC COMMUNITY STUDY
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND



* Upgradient samples; ** Reference Samples

6.0 HUMAN HEALTH RISK ASSESSMENT

The objective of the human health risk assessment (HHRA) for Mattawoman Creek is to determine whether detected concentrations of chemicals pose a significant threat to potential human receptors under current and/or future land use. To determine the baseline conditions, the potential risks to human health at Mattawoman Creek are estimated based on the assumption that no actions will be taken to control chemical releases.

This section contains the methodologies used to evaluate site-specific human health risks at the IHDIV-NSWC. The following current EPA risk assessment guidance and EPA Region 3 supplements were the primary references used to develop the framework contained in this section:

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

- EPA, May 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081.

- EPA, May 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C.

- EPA, August 1997. Exposure Factors Handbook. National Center for Environmental Assessment, Washington, D.C. EPA/600/P-95/002Fa.

- EPA, January 1998. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments). Office of Emergency and Remedial Response, Washington, D.C.

- EPA, September 2001. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim, Review Draft for Public Comment. Office of Emergency and Remedial Response, Washington, D.C. 20460. EPA/540/R99/005.

A human health risk assessment consists of five components: data evaluation; exposure assessment; toxicity assessment; risk characterization, and uncertainty analysis. Sections 6.1 through 6.5 contain

detailed discussions of the methodologies followed for each component of a human health risk assessment. A schematic diagram of the general risk assessment process is provided as Figure 6-1.

In order to evaluate potential risks, four major requirements must be fulfilled: (1) contaminants with toxic characteristics must be found in environmental media; (2) the contaminants must be released by either natural processes or by human action; (3) potential exposure points must exist; and (4) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure pathways are regarded as incomplete, and no potential risks will be considered for human receptors.

The data evaluation section of the risk assessment is primarily concerned with the selection of chemicals of potential concern (COPCs) that are representative of the type and magnitude of potential human health effects. In turn, these COPCs are used to evaluate potential risks.

The toxicity assessment section presents the available human health criteria for all the selected COPCs. Quantitative toxicity indices are presented where they are available. These include dose-response parameters, such as reference doses (RfDs) and cancer slope factors (CSFs); enforceable standards, such as maximum contaminant levels (MCLs); and regulatory guidelines, such as drinking water health advisories.

The exposure assessment section identifies potential human exposure pathways at Mattawoman Creek. Exposure routes are developed from information on source area chemical concentrations, chemical release mechanisms, patterns of human activity, and other pertinent information to develop a conceptual site model. Section 6.3 presents the equations and relevant input parameters for estimating chemical intake.

The risk characterization section (Section 6.4) describes how the estimated intakes are combined with the toxicity information to estimate risks. General uncertainties associated with the risk assessment process are discussed qualitatively in Section 6.5. Uncertainties associated with a particular site are provided in the site-specific sections.

6.1 DATA EVALUATION

Data evaluation, the first component of a human health risk assessment, is a site-specific task involving the compilation and evaluation of analytical data. The main objective of data evaluation is to develop a medium-specific list of COPCs that is used to quantitatively determine potential human health risks.

The selection of COPCs is a qualitative screening process limiting the number of chemicals that are quantitatively evaluated in a human health risk assessment to those site-related constituents that dominate overall potential risks. Screening against risk-based concentrations and background is employed to focus the risk assessment on appropriate chemicals and exposure routes.

In general, a chemical is selected as a COPC and is retained for further risk evaluation if the maximum detected concentration in a sampled medium exceeds a risk-based concentration, referred to as the COPC screening level. Frequency of detection is used to exclude chemicals when data sets of 20 samples or greater are available. Generally, a detection rate of 5 percent or less justifies elimination of the chemical from further consideration provided that the detected concentrations are not representative of a "hot spot" area. Chemicals eliminated from further evaluation at this step are assumed to present minimal risks to potential human receptors. Risk-based COPC screening levels and other health-based standards for solid and aqueous media are presented in Table 6-1.

6.1.1 COPC Screening Level Development

COPCs were identified by a comparison of maximum detected chemical concentrations with screening levels based on EPA Region 3 Risk-Based Concentration (RBCs) Table (EPA, April 2002). The risk-based COPC screening levels used for the human health risk assessment correspond to a systemic Hazard Quotient of 0.1 (Region 3 RBCs were divided by 10 for noncarcinogenic compounds) or a lifetime cancer risk of 1×10^{-6} (for carcinogens). The Region 3 RBCs are developed using protective default exposure scenarios suggested by EPA and currently available reference doses and cancer slope factors. A chemical was retained as a COPC if its maximum detected concentration exceeds its screening level.

There are no RBCs for sediment; therefore, COPCs were selected by comparing detected site concentrations to residential soil ingestion screening levels. The use of soil ingestion screening levels for sediment COPC identification is regarded as a conservative approach because exposure to sediment is anticipated to be less than exposure to soil.

Risk-based COPC screening levels for tap water ingestion, which are based on daily, residential exposure assumptions, were used to select COPCs for surface water. In general, the use of tap water screening levels is regarded as an extremely conservative approach to COPC selection because the surface water in the vicinity of the site is not used as a potable drinking water source.

COPCs in fish tissue were identified by comparing maximum concentrations of chemicals detected in fish tissue samples with screening levels based on EPA Region 3 RBCs (EPA, April 2002) for fish ingestion. The EPA Region 3 RBCs are based on the assumption that a receptor ingests 54 grams of fish per day, 350 days per year for 30 years and that 100 percent of the fish ingested is from the contaminated source.

The use of the EPA Region 3 screening levels is considered conservative because it is unlikely that fish caught in Mattawoman Creek would constitute a significant fraction of an individual's diet.

6.1.1.1 Lead as a COPC

RBCs are not calculated for lead because the EPA has not derived toxicity values for this constituent. However, guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and OSWER recommend 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting where children are frequently present (EPA, July 1994a; July 1994b). Based on this recommendation, a value of 400 mg/kg will be used as a screening level for sediment in Mattawoman Creek. The Safe Drinking Water Act (SDWA) action level of 15 µg/L (EPA, Summer 2000) will be used as the screening level for lead in surface water.

6.1.1.2 Nitrocellulose

Toxicity values are not currently available for nitrocellulose. Consequently, risk-based screening levels used for the selection of chemicals of potential concern are not currently published. However, a review of the conclusions and recommendations of the EPA Health Advisory for Nitrocellulose indicates that the chemical has a very low toxicity: "Based on available toxicity data and chemical and physical properties of the compound, nitrocellulose is apparently non-toxic to dogs, rats, and mice and is not digested or absorbed in these species. These data, along with the relative insolubility of nitrocellulose in water, suggest that Health Advisory values for nitrocellulose in drinking water are unnecessary. The physical characteristics of the drinking water as they relate to turbidity, clarity, taste and similar indicators of palatability appear to be the only guidelines necessary." Toxicity information suggest that the LD_{50} (lethal dose for 50 percent of the test animals) is greater than 5 grams per kilogram. It should be noted that published risk-based concentrations for other chemicals that are considered relatively non-toxic (e.g., aluminum) typically exceed 10,000 µg/L (tap-water) and 10,000 mg/kg (residential soil). Nitrocellulose concentrations detected in the environmental media at Mattawoman Creek do not exceed these concentrations.

6.1.1.3 Arsenic in Fish Tissue

Fish tissue samples were analyzed for total arsenic. However, the form of arsenic considered to be carcinogenic is the inorganic fraction, which only accounts for a very small percentage of the total arsenic found in fish tissue. Recent scientific findings indicate that the percentage of available inorganic arsenic in fish tissue is less than 4%, with marine fish being even lower (Morrissey, et. al., 1999). Due to the high cost and technical constraints of analyzing finfish tissue specifically for inorganic arsenic, finfish samples were analyzed for total arsenic which includes both the inorganic and organic forms. To avoid overstating

the health risk associated with total arsenic in fish tissue, the State of Maryland presently applies a 4 percent adjustment factor to the total arsenic concentration to derive a more realistic estimate of the concentration of inorganic arsenic present in edible fish tissue (MDE, 1999). This 4 percent adjustment factor was applied to the total arsenic concentration in fish tissue to derive an inorganic arsenic concentration in fish tissue.

6.1.1.4 Essential Nutrients and Chemicals without Toxicity Criteria

The essential nutrients calcium, magnesium, potassium, and sodium are not identified as COPCs. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, because of the lack or toxicity criteria, risk-based COPC screening levels are not available for some compounds (e.g., acenaphthylene, benzo(g,h,i)perylene, phenanthrene, Endosulfan I, and gamma-chlordane). Surrogates were selected for these chemicals based on similar chemical structures. Acenaphthene was used as a surrogate for acenaphthylene; pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene; endosulfan was used as a surrogate for endosulfan I, and chlordane was used as a surrogate for gamma-chlordane.

6.1.1.5 Comparison to Background

There were only four background surface water samples, four background sediment samples, and three background fish fillet samples collected for the Mattawoman Creek Study. Consequently, a statistical comparison of area concentrations to background was not performed during the selection of COPCs. No chemical was eliminated as a COPC on the basis of background. The impact of not eliminating chemicals on the basis of background is discussed in the uncertainty analysis.

6.1.2 Selection of Chemicals of Potential Concern

Chemicals of potential concern at Mattawoman Creek were selected for surface water, sediment, and fish using the risk-based COPC screening levels described in Section 6.1.1. A discussion of the chemicals identified as COPCs and the rationale for COPC selection are provided in the following subsections. Chemicals retained as COPCs are presented in Table 6-2. COPC selection tables for each medium are presented in Tables 6-3 through 6-5. RAGS Part D tables for COPC selection are included in Appendix D.

6.1.2.1 Surface Water

Ten VOCs, three SVOCs, three energetics and 22 inorganics were detected in surface water samples collected at Mattawoman Creek. A comparison of the maximum detected surface water concentrations to EPA Region 3 RBCs for tap water is presented in Table 6-3. The following chemicals were detected at

maximum concentrations in surface water that exceeded the risk-based COPC screening level and were retained as COPCs for surface water at Mattawoman Creek:

- VOCs (benzene, ethylbenzene, and trichloroethene)
- Inorganics (arsenic, iron, lead, and manganese)

6.1.2.2 Sediment

Ten VOCs, 26 SVOCs, three pesticides, one PCB, seven energetics, and 24 inorganics were detected in sediment samples collected at Mattawoman Creek. A comparison of the maximum detected sediment concentrations to EPA Region 3 RBCs for residential soil is presented in Table 6-4. The following chemicals were detected at maximum concentrations in sediments that exceeded the risk-based COPC screening level for direct contact to soil and were retained as COPCs for sediments at Mattawoman Creek:

- SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene]

- Inorganics (Aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, thallium, and zinc)

6.1.2.3 Fish

Four SVOCs, five pesticides, one PCB, five energetics and 17 inorganics were detected in fish tissue samples collected at Mattawoman Creek. A comparison of the maximum detected fish tissue concentrations to EPA Region 3 RBCs for fish is presented in Table 6-5. The following chemicals were detected at maximum concentrations in fish tissue that exceeded the risk-based screening level for fish and were retained as COPCs for fish at Mattawoman Creek:

- SVOCs [4-methylphenol and bis(2ethylhexyl)phthalate]
- Pesticides (4,4'-DDE and Dieldrin)
- PCBs (Aroclor-1260)
- Energentics (1,3-Dinitrobenzene, 2-amino-4,6-dinitroluene)
- Inorganics (arsenic, chromium, cyanide, manganese, and mercury)

6.2 TOXICITY ASSESSMENT

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 6.3) to characterize the potential for the occurrence of adverse health effects.

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of potential concern.

The entire toxicological database is used to guide the derivation of CSFs for carcinogenic effects and RfDs for noncarcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to derive CSFs and RfDs come from animal studies.

For noncarcinogenic effects, the most appropriate animal model (i.e., the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern. In the absence of such data; however, a RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL), if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, a RfD may be derived from data for a chemical with structural and toxicologic similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient but are not derived for Group D or E chemicals. (An explanation/definition of these weight-of-evidence classes is provided in Section 6.2.6.) No consideration is given to similarity in the animal and human target organ(s), because a chemical capable of inducing cancer in any animal tissue is considered potentially carcinogenic to humans. Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Toxicological profiles for each of the COPCs are presented in Appendix D. These profiles present a summary of the available literature on carcinogenic and noncarcinogenic effects associated with human exposure to the chemical.

6.2.1 Noncarcinogenic Effects

For noncarcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. For noncarcinogens, a range of exposure exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for noncarcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to a RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight below which adverse noncarcinogenic health effects (i.e., the threshold effect) are not anticipated. A RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

To derive an RfD, EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive a RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to

humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between one and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

Reference doses for the COPCs are presented in Table 6-6. This table also includes the primary target organs affected by a particular chemical. This information may be used in the risk characterization section to segregate risks by target organ effects, unless the total Hazard Index is below unity.

EPA's IRIS database (EPA, July 2002) was consulted as the primary source for RfD values, as well as for CSFs. EPA intends that IRIS supersede all other sources of toxicity information for risk assessment. If values are not available in IRIS, HEAST (EPA, July 1997) is consulted, as well as the current EPA Region 3 Risk-Based Concentration table (EPA, April 2002). If no RfD is available from any of these sources, noncarcinogenic risks are not quantified and potential exposures are addressed in the uncertainty section.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms. Dermal RfDs and the absorption efficiencies used in their determination are also included in Table 6-6. When no absorption rate is available in the literature, no adjustment is made.

6.2.2 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification and a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of three groups in EPA's classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen

Chemicals that cannot be classified as a human carcinogen because of a lack of data are placed in Group D, and those for which there is evidence of noncarcinogenicity in humans are in Group E.

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined as the upperbound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens have none (e.g., lead). Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for both oral and inhalation routes. CSFs for COPCs are presented in Table 6-7. The primary sources of information for these values are EPA (EPA, July 1997; July 2002) and EPA Region 3 (EPA, April 2002).

CSFs exist for several (but not all) Class C compounds, which are identified as "possible" human carcinogens. These compounds typically exhibit inadequate evidence of carcinogenicity in humans and limited evidence in animals. In this human health risk assessment, Class C compounds are evaluated quantitatively as class A/B1/B2 compounds, but the risks associated with exposure to Class C compounds are also discussed separately if these chemicals are major risk drivers, underscoring the uncertainty associated with these estimations.

Dermal CSFs are derived from the corresponding oral values. In the derivation of a dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Table 6-7. When no absorption rate is available in the literature, no adjustment is made.

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF. EPA has published provisional guidance to assess PAHs (EPA, July 1993). Estimated orders of potential potency (rather than a toxicity equivalence factor TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this health risk assessment are as follows:

Compound	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenzo(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	0.1

6.3 EXPOSURE ASSESSMENT METHODOLOGY

The exposure assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations, and estimate chemical intakes under the identified exposure scenarios.

Actual or potential exposures at the IHDIV-NSWC are based on the most likely pathways of contaminant release and transport, as well as human activity patterns. The course that a chemical takes from the source to the potentially exposed individual is defined as the exposure pathway. A complete exposure pathway has four components: a source and mechanism of release; a route of contaminant transport through an environmental medium; a contact point for a human receptor; and an exposure route at the point of contact. This compilation of contaminant sources, likely exposure pathways, and receptors is depicted in a conceptual site model presented in Section 2.0.

6.3.1 Exposure Point Concentrations

The EPC, which is calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time and is used to calculate estimated exposure intakes.

The 95 percent upper confidence limit (UCL) on the mean, which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (EPA, May 1992). The 95 percent UCL is used as the exposure point concentration to assess RME and CTE risks (EPA, May 1993). If the calculated 95 percent UCL exceeds the maximum detected concentration, then the maximum is used as the exposure point concentration in place of the UCL. If the data set has an undefined distribution, then the data are assumed to be log-normally distributed and the 95 percent UCL is used as the exposure point concentration providing that the value does not exceed the maximum concentration. The maximum detected concentration is used as the exposure concentration when the 95 percent UCL exceeds the maximum.

For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration is defined as the maximum detection or arithmetic mean (if less than maximum) for RME and CTE scenarios, respectively (EPA, May 1993).

Conventional statistical methods are used to determine the distribution and UCL of a particular data set (Gilbert, 1987; EPA, May 1992). Sample and duplicate analytical results are averaged for statistical use. Nondetect data points are utilized; in general, one-half the sample-specific quantitation limit is used for these analytical results. Detailed sample calculations, as well as general methodology for the statistical evaluation, are presented in Appendix D. The following paragraphs detail the calculation of the 95 percent UCL.

For normally distributed data, the calculation of the exposure point concentration (i.e., UCL) is a two-step process. First the standard deviation of the sample set must be determined, as follows:

$$S = \left[\frac{\Sigma(X_i - \overline{X})^2}{(n-1)} \right]^{1/2}$$

where: S = standard deviation
X_i = individual sample value
n = number of samples
$\overline{X}$ = mean sample value

The one-sided UCL on the mean is then calculated as follows:

$$UCL = \overline{X} + t\left(\frac{S}{n^{1/2}}\right)$$

where: UCL = 95 percent UCL of the mean
$\bar{x}$ = arithmetic average
t = one-sided t distribution factor ($t_{0.95}$)
S = standard deviation
n = number of samples

For log-normally distributed data sets, the exposure point concentration is calculated using the following equation:

$$UCL = \exp\left(\overline{X} + 0.5S^2 + \frac{HS}{(n-1)^{1/2}}\right)$$

where:	UCL	=	95 percent UCL of the mean
	exp	=	constant (base of the natural log, e)
	$\overline{X}$	=	mean of the transformed data
	S	=	standard deviation of the transformed data
	H	=	H-statistic (from Gilbert, 1987; $H_{0.95}$)
	n	=	number of samples

This equation uses individual sample results that have been transformed using the natural logarithm function.

Exposure point concentrations for the evaluated receptors are presented in Table 6-8. Supporting statistics for the exposure point concentrations are included in Appendix D. RAGS Part D tables for the exposure point concentrations are also provided in Appendix D.

6.3.2 Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of EPA guidance documents, which are cited in the specific intake estimation sections that follow.

Exposures are dependent on the predicted concentrations of chemicals in environmental media and local land use practices, and both are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Section 2.0 presented the exposure pathways and receptors that were evaluated in this HHRA. Table 6-9 provides a site-specific listing of all exposure pathways considered and the basis for inclusion or exclusion of each exposure pathway for each receptor. Table 6-10 provides a site-specific summary of the potential receptors and exposure routes that are addressed quantitatively in the HHRA.

Exposure model parameters are presented in Table 6-11 for the exposure assessment of the various receptors evaluated in the quantitative risk assessment. RAGS Part D tables for the exposure assumptions are presented in Appendix D. These values are generally the same exposure assumptions that have been used in previous risk assessments that were prepared for other sites at IHDIV-NSWC Indian Head (TtNUS, July 1999, June 2001), although some values have been updated to reflect current

EPA guidance (EPA, September 2001). These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in the site-specific sections, to calculate intakes, which will be used to determine risks. Individual chemical intakes for each receptor/exposure route combination are presented in the spreadsheets in Appendix D.

Noncarcinogenic intakes are estimated using the concept of an average annual exposure. Carcinogenic intakes are calculated as an incremental lifetime exposure, which assumes a life expectancy of 70 years.

6.3.2.1 Incidental Ingestion of Surface Water

Direct contact with surface waters while swimming or wading could result in the incidental ingestion of small amounts of water. Intakes for incidental ingestion of surface water were estimated using the following general equation (EPA, December 1989):

$$\text{Intake}_{wi} = \frac{(C_{wi})(CR)(ET)(EF)(ED)}{(BW)(AT)}$$

where:

Intake_{wi}	=	intake of chemical "i" from water (mg/kg/day)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
CR	=	contact rate for surface water (L/hr)
ET	=	exposure time for surface water (hr/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yr x 365 days/yr

No site-specific receptor or activity information is available to estimate contact rates for potential recreational users. Therefore, the conventional value of 0.05 L/hour (EPA, April 1988) was used for all applicable receptors under CTE and RME conditions. For exposures while swimming EPA's Exposure Factor Handbook (EPA, August 1997) recommends an exposure time of 1 hour per event and an exposure frequency of one event per month for the general population. Taking into account that individuals in the study area may swim more frequently then the general population, an exposure frequency of 2 hours per event and one event per week during the summer months (or 16 events a year) were used to evaluate exposures to recreational users under the RME scenario. For the CTE scenario, it was assumed that recreational users swim 1 hour per event and eight events per year. For the RME,

exposure durations are set at 10 years for the adolescent recreational user and 30 years for the adult recreational users. For the CTE scenario, exposure durations are set at 10 years for the adolescent recreational user and 9 years for the adult recreational users.

6.3.2.2 Dermal Contact with Surface Water

Dermal contact with surface water may also occur while receptors are involved in recreational or work activities. The following equation was used to assess exposures resulting from dermal contact with water (EPA, September 2001):

$$DAD_{wi} = \frac{(DA_{event})(EV)(ED)(EF)(SA)}{(BW)(AT)}$$

where:

DAD_{wi}	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
DA_{event}	=	absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (yr)
EF	=	exposure frequency (days/yr)
SA	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yr x 365 days/yr

Exposed surface areas of the body available for dermal contact are determined on a receptor-specific basis since they correspond with assumed human activities and clothing worn during exposure events. Current guidance (EPA, September 2001; August 1997) was used to develop the following assumptions concerning the amount of skin surface area available for contact for a receptor:

- For construction workers, the skin surface area was assumed to be 3,300 cm^2, which is the 50th percentile areas for the head, hands, and forearms (EPA, September 2001).

- For adolescent recreational users, the total body surface area (12,400 cm^2) was assumed to be available for surface water contact (EPA, August 1997).

- For adult recreational users, the total body surface area (18,000 cm^2) was assumed to be available for surface water contact (EPA, September 2001).

Construction workers were assumed to be exposed to surface water 8 hours/day for 60 days a year under the RME scenario and 4 hours/day for 30 days under the CTE scenario. The same exposure times, exposure frequencies, and exposure durations used to evaluate incidental exposures to surface water are used for evaluating dermal contact with surface water for the adolescent and adult recreational users.

The absorbed dose per event (DA_{event}) was estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^*, \text{ then: } DA_{event} = 2(FA)(K_p)(C_{wi})(CF)\left[\frac{\sqrt{6\,\tau\, t_{event}}}{\pi}\right]$$

$$\text{If } t_{event} > t^*, \text{ then: } DA_{event} = (FA)(K_p)(C_{wi})(CF)\left[\frac{t_{event}}{1+B} + 2\,\tau\left[\frac{1+3B+3B^2}{(1+B)^2}\right]\right]$$

where:

DA_{event}	=	absorbed dose per event
FA	=	fraction absorbed (dimensionless) – chemical specific
t_{event}	=	duration of event (hr/event)
t^*	=	time it takes to reach steady-state conditions (hr)
K_p	=	permeability coefficient from water through skin (cm/hr)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
τ	=	lag time (hr)
π	=	constant (dimensionless; equal to 3.14159)
CF	=	conversion factor (0.001 L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (K_p, FA, τ, B, and t^*) were obtained from the current dermal guidance (EPA, September 2001, Exhibit B-3) and are included in Table 6-12. If no published values were available for a particular compound, they were calculated using equations provided in the EPA dermal guidance.

The following steady-state equation was used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_{wi})(t_{event})$$

The dermal permeability (K_p) values recommended in the EPA dermal guidance (EPA, September 2001), were used to calculate DA_{event} for inorganic COPCs.

6.3.2.3 Incidental Ingestion of Sediment

Direct physical contact with sediment may result in the incidental ingestion of chemicals. Chemical intake for incidental ingestion of sediment was estimated in the following manner (EPA, December 1989):

$$Intake_{si} = \frac{(C_{si})(IR_s)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

$Intake_{si}$	=	intake of chemical "i" from sediment (mg/kg/day)
C_{si}	=	concentration of chemical "i" in sediment (mg/kg)
IR_s	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (dimensionless)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (1×10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yr x 365 days/yr

For the RME scenario, the ingestion rate was set at 240 mg/day for the construction worker and 100 mg/day for the adolescent recreational user and adult recreational user (EPA, May 1993). For the CTE scenario, the ingestion rate was set at 120 mg/day for the construction worker and 50 mg/day for the adolescent recreational user and adult recreational user (EPA, May 1993). The same exposure frequencies and durations used to evaluate exposures to surface water were used to estimate exposure to sediments.

6.3.2.4 Dermal Contact with Sediment

Direct physical contact with sediment may result in the dermal absorption of chemicals. Exposure associated with dermal contact with sediment was estimated in the following manner (EPA, December 1989):

$$Intake_{si} = \frac{(C_{si})(SA)(AF)(ABS)(CF)(EF)(ED)}{(BW)(AT)}$$

where: $Intake_{si}$ = amount of chemical "i" absorbed during contact with sediment (mg/kg/day)

C_{si} = concentration of chemical "i" in sediment (mg/kg)

SA = skin surface area available for contact (cm^2/day)

AF = skin adherence factor (mg/cm^2)

ABS = absorption factor (dimensionless)

CF = conversion factor (1×10^{-6} kg/mg)

EF = exposure frequency (days/yr)

ED = exposure duration (yr)

BW = body weight (kg)

AT = averaging time (days);
for noncarcinogens, AT = ED x 365 days/yr;
for carcinogens, AT = 70 yr x 365 days/yr

The same exposure frequencies and durations used to evaluate exposures to surface water were used to estimate exposure to sediments. Exposed surface areas of the body available for dermal contact are determined on a receptor-specific basis since they correspond with assumed human activities and clothing worn during exposure events. Current guidance (EPA, September 2001; August 1997) was used to develop the following assumptions concerning the amount of skin surface area available for contact for a receptor:

- For construction workers, the surface area assumed to be available for sediment contact (4,300 cm^2) was the arithmetic mean value for the head, arms, and hands.

- For adolescent recreational users, 30 percent (3,720 cm^2) of the total body surface area was assumed to be available for sediment contact.

- For adult recreational users, 30 percent (6,000 cm^2) of the total body surface area was assumed to be available for sediment contact.

Current EPA Guidance (EPA, August 1997; September 2001) was used to determine soil adherence factors and chemical-specific absorption factors. For COPCs in sediment, the following soil adherence factors will be used for the RME and CTE exposure scenarios:

- Construction workers – 0.2 mg/cm^2 for the RME and 0.02 mg/cm^2 for the CTE
- Adolescent recreational users – 0.2 mg/cm^2 for the RME and 0.02 mg/cm^2 for the CTE
- Adult recreational users – 0.07 mg/cm^2 for the RME and 0.01 mg/cm^2 for the CTE

For the constituents identified as COPCs in sediment, the following absorption factors were used (EPA, September 2001, unless otherwise noted):

- PCBs – 0.14
- PAHs – 0.13
- DDD, DDE, and DDT – 0.03
- Arsenic – 0.03
- Cadmium – 0.001
- Semivolatile Organics – 0.1
- Other Inorganics and Volatile Organics – not evaluated for dermal contact with sediment (EPA, September 2001)

6.3.2.5 Fish Ingestion

The fish consumption exposure pathway was evaluated for adolescent and adult recreational users. Intakes for the fish ingestion exposure route were estimated using the following equation (EPA, December 1989):

$$\text{Intake} = \frac{(C \times IR \times FI \times EF \times ED)}{(BW \times AT)}$$

where:

Intake	=	ingestion intake (mg/kg-day)
C	=	chemical concentration in fish tissue (mg/kg)
IR	=	ingestion rate (kg/meal)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (meals/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yr x 365 days/yr

The Exposure Factor's Handbook (EPA, August 1997) reports that recreational fisherman consume 1.2 fish meals/week (95 percentile value). Taking into account that local fishermen may consume more fish than the average fisherman, it was assumed that recreational fisherman consume 2 fish meals/week or 104 fish meals/year under the RME scenario and 1.2 fish meals/week or 64 meals/year under the CTE scenario. The ingestion rate of 0.129 kg/meal (EPA, August 1997) was used for the RME and CTE scenarios.

6.3.3 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters for this chemical. Exposure to lead can be evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead, Version 1.0 (EPA, May 2002). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Exposures to lead by nonresidential adults are evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996). The approach focuses on estimating fetal blood lead concentrations in women exposed to lead-contaminated soils.

Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects to children from this chemical is believed to be in the range of 10 µg/dL to 15 µg/dL. Blood-lead levels greater than 10 µg/dL are considered to be a "concern."

In general, the IEUBK Model and Technical Review Work Group Model for lead are used to address exposure to lead when groundwater and surface water concentrations exceed the 15 µg/L Federal Action Level promulgated under the Safe Drinking Water Act and when detected soil concentrations exceeded the OSWER soil screening level of 400 mg/kg for residential land use (EPA, July 1994b). Exposure concentrations, as well as default parameters for some input parameters, were used in the evaluation. The input parameters used and the results of lead models, estimated blood-lead levels, and probability density histograms are presented in Appendix D.

6.4 RISK CHARACTERIZATION

This section provides a characterization of the potential human health risks associated with the potential exposures to COPCs at Mattawoman Creek. Section 6.4.1 outlines the methods used to quantitatively

estimate the type and magnitude of potential risks for human receptors. A summary of the risk characterization for Mattawoman Creek is provided in Section 6.4.2.

6.4.1 Risk Estimation Methods

Quantitative estimates of risk were calculated using intake and toxicity values according to risk assessment methods outlined in current EPA guidance (EPA, December 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as Incremental Cancer Risks (ICRs), which are derived using published CSFs. Noncarcinogenic risk estimated are presented in the form of HQs that are derived using published RfDs.

ICR estimates were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$ICR = (\text{Estimated Exposure Intake})(CSF)$$

If the above equation results in an ICR greater than 0.01, the following equation was used:

$$ICR = 1 - [\exp(-\text{Estimated Exposure Intake})(CSF)]$$

The ICRs for all COPCs in an exposure scenario were summed to give a cumulative ICR. An ICR of 1×10^{-6} indicates that the exposed receptor has a one-in-one-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.

Noncarcinogenic risks were assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

$$HQ = (\text{Estimated Exposure Intake}) / (RfD)$$

An HI was generated by summing the individual HQs for all of the COPCs. It should be noted that HI is not a mathematical prediction of the severity of toxic effects; therefore, it is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

6.4.2 Comparison of Quantitative Risk Estimates to Benchmarks

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. EPA has defined

the range of 10^{-4} to 10^{-6} as the ICR "target range" for most hazardous waste facilities addressed under Comprehensive Environmental Response Compensation and Liability Act (Superfund) (CERCLA). Cumulative ICRs greater than 1×10^{-4} generally will indicate that some degree of remediation is required, and ICRs below 1×10^{-6} will normally indicate that remedial efforts are not necessary. Whenever ICRs fall between 10^{-4} and 10^{-6}, decisions for remediation are made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be COCs.

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 were 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.

6.4.3 Results of the Risk Characterization

This section contains a summary of the results of the risk characterization for Mattawoman Creek. Quantitative risk estimates for potential human receptors are developed for those chemicals identified as COPCs. Potential ICRs and HIs were calculated for construction workers, adolescent recreational users, and adult recreational users under the RME and CTE scenarios and are summarized in Tables 6-13 and 6-14, respectively. Sample calculations and the results of the risk assessment in RAGS Part D format (EPA, January 1998) are included in Appendix D.

6.4.3.1 Construction Worker

The estimated ICRs for the construction worker exposed to surface water and sediments at Mattawoman Creek were less than the EPA target risk range of 10^{-4} to 10^{-6}. The combined ICRs for the construction worker were 2.5×10^{-7} and 5.6×10^{-8} for the RME and CTE exposures, respectively.

The cumulative HI for the construction worker exposed to surface water and sediment at Mattawoman Creek was 0.1 for the RME scenario and 0.04 for the CTE scenario. These results are well below the acceptable level of 1.0, which indicates that there is minimal potential for adverse health affects under the conditions established in the risk assessment.

6.4.3.2 Adolescent Recreational User

The estimated ICRs for the adolescent recreational user exposed to surface water, sediments, and fish at Mattawoman Creek were 8.8×10^{-5} and 5.2×10^{-5} for the RME and CTE scenarios, respectively, which are within EPA's target risk range of 10^{-4} to 10^{-6}.

The total cumulative HIs for the adolescent recreational user exposed to surface water, sediments, and fish tissue at Mattawoman Creek were 13 and 8 for the RME and CTE scenarios, respectively. HIs for exposure to surface water and sediment for both the RME and CTE scenarios were less than the acceptable level of 1.0. HIs for ingestion of fish were 13 for the RME scenario and 8 for the CTE scenario, which are greater than the acceptable level of 1.0. 2-Amino-4,6-dinitrotoluene (HQ = 1.4), and 4-methylphenol (HQ = 11) were the major contributors to the HI for ingestion of fish from Mattawoman Creek.

6.4.3.3 Adult Recreational Users

The estimated ICRs for the adult recreational user exposed to surface water, sediments, and fish at Mattawoman Creek were 1.6×10^{-4} and 2.9×10^{-5} for the RME and CTE scenarios, respectively. ICRs for exposures for surface water and sediment for both the RME and CTE scenarios were less than EPA's target risk range of 10^{-4} to 10^{-6}. The ICR for ingestion of fish (1.6×10^{-4}) under the RME scenario exceeds the EPA's target risk range. While the ICR of 2.9×10^{-5} for the CTE scenario was within the target risk range, aroclor-1260 (ICR = 1.3×10^{-4}) was the major contributor to the ICR for ingestion of fish from Mattawoman Creek.

The total cumulative HIs for the adult recreational user exposed to surface water, sediments, and fish tissue at Mattawoman Creek were 8 and 5 for the RME and CTE scenarios, respectively. HIs for exposure to surface water and sediment for both the RME and CTE scenarios were less than the acceptable level of 1.0. HIs for ingestion of fish were 8 for the RME scenario and 5 for the CTE scenario, which are greater than the acceptable level of 1.0. 4-Methylphenol (HQ = 6.7) was the major contributor to the HI for ingestion of fish from Mattawoman Creek.

The ICRs and HIs calculated for adolescents and adult recreational users consuming fish caught in Mattawoman Creek are subject to uncertainty because only three background fish fillet samples were collected a statistical comparison to background could not be performed during the selection of COPCs. Consequently, no chemical was eliminated as a COPC on the basis of background.

6.4.4 <u>Results of Lead Modeling</u>

Lead was identified as a COPC in sediment in Mattawoman Creek. As discussed in Section 6.1.1, there are no human health screening criteria for lead in sediment. Therefore, the OSWER screening level of 400 mg/kg for childhood exposure to lead in soil was used to screen lead in sediment. Lead was detected in all 46 sediment samples but only in six samples at concentrations which exceeded 400 mg/kg. Five of the six samples were located in Area 1, and one sample was located in Area 5.

There were no exceedances of the OSWER soil screening level in sediment samples collected from Areas 2, 3, and 4.

Concentrations of lead in sediment samples collected in Area 1 range from 1.7 mg/kg (MTC029) to 76,400 mg/kg (IS11SD01). The average concentration of lead in sediment samples from Area 1 (4,474 mg/kg) exceeds the OSWER soil screening level (400 mg/kg). However, if sample IS11SD01 is removed from the Area 1 data set then the average lead concentration is 297 mg/kg. Lead concentrations in the five samples that exceeded the OSWER soil screening level ranged from 707 mg/kg to 1,160 mg/kg. The five samples with lead concentrations that exceeded the OSWER soil screening level in Area 1 were all located in the same region (i.e., CH2M Hill Site 11).

As discussed in Section 6.3.3, EPA recommends that exposures to lead by nonresidential adults be evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996). The slope factor approach was used to evaluate exposures to lead in sediment by construction workers in Area 1. The model recommends that the average lead concentration be used as the exposure point concentration. Two exposure point concentrations were used in the analysis. First, the average lead concentration for samples located in the section of Area 1 with elevated lead concentrations (10,122 mg/kg) was used as an exposure point concentration. Second, an average lead concentration of 653 mg/kg for samples with elevated lead concentrations excluding the maximum detected concentration of 76,400 mg/kg was used as an exposure point concentration. The incidental sediment ingestion rates were assumed to be 100 mg/day, and the exposure frequency was assumed to be 60 days/year. Results of the analysis are included in Appendix D. The lead concentration of 10,122 mg/kg results in 44 percent of construction workers having a blood lead level great than 10 µg/dL and a geometric mean blood lead level of 28 µg/dL. This exceeds the benchmark of no more than 5 percent of children (or fetuses of exposed women) exceeding 10 µg/dL. The lead concentration of 653 mg/kg results in 1.6 percent of construction workers having a fetal blood lead level greater than 10 µg/dL and a geometric mean blood lead level of 7 µg/dL. This result does not exceed the benchmark of no more than 5 percent of children (or fetuses of exposed women) exceeding 10 µg/dL.

Concentrations of lead in sediment samples collected in Area 5 range from 16 mg/kg (MTC025) to 3,010 mg/kg (MTC026). The average concentration of lead in sediment samples from Area 3 was 341 mg/kg, which is less than the OSWER soil screening level. The slope factor approach that was used to evaluate exposures to lead in sediment by construction workers in Area 1 was also used for Area 3. Results of the model are included in Appendix D. The evaluation of a lead concentration of 341 mg/kg results in 1.1 percent of construction workers having a fetal blood lead level greater than 10 µg/dL and a geometric mean blood lead level of 6.4 µg/dL. These results do not exceed the 5 percent benchmark.

The slope factor approach was not used to evaluate exposures to lead in sediment by recreational users because the exposure frequency for recreational users is less than the recommended minimum value for the model. Risks for recreational users exposed to lead in sediment are expected to be less than those for construction workers since their exposures are not as contact intensive as construction workers.

Lead was also identified as a COPC in surface water in Mattawoman Creek. As previously discussed there are no human health surface water criteria available for lead so the Federal Action Level promulgated under the Safe Drinking Water Act of 15 µg/L was used to screen COPCs in surface water. Lead was detected in 9 of 44 surface water samples, but was only detected in one sample (38.4 µg/L - IS11SW01) at a concentration which exceeded the screening criteria. (The maximum detected lead concentration in sediments was also detected at this location.) The detected concentrations of lead in the remaining surface water samples were less than 8 µg/L. The average concentration of lead in surface water was 2 µg/L, which is less than the screening level of 15 µg/L. The adult lead model only evaluates risks from exposures to soil/sediment; consequently, risks could not be estimated from exposures to lead in surface water. No adverse health effects are expected from exposures to lead in surface water since concentrations of lead in only one sample exceeded the screening criteria, the average concentration of lead is less than the screening criteria, and surface water from Mattawoman creek is not used as a drinking water source.

In summary, concentrations of lead in sediment samples from Areas 2, 3, and 4 were less than the OSWER soil screening level indicating that no adverse health effects are anticipated from exposure to lead in sediment from these areas. Lead was detected at concentrations exceeding the OSWER soil screening level in one sediment sample from Area 5, but the results of the adult lead model indicate that risks resulting from exposure to lead in sediment at Area 5 would be within acceptable levels. Lead was detected at concentrations exceeding the OSWER screening level in five sediment samples from Area 1. The results of the adult lead model indicate unacceptable risks from lead in sediment at sample location IS11SD01, although risks from exposures to lead in sediment samples collected from other locations from within Area 1 were within acceptable levels. Lead was detected in one surface water sample at a concentration which exceeded the screening level for drinking water, but no adverse health effects are anticipated since the average lead concentration in surface water is less than the screening criteria, and surface water from Mattawoman Creek is not used as a drinking water source.

6.5 UNCERTAINTY ANALYSIS

There is uncertainty associated with all aspects of the baseline HHRA presented in this section. A summary of the uncertainties, including a discussion of how they may affect the final risk numbers, is provided in this section.

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, the numbers, types and distributions of samples, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight-of-evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions, which consider safety factors, are made so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward overpredicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an acceptable risk level (i.e., 10^{-6}), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed an acceptable risk level (i.e., 10^{-4}), a conclusion can be difficult unless uncertainty is considered.

6.5.1 Data Evaluation

The most significant issues related to uncertainty in COPC selection are the elimination of chemicals on the basis of frequency of detection, the inclusion of chemicals potentially attributable to background, the screening levels that are used, and the absence of screening levels for a few chemicals detected in the site media. A brief discussion of each of these issues is provided in the remainder of this section.

6.5.1.1 Elimination of Chemicals as COPCs on the Basis of Frequency of Detection

Naphthalene was not retained as a COPC in surface water because its frequency of detection was less than 5 percent. Naphthalene was detected in only one of 38 surface water samples. The maximum detected concentration 2 µg/L exceeded one-tenth of its EPA Region 3 RBC of 6.5 µg/L but was less than the RBC. Therefore, elimination of naphthalene as a COPC in surface water at Mattawoman Creek on the basis of low frequency of detection does not significantly impact the results of the human health risk assessment.

6.5.1.2 Chemicals Potentially Attributable to Background

There were only four background surface water samples, four background sediment samples, and three background fish fillet samples collected for the Mattawoman Creek Study. Consequently, a statistical comparison to background could not be performed during the selection of COPCs. Consequently, no chemical was eliminated as a COPC on the basis of background. ICRs for exposures to surface water and sediments were less than 1×10^{-6} and HIs were less than 0.1; therefore, the evaluation of chemicals in surface water/sediment potentially attributable to background in the HHRA does not significantly impact the results.

Arsenic was identified as a major contributor to the ICR and HI for adolescent and adult recreational users consuming fish caught from Mattawoman Creek. Arsenic was detected in 8 of 16 fish fillet samples at a maximum detected concentration of 1.6 mg/kg. Arsenic was also detected in 2 of 3 background fish fillet samples at concentrations of 2 and 2.2 mg/kg. The concentration of arsenic in fish tissue is less than

the concentration in the background samples suggesting that arsenic is present in fish tissue samples at background levels.

6.5.1.3 COPC Screening Levels

The use of risk-based screening values based on conservative land use scenarios (i.e., residential land use for sediment and ingestion of tap water for surface water), corresponding to an ICR of 10^{-6} and HI of 0.1, should ensure that all the significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to an ICR less than 10^{-6} and an HI less than 0.1 should not affect the final conclusions of the risk assessment because these chemicals are not expected to cause a potential health concern at the detected concentrations.

6.5.1.4 Chemicals Without Established Screening Levels

Risk-based screening levels are currently not available for some constituents [e.g., acenaphthylene, benzo(g,h,i)perylene, phenanthrene, endosulfan I, and gamma-chlordane]. Therefore, surrogates were selected for these chemicals based on similar chemical structures. In the COPC screening, acenaphthene was used as a surrogate for acenaphthylene, pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene, endosulfan was used as a surrogate for endosulfan I, and chlordane was used as a surrogate for gamma-chlordane. Applying the toxicity values of one compound to another adds to the uncertainty in the risk assessment both in regard to the selection of COPCs and in the subsequently calculated risks.

6.5.2 Exposure Assessment

Uncertainty in the exposure assessment arises because of the methods used to calculate exposure point concentrations, the determination of land use conditions, the selection of receptors and scenarios, the estimation of exposure point concentrations, and the selection of exposure parameters. Each of these is discussed below.

6.5.2.1 Land Use

The current land use patterns at IHDIV-NSWC are well established, thereby limiting the uncertainty associated with land use assumptions. Land use at the site is currently limited and is expected to be limited in the future, as long as IHDIV-NSWC remains open.

6.5.2.2 Exposure Point Concentrations

Uncertainty is associated with the use of the 95 percent UCL on the mean concentration as the EPC. As a result of using the 95 percent UCL, the estimations of potential risk for the RME scenario are most likely to be overstated since this is a representation of the upper limit that potential receptors would be exposed to over the entire exposure period. In some cases (because the UCL was greater than the maximum concentration), the maximum concentration was used as the EPC. Use of the maximum concentration tends to overestimate potential risks because receptors are assumed to be exposed continuously to the maximum concentration for the entire exposure period. Uncertainty is also introduced when the nondetects are assigned a value of one-half the sample quantitation limit in the calculation of the EPC. This may either overstate or understate the risks to the receptors.

6.5.2.3 Exposure Routes and Receptor Identification

The determination of various receptor groups and exposure routes of potential concern was based on current land use observed at the site and the anticipated future land use. Therefore, the uncertainty associated with the selection of exposure routes and potential receptors is minimal because they are considered to be well defined.

6.5.2.4 Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, in most cases, the EPA guidelines (EPA, March 1991) on the RME receptor were used, which generally specify the use of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, the uncertainty can be assessed quantitatively for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often, the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty.

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values, including EPA guidance (EPA, March 1991; May 1993; August 1997; September 2001). For the RME scenario, the value representing the 95th percentile is generally selected

for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions but does not indicate what a more average or typical exposure might be or what risk range might be expected for individuals in the exposed population.

To address these issues, EPA (EPA, February 1992) has suggested the use of the CTE receptor, whose intake variables are often set at approximately the 50th percentile of the distribution. The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although EPA does provide limited guidance for the CTE evaluation (EPA, May 1993).

6.5.3 Toxicity Assessment

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

6.5.3.1 Derivation of Toxicity Criteria

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using the EPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of noncancer effects, however, positive animal data often suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. 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; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment and derivation of an RfD for the noncarcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate.

Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For noncancer effects, additional uncertainty factors may be applied in the derivation of the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for noncancer effects arises from the use of an effect level in the estimation of an RfD, because this estimation is predicated on the assumption of a threshold less than which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD for chronic exposure from subchronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the subchronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

6.5.3.2 Uncertainty Associated with Evaluation of the Dermal Exposure Pathway

According to RAGS Part E (EPA, September 2001), risks for dermal absorption of chemicals in soil are to be quantitatively evaluated for arsenic, cadmium, chlordane, 2,4-dichlorophenoxyacetic acid, DDT, TCDD (and other dioxins), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pentachlorophenol, and semivolatile organic compounds only because of the limited information guidance available to evaluate dermal exposure to other constituents. Therefore, risks from dermal exposure to

aluminum, antimony, chromium, copper, iron, manganese, mercury, silver, thallium, and zinc (the COPC metals detected in the solid media in addition to cadmium) were not quantified in the risk assessment. Consequently, potential risks may be underestimated by excluding these constituents from the dermal risk assessment calculations.

The model for dermal exposure to soil and sediment assumes that only a very thin, constant thickness layer of soil is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil 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 (EPA, September 2001), 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.

Experimental determination of absorption rates indicates that interspecies differences are considerable, which, along with other variabilities related to condition and age of skin, differences in lag time, and site of application effects, yields appreciable uncertainty in estimated dermal exposures 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.

6.5.3.3 Uncertainty Associated with the Concentration of Arsenic in Fish Tissue

As discussed in Section 6.1.1.4, fish tissue samples were analyzed for total arsenic. However, arsenic in the edible portions of fish is predominantly present as the arsenic-containing organic compound arsenobetaine (Cullen and Reimer, 1989; Edminds and Francesconi, 1987a; NAS, 1991). Arsenobetaine is a stable compound, which has been shown to be metabolically inert and nontoxic in a number of studies (Cannon et al., 1983; Bos et al., 1985; Kaise et al., 1985; Sabbionia et al., 1991; Vahter et al., 1983) and is not generally considered a threat to human health (ATSDR, 2000). Based upon data in literature, MacIntosh et al. (1997) estimated that inorganic arsenic accounts for 1.5 percent of total arsenic in fish. Other recent scientific findings indicate that the percentage of available inorganic arsenic in fish tissue is less than 4 percent (Morrissey et al, 1999). To avoid overstating the health risk associated with total arsenic in fish tissue, the state of Maryland presently applies a 4 percent adjustment factor to the total arsenic concentration to derive a more realistic estimate of the concentration of inorganic arsenic present in edible fish tissue (MDE, 1999). This 4 percent adjustment factor was applied to the total arsenic concentration in fish tissue to derive an inorganic arsenic concentration in fish tissue. The use of estimated inorganic arsenic concentrations introduces some uncertainty into the HHRA. Although, using an adjustment factor from the high end of reported values ensures that the estimated inorganic arsenic concentrations are biased high, therefore, the estimated risks will also be biased high.

6.5.4 Risk Characterization

Uncertainty in risk characterization results from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing noncancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Even when compounds affect the same target organs, they may have different mechanisms of action or differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity is considered because in most cases it represents a conservative estimate of risk.

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.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Because chemical-specific interactions cannot be predicted, the likelihood for risks to be overpredicted or underpredicted cannot be defined, but the methodology that was used is based on current EPA guidance.

6.6 SUMMARY

The human health risk assessment for Mattawoman Creek considered current/future construction workers, adolescent recreational users, and adult recreational users exposed to surface water and sediment. Adolescent and adult recreational users were also evaluated for exposure to potentially contaminated fish. Off-site residents were considered to be part of the recreational receptor group; therefore, off-site residents were not evaluated as a separate receptor group. Both RME and CTE scenarios were evaluated. Table 6-15 summarizes the chemicals of concern for Mattawoman Creek.

The list of COPCs for Mattawoman Creek includes the following:

- Surface water - benzene, ethylbenzene, trichloroethene, arsenic, iron, lead, and manganese.

- Sediment - benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, thallium, and zinc.

- Fish tissue - 4-methylphenol and bis(2ethylhexyl)phthalate, 4,4'-DDE, dieldrin, aroclor-1260, arsenic, chromium, cyanide, manganese, and mercury.

Incremental cancer risks and hazard indices for exposures to sediment and surface water by construction workers, adolescent recreational users, and adult recreational users were within acceptable levels for the RME and CTE scenarios.

The incremental cancer risk for ingestion of fish by adult recreational users exceeded EPA's target risk range of 10^{-4} to 10^{-6} for both the RME and CTE scenarios. Aroclor-1260 was the major contributor to the incremental cancer risk for ingestion of fish from Mattawoman Creek.

The hazard indices for ingestion of fish by adolescent and adult recreational users exceeded the acceptable level of 1. 2-Amino-4,6-dinitrotoluene and 4-methylphenol were the major contributors for the adolescent recreational user under the RME scenario. 4-methylphenol was the major contributor for the adolescent recreational user under the CTE scenario and the adult recreational user under the RME and CTE scenarios.

The hazard indices for ingestion of fish by adolescent and adult recreational users are subject to uncertainty because only three background fish fillet samples were collected so a statistical comparison to background could not be performed during the selection of COPCs. Consequently, no chemical was eliminated as a COPC on the basis of background.

Potential risks from exposures to perchlorate in surface water and fish tissue by adolescent and adult recreational users were evaluated using a draft RfD. The hazard indices for adolescent and adult recreational users exposed to perchlorate in surface water were less than 1 for both the RME and CTE scenarios. The hazard indices for adolescent and adult recreational users consuming fish from Mattawoman Creek exceeded 1. The hazard indices for adolescent and adult recreational users exposed to perchlorate in fish tissue are subject to the following sources of uncertainty:

- The RfD used to estimate the HIs is considered a draft and is currently undergoing peer review.

- Perchlorate was only detected in one of 16 fish fillet samples, but was not detected in the whole body fish samples.

- Perchlorate is not believed to bioconcentrate in fish, consequently the detected concentration in fish tissue is unexpected based on the detected concentrations in surface water. The laboratory reported that the fish tissue samples were diluted due to matrix inferences. It is possible that the detected concentration of perchlorate in the one fish tissue sample is a false positive.

- Perchlorate was not detected in any of the fish samples that were collected as part of a study performed at Indian Head by Parsons Engineering Science, Inc. (June 2001).

Exposures to lead in sediment by construction workers were evaluated using the adult lead model. Results of the adult lead model analysis indicate that blood-lead levels for children (fetuses of exposed woman) were above the level of concern (10 µg/dL) for lead concentrations in Area 1 sediments. The unacceptable risks from exposure to lead in sediment were due to elevated lead concentrations in the sediment sample collected from location IS11SD01. Risks from exposures to lead in sediment by construction workers are within acceptable levels if the sample from location IS11SD01 is removed from the Area 1 data set.

Lead was detected in one surface water sample at a concentration which exceeded the screening level for drinking water, but no adverse health effects are anticipated since the average lead concentration in surface water is less than the screening criteria, and surface water from Mattawoman Creek is not used as a drinking water source.

TABLE 6-1

SCREENING CRITERIA USED IN THE SELECTION OF COPCs
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	EPA Region 3 Risk-Based Concentration (1)		
		Soil Residential (mg/kg)	Fish Tissue (mg/kg)	Tap Water (ug/L)
Volatile Organic Compounds				
67-64-1	Acetone	7800 N	140 N	610 N
71-43-2	Benzene	12 C	0.057 C	0.32 C
75-25-2	Bromoform	81 C	0.4 C	8.5 C
75-15-0	Carbon Disulfide	7800 N	140 N	1000 N
67-66-3	Chloroform	780 N	14 N	0.15 C
74-87-3	Chloromethane	490 C	240 C	2.1 C
156-59-2	cis-1,2-Dichloroethene	780 N	14 N	61 N
60-29-7	Diethyl Ether	16000 N	270 N	1200 N
100-41-4	Ethylbenzene	7800 N	140 N	3.3 C
1634-04-4	Methyl Tert-Butyl Ether	160 C	0.79 C	2.6 C
78-93-3	Methyl Ethyl Ketone	47000 N	810 N	1900 N
108-88-3	Toluene	16000 N	270 N	750 N
1330-20-7	Total Xylenes	160000 N	2700 N	12000 N
79-01-6	Trichloroethene	1.6 C	0.0079 C	0.026 C
Semivolatile Organic Compounds				
91-57-6	2-Methylnaphthalene	1600 N	27 N	120 N
106-44-5	4-Methylphenol	390 N	6.8 N	180 N
83-32-9	Acenaphthene	4700 N	81 N	370 N
208-96-8	Acenaphthylene	4700 (2) N	81 (2) N	370 (2) N
120-12-7	Anthracene	23000 N	410 N	1800 N
100-52-7	Benzaldehyde	7800 N	140 N	3700 N
56-55-3	Benzo(a)anthracene	0.87 C	0.0043 C	0.092 C
50-32-8	Benzo(a)pyrene	0.087 C	0.00043 C	0.0092 C
205-99-2	Benzo(b)fluoranthene	0.87 C	0.0043 C	0.092 C
191-24-2	Benzo(g,h,i)perylene	2300 (3) N	41 (3) N	180 (3) N
207-08-9	Benzo(k)fluoranthene	8.7 C	0.043 C	0.92 C
117-81-7	Bis(2-ethylhexyl)phthalate	46 C	0.23 C	4.8 C
86-74-8	Carbazole	32 C	0.16 C	3.3 C
218-01-9	Chrysene	87 C	0.43 C	9.2 C
53-70-3	Dibenzo(a,h)anthracene	0.087 C	0.00043 C	0.0092 C
132-64-9	Dibenzofuran	310 N	5.4 N	24 N
84-66-2	Diethyl Phthalate	63000 N	1100 N	29000 N
84-74-2	Di-n-Butyl Phthalate	7800 N	140 N	3700 N
206-44-0	Fluoranthene	3100 N	54 N	1500 N
86-73-7	Fluorene	3100 N	54 N	240 N
193-39-5	Indeno(1,2,3-cd)pyrene	0.87 C	0.0043 C	0.092 C
91-20-3	Naphthalene	1600 N	27 N	6.5 N
86-30-6	N-Nitrosodiphenylamine	130 C	0.64 C	14 C
85-01-8	Phenanthrene	2300 (3) N	41 (3) N	180 (3) N
108-95-2	Phenol	47000 N	810 N	22000 N
129-00-0	Pyrene	2300 N	41 N	180 N

TABLE 6-1

SCREENING CRITERIA USED IN THE SELECTION OF COPCs
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	EPA Region 3 Risk-Based Concentration (1)		
		Soil Residential (mg/kg)	Fish Tissue (mg/kg)	Tap Water (ug/L)
Explosives				
99-35-4	1,3,5-trinitrobenzene	2300 N	41 N	1100 N
606-20-2	2,6-Dinitrotoluene	78 N	1.4 N	3.7 N
99-65-0	1,3-Dinitrobenzene	7.8 N	0.14 N	3.7 N
118-96-7	2,4,6-Trinitrotoluene	21 C	1.1 C	2.2 C
35572-78-2	2-Amino-4,6-dinitrotoluene	4.7 N	0.081 N	2.2 N
99-08-1	3-Nitrotoluene	1600 N	27 N	120 N
99-99-0	4-Nitrotoluene	780 N	14 N	61 N
2691-41-0	HMX	3900 N	68 N	1800 N
9004-70-0	Nitrocellulose	NA	NA	NA
556-88-7	Nitroguanidine	NA	NA	NA
Pesticides/PCBs				
72-54-8	4,4'-DDD	2.7 C	0.013 C	0.28 C
72-55-9	4,4'-DDE	1.9 C	0.0093 C	0.2 C
319-84-6	Alpha-BHC	0.1 C	0.0005 C	0.011 C
12672-29-6	Aroclor-1248	320 C	0.0016 C	0.033 C
11096-82-5	Aroclor-1260	0.32 C	0.0016 C	0.033 C
60-57-1	Dieldrin	0.04 C	0.0002 C	0.0042 C
959-98-8	Endosulfan I	470 (4) N	8.1 (4) N	220 (4) N
72-20-8	Endrin	23 N	0.41 N	11 N
5103-74-2	Gamma-Chlordane	1.8 (5) C	0.009 (5) C	0.19 (5) C
Metals				
7429-90-5	Aluminum	78000 N	1400 N	37000 N
7440-36-0	Antimony	31 N	0.54 N	15 N
7440-38-2	Arsenic	0.43 C	0.0021 C	0.045 C
7440-39-3	Barium	5500 N	95 N	2600 N
7440-41-7	Beryllium	160 N	2.7 N	73 N
7440-43-9	Cadmium	78 N	1.4 N	18 N
7440-70-2	Calcium	NA	NA	NA
7440-47-3	Chromium	230 (6) N	4.1 (6) N	110 (6) N
7440-48-4	Cobalt	1600 N	27 N	730 N
7440-50-8	Copper	3100 N	54 N	1500 N
57-12-5	Cyanide	1600 N	27 N	730 N
7439-89-6	Iron	23000 N	410 N	11000 N
7439-92-1	Lead	400 (7)	NA	15 (8)
7439-95-4	Magnesium	NA	NA	NA
7439-96-5	Manganese	1600 N	27 N	730 N
7439-97-6	Mercury	23 (9) N	0.14 (10) N	11 (9) N
7440-02-0	Nickel	1600 N	27 N	730 N
7440-09-7	Potassium	NA	NA	NA
7782-49-2	Selenium	390 N	6.8 N	180 N
7440-22-4	Silver	390 N	6.8 N	180 N

TABLE 6-1

SCREENING CRITERIA USED IN THE SELECTION OF COPCs
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	EPA Region 3 Risk-Based Concentration (1)		
		Soil Residential (mg/kg)	Fish Tissue (mg/kg)	Tap Water (ug/L)
7440-23-5	Sodium	NA	NA	NA
7440-28-0	Thallium	5.5 N	0.095 N	2.6 N
7440-62-2	Vanadium	550 N	9.5 N	260 N
7440-66-6	Zinc	23000 N	410 N	11000 N
	MISCELLANEOUS			
14797-55-8	Nitrate	130000 N	2200 N	58000 N
14797-73-0	Perchlorate	NA	NA	NA

Notes:
1 - USEPA Region 3 Risk-Based Concentration Table, April 2, 2002.
(Cancer benchmark value = 1E-06, HI = 1.0)
2 - Value is for acenaphthene.
3 - Value is for pyrene.
4 - Value is for Endosulfan.
5 - Value is for chlordane.
6 - Value is for hexavalent chromium.
7 - OSWER screening level. EPA,1994:Guidance on Residential Lead-Based Paint, Lead-Contaminated Dust, and Lead-Contaminated Soil.
8 - OSWER action level. USEPA, 2000: Drinking Water Standards and Health Advisories.
9 - Value is for mercuric chloride.
10 - Value is for methyl mercury.
NA - No criteria available.
C = Carcinogenic
N = Non-Carcinogenic

TABLE 6-2

CHEMICALS RETAINED AS COPCs
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Chemical	Surface Water Direct Contact	Sediment Direct Contact	Fish Tissue Direct Contact
Volatile Organic Compounds			
Benzene	X		
Ethylbenzene	X		
Trichloroethene	X		
Semivolatile Organic Compounds			
4-Methylphenol			X
Benzo(a)anthracene		X	
Benzo(a)pyrene		X	
Benzo(b)fluoranthene		X	
Bis(2-ethylhexyl)phthalate			X
Dibenzo(a,h)anthracene		X	
Indeno(1,2,3-cd)pyrene		X	
Pesticide/PCB			
4,4'-DDE			X
Aroclor-1260			X
Dieldrin			X
Energetics			
1,3-Dinitrobenzene			X
2-Amino-4,6-dinitrotoluene			X
Inorganics			
Aluminum		X	
Antimony		X	
Arsenic	X	X	X
Cadmium		X	
Chromium		X	X
Copper		X	
Cyanide			X
Iron	X	X	
Lead	X	X	
Manganese	X	X	X
Mercury		X	X
Silver		X	
Thallium		X	
Zinc		X	
Miscellaneous			
Perchlorate	X		X

Notes:
X - Indicates chemical was retained as a COPC.

TABLE 6-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	U.S. EPA Region 3 RBC-Tap Water (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Volatile Organic Compounds																
67-64-1	ACETONE	5	J	5	J	ug/L	MTCSW00801	1/5	10	5	NA	61 N	NA	NA	No	BSL
71-43-2	**BENZENE**	0.7	J	8		ug/L	MTCSW01001	5/38	1 - 10	8	NA	**0.32 C**	NA	NA	**Yes**	ASL
75-25-2	BROMOFORM	0.5	J	0.5	J	ug/L	MTCSW00301	1/38	1 - 10	0.5	NA	8.5 C	NA	NA	No	BSL
156-59-2	CIS-1,2-DICHLOROETHENE	4		4		ug/L	MTCSW02101	1/38	1 - 10	4	NA	6.1 N	NA	NA	No	BSL
60-29-7	DIETHYL ETHER	6	J	6	J	ug/L	MTCSW02101	1/28	1 - 10	6	NA	120 N	NA	NA	No	BSL
100-41-4	**ETHYLBENZENE**	0.6	J	7		ug/L	MTCSW01001	5/38	1 - 10	7	NA	**3.3 C**	NA	NA	**Yes**	ASL
1634-04-4	METHYL TERT-BUTYL ETHER	1	J	1	J	ug/L	IS11SW01	1/4	10	1	NA	2.6 C	NA	NA	No	BSL
108-88-3	TOLUENE	0.6	J	30		ug/L	MTCSW01501	8/38	1 - 10	30	NA	75 N	NA	NA	No	BSL
1330-20-7	TOTAL XYLENES	1		48		ug/L	MTCSW01001	7/38	1 - 10	48	NA	1200 N	NA	NA	No	BSL
79-01-6	**TRICHLOROETHENE**	1		6		ug/L	MTCSW02101	2/38	1 - 10	6	NA	**0.026 C**	NA	NA	**Yes**	ASL
Semivolatile Organic Compounds																
91-57-6	2-METHYLNAPHTHALENE	2	J	2	J	ug/L	MTCSW01001	1/38	5 - 10	2	NA	12 N	NA	NA	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	1	J	1	J	ug/L	IS11SW01, MTCSW00501, MTCSW02301-D, MTCSW02601, S39SW0020001, S39SW0040001, MTCSW02401	7/38	5 - 10	1	NA	4.8 C	NA	NA	No	BSL
91-20-3	NAPHTHALENE	2	J	2	J	ug/L	MTCSW01001	1/38	5 - 10	2	NA	**0.65 N**	NA	NA	No	FREQ
Energetics																
99-65-0	1,3-DINITROBENZENE	0.075	J	0.075	J	ug/L	IS11SW01	1/38	0.1 - 0.2	0.075	NA	0.37 N	NA	NA	No	BSL
99-99-0	4-NITROTOLUENE	0.11	J	0.11	J	ug/L	IS17SW02	1/38	0.2 - 0.56	0.11	NA	6.1 N	NA	NA	No	BSL
2691-41-0	HMX	0.15	J	0.15	J	ug/L	MTCSW01001	1/38	0.1 - 0.5	0.15	NA	180 N	NA	NA	No	BSL
Inorganics																
7429-90-5	ALUMINUM	124		918		ug/L	S39SW0020001-D	23/44	4.6 - 190	918	NA	3700 N	NA	NA	No	BSL
7440-38-2	**ARSENIC**	4.2	K	8.3	K	ug/L	MTCSW02101	7/44	3.3 - 4.2	8.3	NA	**0.045 C**	NA	NA	**Yes**	ASL
7440-39-3	BARIUM	19	J	76.8		ug/L	S39SW0050001	44/44	NA	76.8	NA	260 N	NA	NA	No	BSL
7440-41-7	BERYLLIUM	0.12		0.12		ug/L	MTCSW00601	1/44	0.1 - 0.42	0.12	NA	7.3 N	NA	NA	No	BSL
7440-43-9	CADMIUM	0.11	K	0.21	K	ug/L	MTCSW02301-D	3/44	0.1 - 0.4	0.21	NA	1.8 N	NA	NA	No	BSL
7440-70-2	CALCIUM	9490		34400		ug/L	S39SW0030001	44/44	NA	34400	NA	NA	NA	NA	No	NUT
7440-47-3	CHROMIUM	0.57	K	3.4	K	ug/L	MTCSW00401	2/44	0.4 - 2.4	3.4	NA	11 (7) N	NA	NA	No	BSL
7440-48-4	COBALT	6.3		6.3		ug/L	S39SW0020001-D	1/44	0.4 - 2.3	6.3	NA	73 N	NA	NA	No	BSL
7440-50-8	COPPER	2.4	J	28.1	K	ug/L	MTCSW02101	8/44	1.1 - 9.1	28.1	NA	150 N	NA	NA	No	BSL
57-12-5	CYANIDE	1.1	L	10		ug/L	MTCSW00501, IS17SW02	5/44	0.98 - 10.3	10	NA	73 N	NA	NA	No	BSL
7439-89-6	**IRON**	84.8		1620	K	ug/L	S39SW0020001-D	44/44	NA	1620	NA	**1100 N**	NA	NA	**Yes**	ASL
7439-92-1	**LEAD**	1.3	J	38.4		ug/L	IS11SW01	9/44	1.2 - 4.1	38.4	NA	**15 (8)**	NA	NA	**Yes**	ASL
7439-95-4	MAGNESIUM	5140		34300		ug/L	S39SW0030001	44/44	0	34300	NA	NA	NA	NA	No	NUT
7439-96-5	**MANGANESE**	9.3	K	202		ug/L	S39SW0020001-D	44/44	1.6	202	NA	**73 N**	NA	NA	**Yes**	ASL
7440-02-0	NICKEL	1.9		4		ug/L	S39SW0020001-D	11/44	1.9 - 8.2	4	NA	73 N	NA	NA	No	BSL
7440-09-7	POTASSIUM	2630	J	12400		ug/L	S39SW0010001, S39SW0030001, S39SW0040001	44/44	NA	12400	NA	NA	NA	NA	No	NUT
7782-49-2	SELENIUM	5.8		5.8		ug/L	IS17SW05	1/44	2.8 - 860	5.8	NA	18 N	NA	NA	No	BSL
7440-22-4	SILVER	1.1		6		ug/L	S39SW0020001-D	1/44	0.6 - 3.1	6	NA	18 N	NA	NA	No	BSL
7440-23-5	SODIUM	11900		211000	J	ug/L	S39SW0030001	44/44	NA	211000	NA	NA	NA	NA	No	NUT
7440-62-2	VANADIUM	0.73	K	7.4		ug/L	MTCSW02101	36/44	0.99 - 2.1	7.4	NA	26 N	NA	NA	No	BSL
7440-66-6	ZINC	16		90.4		ug/L	S39SW0050001	6/44	0.7 - 53.5	90.4	NA	1100 N	NA	NA	No	BSL

TABLE 6-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE WATER
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (1)	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	U.S. EPA Region 3 RBC-Tap Water (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Dissolved Metals																
7440-38-2	**ARSENIC**	3.75	K	5.4	K	ug/L	MTCSW01201-F	4/38	3.6 - 4.2	5.4	NA	**0.045 C**	NA	NA	**Yes**	ASL
7440-39-3	BARIUM	17	J	62.3		ug/L	MTCSW01901-F	36/38	22.4 - 80.3	62.3	NA	260 N	NA	NA	No	BSL
7440-43-9	**CADMIUM**	0.11	K	6.5	K	ug/L	MTCSW02501-F	16/38	0.1 - 0.5	6.5	NA	**1.8 N**	NA	NA	**Yes**	ASL
7440-70-2	CALCIUM	9120		16300		ug/L	MTCSW02101-F	38/38	NA	16300	NA	NA	NA	NA	No	NUT
7440-47-3	CHROMIUM	9.7	K	9.7	K	ug/L	MTCSW00201-F-D	1/38	0.46 - 4.4	9.7	NA	11 (7) N	NA	NA	No	BSL
7440-50-8	COPPER	2.2	J	69.1		ug/L	MTCSW02101-F	5/38	1 - 29.7	69.1	NA	150 N	NA	NA	No	BSL
7439-89-6	IRON	28.2	J	456		ug/L	IS17SW01	10/38	12.8 - 74.9	456	NA	2200 N	NA	NA	No	BSL
7439-92-1	**LEAD**	1.3		66.9		ug/L	MTCSW02401-F	4/38	1.2 - 1.6	66.9	NA	**15 (8)**	NA	NA	**Yes**	ASL
7439-95-4	MAGNESIUM	4840	J	8780		ug/L	MTCSW00401-F	36/38	5960 - 6050	8780	NA	NA	NA	NA	No	NUT
7439-96-5	**MANGANESE**	1.7	J	86.7		ug/L	IS17SW01	14/38	0.81 - 11.6	86.7	NA	**73 N**	NA	NA	**Yes**	ASL
7440-02-0	NICKEL	3.1	J	17.9	J	ug/L	IS17SW01	5/38	1.8 - 6.8	17.9	NA	73 N	NA	NA	No	BSL
7440-09-7	POTASSIUM	2400	J	3980		ug/L	MTCSW00401-F, MTCSW02101-F	38/38	NA	3980	NA	NA	NA	NA	No	NUT
7782-49-2	SELENIUM	4.9	J	4.9	J	ug/L	IS17SW04	1/38	4.3	4.9	NA	18 N	NA	NA	No	BSL
7440-23-5	SODIUM	11300		26500		ug/L	MTCSW01001-F	38/38	NA	26500	NA	NA	NA	NA	No	NUT
7440-62-2	VANADIUM	0.48		3.4		ug/L	MTCSW02101-F	26/38	0.4 - 1.4	3.4	NA	26 N	NA	NA	No	BSL
7440-66-6	ZINC	29.9		29.9		ug/L	IS17SW04	1/38	5.3 - 119	29.9	NA	1100 N	NA	NA	No	BSL
Miscellaneous Parameters																
14797-55-8	NITRATE	0.047	J	0.19	J	mg/L	MTCSW02101	5/23	0.05	0.19	NA	5.8 N	NA	NA	No	BSL
14797-73-0	PERCHLORATE	1.36	J	3.05	J	ug/L	IS11SW04	3/38	3.39 - 5	3.05	NA	NA	NA	NA	No	ASL

Notes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No Background data available.
5 - U.S. EPA Region 3 Risk-Based Concentration Table, April 2, 2002. (RBCs for noncarcinogenic compounds are divided by 10 to correspond to a HI of 0.1).
6 - Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)
No Toxicity Information (NTX)
Detection frequency less than 5% (FREQ)
7 - Value is for hexavalent chromium.
8 - OSWER action level. USEPA, 2000: Drinking Water Standards and Health Advisories.
9 - Calculated value using U.S. EPA Region 3 RBC guidance.
Shading indicates that the maximum detected concentration exceeded the screening criteria therefore the chemical was retained as a COPC.

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

TABLE 6-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	U.S. EPA Region 3 RBC-Residential (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Volatile Organic Compounds																
78-93-3	2-BUTANONE	14	J	390		ug/kg	S39SD0070001	3/40	10 - 50	390	NA	4700000 N	NA	NA	No	BSL
67-64-1	ACETONE	7	J	2400	J	ug/kg	S39SD0070001	26/40	8.7 - 160	2400	NA	780000 N	NA	NA	No	BSL
75-15-0	CARBON DISULFIDE	2	J	45	J	ug/kg	MTCSD00901	26/40	10 - 16	45	NA	780000 N	NA	NA	No	BSL
67-66-3	CHLOROFORM	10	J	12	J	ug/kg	MTCSD02301-D	2/40	10 - 50	12	NA	78000 N	NA	NA	No	BSL
74-87-3	CHLOROMETHANE	14	J	14	J	ug/kg	IS11SD010001	1/40	10 - 50	14	NA	49000 C	NA	NA	No	BSL
156-59-2	CIS-1,2-DICHLOROETHENE	2	J	2	J	ug/kg	MTCSD02101	1/32	10 - 50	2	NA	78000 N	NA	NA	No	BSL
60-29-7	DIETHYL ETHER	6	J	57	J	ug/kg	MTCSD02101	2/28	10 - 50	57	NA	1600000 N	NA	NA	No	BSL
1634-04-4	METHYL TERT-BUTYL ETHER	3	J	3	J	ug/kg	MTCSD02201	1/32	10 - 50	3	NA	160000 C	NA	NA	No	BSL
108-88-3	TOLUENE	0.8	J	4	J	ug/kg	MTCSD01901	4/40	10 - 50	4	NA	1600000 N	NA	NA	No	BSL
79-01-6	TRICHLOROETHENE	5	J	5	J	ug/kg	MTCSD02101	1/40	10 - 50	5	NA	1600 C	NA	NA	No	BSL
Semivolatile Organic Compounds																
99-35-4	1,3,5-TRINITROBENZENE	0.094	J	0.094	J	ug/kg	IS17SD020001	1/38	0.25 - 40.2	0.094	NA	230000 N	NA	NA	No	BSL
606-20-2	2,6-DINITROTOLUENE	0.1	J	0.1	J	ug/kg	IS17SD030001	1/46	0.0476 - 1000	0.1	NA	7800 N	NA	NA	No	BSL
91-57-6	2-METHYLNAPHTHALENE	48	J	85	J	ug/kg	MTCSD02101	2/40	390 - 1600	85	NA	160000 N	NA	NA	No	BSL
106-44-5	4-METHYLPHENOL	80	J	80	J	ug/kg	MTCSD01201-D	1/40	390 - 1600	80	NA	39000 N	NA	NA	No	BSL
83-32-9	ACENAPHTHENE	50	J	120	J	ug/kg	MTCSD02101	2/40	390 - 1600	120	NA	470000 N	NA	NA	No	BSL
208-96-8	ACENAPHTHYLENE	52	J	340	J	ug/kg	MTCSD01201-D	2/40	390 - 1600	340	NA	470000 (7)N	NA	NA	No	BSL
120-12-7	ANTHRACENE	69	J	540	J	ug/kg	MTCSD01201-D	4/40	390 - 1600	540	NA	2300000 N	NA	NA	No	BSL
56-55-3	**BENZO(A)ANTHRACENE**	70	J	1700	J	ug/kg	MTCSD01201-D	11/40	390 - 1600	1700	NA	**870 C**	NA	NA	**Yes**	ASL
50-32-8	**BENZO(A)PYRENE**	77	J	1800	J	ug/kg	MTCSD01201-D	11/40	390 - 1600	1800	NA	**87 C**	NA	NA	**Yes**	ASL
205-99-2	**BENZO(B)FLUORANTHENE**	51	J	2000	J	ug/kg	MTCSD01201-D	21/40	390 - 1600	2000	NA	**870 C**	NA	NA	**Yes**	ASL
191-24-2	BENZO(G,H,I)PERYLENE	51	J	1100	J	ug/kg	MTCSD01201-D	6/40	390 - 1600	1100	NA	230000 (8)N	NA	NA	No	BSL
207-08-9	BENZO(K)FLUORANTHENE	50	J	1500	J	ug/kg	MTCSD02101	7/40	390 - 1600	1500	NA	8700 C	NA	NA	No	BSL
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	48	J	410	J	ug/kg	S39SD0040001	6/40	50 - 1600	410	NA	46000 C	NA	NA	No	BSL
86-74-8	CARBAZOLE	96	J	140	J	ug/kg	MTCSD02101	3/40	390 - 1600	140	NA	32000 C	NA	NA	No	BSL
218-01-9	CHRYSENE	46	J	1700	J	ug/kg	MTCSD01201-D	17/40	390 - 1600	1700	NA	87000 C	NA	NA	No	BSL
84-74-2	DI-N-BUTYL PHTHALATE	470	J	640	J	ug/kg	S39SD0080001	4/40	390 - 1600	640	NA	780000 N	NA	NA	No	BSL
53-70-3	**DIBENZO(A,H)ANTHRACENE**	55	J	220	J	ug/kg	MTCSD01201-D	4/40	390 - 1600	220	NA	**87 C**	NA	NA	**Yes**	ASL
132-64-9	DIBENZOFURAN	80	J	94	J	ug/kg	MTCSD02101	2/40	390 - 1600	94	NA	31000 N	NA	NA	No	BSL
84-66-2	DIETHYL PHTHALATE	65	J	840		ug/kg	MTCSD01501	3/40	390 - 1600	840	NA	6300000 N	NA	NA	No	BSL
206-44-0	FLUORANTHENE	56	J	4000	J	ug/kg	MTCSD01201-D	21/40	390 - 1600	4000	NA	310000 N	NA	NA	No	BSL
86-73-7	FLUORENE	64	J	200	J	ug/kg	MTCSD02101	3/40	390 - 1600	200	NA	310000 N	NA	NA	No	BSL
193-39-5	**INDENO(1,2,3-CD)PYRENE**	55	J	1100	J	ug/kg	MTCSD01201-D	7/40	390 - 1600	1100	NA	**870 C**	NA	NA	**Yes**	ASL
86-30-6	N-NITROSODIPHENYLAMINE	42	J	4800	J	ug/kg	MTCSD02101	10/40	390 - 1600	4800	NA	130000 C	NA	NA	No	BSL
91-20-3	NAPHTHALENE	50	J	71	J	ug/kg	MTCSD02101	2/40	390 - 1600	71	NA	160000 N	NA	NA	No	BSL
85-01-8	PHENANTHRENE	77	J	2600	J	ug/kg	MTCSD01201-D	10/40	390 - 1600	2600	NA	230000 (8)N	NA	NA	No	BSL
129-00-0	PYRENE	48	J	4000	J	ug/kg	MTCSD01201-D	22/40	390 - 1600	4000	NA	230000 N	NA	NA	No	BSL
Pesticides/PCBs																
72-54-8	4,4'-DDD	6	J	7.7	J	ug/kg	S39SD0070001	2/36	3.7 - 16	7.7	NA	2700 C	NA	NA	No	BSL
72-55-9	4,4'-DDE	4.1	J	6	J	ug/kg	S39SD0070001	2/36	3.7 - 16	6	NA	1900 C	NA	NA	No	BSL
319-84-6	ALPHA-BHC	0.7	J	0.7	J	ug/kg	S39SD0030001	1/36	1.9 - 8.1	0.7	NA	100 C	NA	NA	No	BSL
12672-29-6	AROCLOR-1248	170		170		ug/kg	MTCSD00401	1/36	37 - 160	170	NA	320 C	NA	NA	No	BSL
Energetics																
99-65-0	1,3-DINITROBENZENE	0.069	J	0.069	J	mg/kg	IS17SD020001	1/46	0.0372 - 0.25	0.069	NA	0.78 N	NA	NA	No	BSL
118-96-7	2,4,6-TRINITROTOLUENE	0.066	J	0.1	J	mg/kg	IS17SD020001	2/46	0.0356 - 0.25	0.1	NA	21 C	NA	NA	No	BSL
35572-78-2	2-AMINO-4,6-DINITROTOLUENE	0.22	J	0.22	J	mg/kg	IS17SD050001	1/46	0.0467 - 0.25	0.22	NA	0.47 N	NA	NA	No	BSL
99-08-1	3-NITROTOLUENE	0.18	J	0.22	J	mg/kg	IS17SD020001	2/46	0.0818 - 0.25	0.22	NA	160 N	NA	NA	No	BSL
99-99-0	4-NITROTOLUENE	0.14	J	0.14	J	mg/kg	IS11SD040001	1/46	0.0872 - 0.25	0.14	NA	78 N	NA	NA	No	BSL
2691-41-0	HMX	0.1	J	0.1	J	mg/kg	MTCSD02401	1/46	0.0705 - 0.5	0.1	NA	390 N	NA	NA	No	BSL
9004-70-0	NITROCELLULOSE	2	J	4780		mg/kg	MTCSD02101	30/36	0.52 - 16.4	4780	NA	NA	NA	NA	No	NTX

TABLE 6-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SEDIMENT
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	U.S. EPA Region 3 RBC-Residential (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
Inorganics																
7429-90-5	**ALUMINUM**	245		19600		mg/kg	S39SD0070001	46/46	NA	19600	NA	**7800 N**	NA	NA	**Yes**	ASL
7440-36-0	**ANTIMONY**	0.69	L	63.9	L	mg/kg	IS11SD020001	8/46	0.4 - 5.2	63.9	NA	**3.1 N**	NA	NA	**Yes**	ASL
7440-38-2	**ARSENIC**	1.1	K	70.7	J	mg/kg	MTCSD02601	36/46	0.69 - 10.3	70.7	NA	**0.43 C**	NA	NA	**Yes**	ASL
7440-39-3	BARIUM	5.5		169		mg/kg	IS11SD010001	46/46	NA	169	NA	550 N	NA	NA	No	BSL
7440-41-7	BERYLLIUM	0.061	J	1.6	J	mg/kg	MTCSD01901	40/46	0.055 - 0.22	1.6	NA	16 N	NA	NA	No	BSL
7440-43-9	**CADMIUM**	0.074	K	116	J	mg/kg	MTCSD02601	38/46	0.07 - 0.8	116	NA	**3.9 N**	NA	NA	**Yes**	ASL
7440-70-2	CALCIUM	85		22100	J	mg/kg	IS11SD020001	44/46	151 - 198	22100	NA	NA	NA	NA	No	NUT
7440-47-3	**CHROMIUM**	1.8	K	69.7	L	mg/kg	IS11SD040001	46/46	NA	69.7	NA	**23 (9)N**	NA	NA	**Yes**	ASL
7440-48-4	COBALT	1.5		34.7		mg/kg	S39SD0020001	44/46	1.4 - 5.1	34.7	NA	160 N	NA	NA	No	BSL
7440-50-8	**COPPER**	3	J	757	L	mg/kg	IS11SD010001	43/46	0.3 - 4.7	757	NA	**310 N**	NA	NA	**Yes**	ASL
57-12-5	CYANIDE	0.12	J	4.7	J	mg/kg	MTCSD00201	4/46	0.14 - 2.7	4.7	NA	160 N	NA	NA	No	BSL
7439-89-6	**IRON**	1710		134000	J	mg/kg	IS11SD030001	46/46	NA	134000	NA	**2300 N**	NA	NA	**Yes**	ASL
7439-92-1	**LEAD**	1.7		76400	J	mg/kg	IS11SD010001	46/46	NA	76400	NA	**400 (10)**	NA	NA	**Yes**	ASL
7439-95-4	MAGNESIUM	108	J	3190	J	mg/kg	IS11SD020001	43/46	56.2 - 106	3190	NA	NA	NA	NA	No	NUT
7439-96-5	**MANGANESE**	28.2		1470	J	mg/kg	MTCSD01901	46/46	0	1470	NA	**160 N**	NA	NA	**Yes**	ASL
7439-97-6	**MERCURY**	0.02		8.7		mg/kg	S39SD0070001	32/45	0.05 - 0.17	8.7	NA	**2.3 N**	NA	NA	**Yes**	ASL
7440-02-0	NICKEL	1.3	K	46.4	L	mg/kg	IS11SD040001	44/46	1.2 - 2	46.4	NA	160 N	NA	NA	No	BSL
2023695	POTASSIUM	74.7		1530	J	mg/kg	MTCSD00901	45/46	8.9 - 44.8	1530	NA	NA	NA	NA	No	NUT
7782-49-2	SELENIUM	1.7	L	1.7	L	mg/kg	IS11SD030001	1/45	0.65 - 3.9	1.7	NA	39 N	NA	NA	No	BSL
7440-22-4	**SILVER**	0.12	L	308		mg/kg	S39SD0040001	33/46	0.099 - 0.82	308	NA	**39 N**	NA	NA	**Yes**	ASL
7440-23-5	SODIUM	372	J	23000	J	mg/kg	MTCSD02601	4/46	34.9 - 607	23000	NA	NA	NA	NA	No	NUT
7440-28-0	**THALLIUM**	1.1	K	4.2		mg/kg	IS11SD010001	9/46	0.64 - 3.6	4.2	NA	**0.55 N**	NA	NA	**Yes**	ASL
7440-62-2	VANADIUM	3.5	K	53.4		mg/kg	MTCSD02101	46/46	NA	53.4	NA	55 N	NA	NA	No	BSL
7440-66-6	**ZINC**	8.8	J	71000	J	mg/kg	MTCSD02601	40/46	3.5 - 149	71000	NA	**2300 N**	NA	NA	**Yes**	ASL

Notes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No Background data available for this site.
5 - U.S. EPA Region 3 Risk-Based Concentration Table, April 2, 2002. (RBCs for noncarcinogenic compounds are divided by 10 to correspond to a HI of 0.1).
6 - Rationale Codes — Selection Reason: Above Screening Levels (ASL); Deletion Reason: Essential Nutrient (NUT)
7 - Value is for acenaphthene. — Below Screening Level (BSL)
8 - Value is for pyrene. — No Toxicity Information (NTX)
9 - Value is for hexavalent chromium.
10 - OSWER screening level. U.S. EPA, 1994: Guidance on Residential Lead-Based Paint, Lead Contaminated Dust, and Lead Contaminated Soil.
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC.

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

TABLE 6-5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - FISH TISSUE
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Nondetects(2)	Concentration Used for Screening(3)	Background Value(4)	U.S. EPA Region 3 RBC (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
	Semivolatile Organic Compounds															
106-44-5	**4-Methylphenol**	80	J	64000		ug/kg	MTCCT00302	11/16	330	64000	NA	**680 N**	NA	NA	**Yes**	ASL
100-52-7	Benzaldehyde	43	J	91	J	ug/kg	MTCLB005	5/16	330 - 9800	91	NA	14000 N	NA	NA	No	BSL
117-81-7	**Bis(2-Ethylhexyl)Phthalate**	75	J	2200		ug/kg	MTCCT00403	14/16	330	2200	NA	**230 C**	NA	NA	**Yes**	ASL
108-95-2	Phenol	54	J	150	J	ug/kg	MTCCT005	3/16	330 - 9800	150	NA	81000 N	NA	NA	No	BSL
	Pesticides/PCBs															
72-55-9	**4,4'-DDE**	4.2		110		ug/kg	MTCCT00301	12/16	3.3	110	NA	**9.3 C**	NA	NA	**Yes**	ASL
11096-82-5	**Aroclor-1260**	39		380	J	ug/kg	MTCCT00301	12/16	33	380	NA	**1.6 C**	NA	NA	**Yes**	ASL
60-57-1	**Dieldrin**	7.3	J	7.3	J	ug/kg	MTCCT00301	1/15	3.3	7.3	NA	**0.2 C**	NA	NA	**Yes**	ASL
959-98-8	Endosulfan I	2.1	J	2.1	J	ug/kg	MTCCT00102	1/16	1.7	2.1	NA	810 (7) N	NA	NA	No	BSL
72-20-8	Endrin	5		5		ug/kg	MTCCT00402	1/16	3.3	5	NA	41 N	NA	NA	No	BSL
5103-74-2	Gamma-Chlordane	3.2	J	8.5	J	ug/kg	MTCCT00301	3/14	1.7	8.5	NA	9 (8) C	NA	NA	No	BSL
	Energetics															
99-65-0	**1,3-Dinitrobenzene**	0.057	J	0.057	J	mg/kg	MTCCT005	1/16	0.25	0.057	NA	**0.014 N**	NA	NA	**Yes**	ASL
35572-78-2	**2-Amino-4,6-Dinitrotoluene**	0.096	J	0.096	J	mg/kg	MTCCT00402	1/16	0.25	0.096	NA	**0.0081 N**	NA	NA	**Yes**	ASL
2691-41-0	HMX	0.083	J	0.083	J	mg/kg	MTCCT005	1/16	0.25	0.083	NA	6.8 N	NA	NA	No	BSL
9004-70-0	Nitrocellulose	5.7		5.7		mg/kg	MTCCT00402	1/16	1.2 - 3.5	5.7	NA	NA	NA	NA	No	NTX
556-88-7	Nitroguanidine	0.12	J	0.19	J	mg/kg	MTCLB00401	2/16	0.25	0.19	NA	NA	NA	NA	No	NTX
	Inorganics															
7429-90-5	Aluminum	2.8		22.4		mg/kg	MTCCT00102	8/16	1.4 - 4.1	22.4	NA	140 N	NA	NA	No	BSL
7440-38-2	**Arsenic**	0.026		0.064	K	mg/kg	MTCLB00202	8/16	0.57 - 0.84	1.6	NA	**0.0021 C**	NA	NA	**Yes**	ASL
7440-39-3	Barium	0.3		0.74		mg/kg	MTCLB005	4/16	0.06 - 0.42	0.74	NA	9.5 N	NA	NA	No	BSL
7440-43-9	Cadmium	0.017		0.034		mg/kg	MTCCT00101	9/16	0.014 - 0.02	0.034	NA	0.14 N	NA	NA	No	BSL
7440-70-2	Calcium	101		16900		mg/kg	MTCLB005	16/16	NA	16900	NA	NA	NA	NA	No	NUT
7440-47-3	**Chromium**	0.92	K	6.2		mg/kg	MTCLB00202	3/16	0.17 - 0.32	6.2	NA	**0.41 (9) N**	NA	NA	**Yes**	ASL
7440-50-8	Copper	3.6		3.6		mg/kg	MTCCT005	1/16	0.3 - 1.1	3.6	NA	5.4 N	NA	NA	No	BSL
57-12-5	**Cyanide**	0.49		5.5		mg/kg	MTCLB00201	2/16	0.3 - 0.43	5.5	NA	**2.7 N**	NA	NA	**Yes**	ASL
7439-89-6	Iron	7.3	J	48		mg/kg	MTCLB00202	8/16	3 - 7.5	48	NA	41 N	NA	NA	No	BSL
7439-92-1	Lead	0.2		1.1		mg/kg	MTCLB00202	4/16	0.16 - 0.54	1.1	NA	NA	NA	NA	No	NTX
7439-95-4	Magnesium	113		611		mg/kg	MTCLB005	16/16	NA	611	NA	NA	NA	NA	No	NUT
7439-96-5	**Manganese**	0.39	K	4	J	mg/kg	MTCCT00302	15/16	0.34	4	NA	**2.7 N**	NA	NA	**Yes**	ASL
7439-97-6	**Mercury**	0.052		0.098		mg/kg	MTCLB005	2/16	0.042 - 0.05	0.098	NA	**0.014 (10) N**	NA	NA	**Yes**	ASL
7440-09-7	Potassium	1400	J	3680		mg/kg	MTCLB005	16/16	NA	3680	NA	NA	NA	NA	No	NUT
7440-23-5	Sodium	200		880		mg/kg	MTCCT005	16/16	NA	880	NA	NA	NA	NA	No	NUT
7440-66-6	Zinc	6.1	J	11.9		mg/kg	MTCLB00201	9/16	5.1 - 7.2	11.9	NA	41 N	NA	NA	No	BSL
	Miscellaneous Parameters															
14797-73-0	Perchlorate	10200		10200		ug/kg	MTCLB00201	1/16	2500 - 5000	10200	NA	NA	NA	NA	No	NTX

Notes:
1 - Sample and duplicate are counted as two separate samples when determining the minimum and maximum detected concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background values.
5 - U.S. EPA Region 3 Risk-Based Concentration Table, April 2, 2002. (RBCs for noncarcinogenic compounds are divided by 10 to correspond to a HI of 0.1).
6 - Rationale Codes
Selection Reason: Above Screening Levels (ASL)
No Toxicity Information (NTX)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)
Below Background Value (BKG)

7 - Value is for Endosulfan.
8 - Value is for chlordane.
9 - Value is for hexavalent chromium.
10 - Value is for methyl mercury.
11 - Calculated value using U.S. EPA Region 3 RBC guidance.
Shaded cells indicate that the specified criterion has been exceeded or that the chemical has been selected as a COPC.

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

TABLE 6-6

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

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 (3) (MM/DD/YY)
Volatile Organic Compounds										
Benzene	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Carcinogen	NA	IRIS	07/03/02
Ethylbenzene	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Liver,Kidney	1000/1	IRIS	07/03/02
Trichloroethene	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Liver	NA	IRIS	07/03/02
Semivolatile Organic Compounds										
4-Methylphenol	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	CNS,Respiratory	NA	IRIS	07/03/02
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	07/03/02
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	07/03/02
Pesticides/PCBs										
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor-1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	Chronic	5.0E-05	mg/kg/day	1	5.0E-05	mg/kg/day	Liver	300/1	IRIS	07/03/02
Explosives										
1,3-Dinitrobenzene	Chronic	1.0E-04	mg/kg/day	1	1.0E-04	mg/kg/day	Spleen	3000/1	IRIS	07/03/02
2-Amino-4,6-Dinitrotoluene	Chronic	6.0E-05	mg/kg/day	1	6.0E-05	mg/kg/day	Liver	NA	IRIS	07/03/02
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	Immune, Nails	NA	IRIS	07/03/02
Antimony	Chronic	4.0E-04	mg/kg/day	0.15	6.0E-05	mg/kg/day	Blood	1000/1	IRIS	07/03/02
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	07/03/02
Cadmium	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	IRIS	07/03/02
Chromium	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	07/03/02
Copper	Chronic	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	GS	NA	HEAST	7/97
Cyanide	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	100/5	IRIS	07/03/02
Iron	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Liver, Blood, GS	NA	IRIS	07/03/02
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese(sediment)	Chronic	7.2E-02	mg/kg/day	0.04	2.9E-03	mg/kg/day	CNS	1/1	IRIS	07/03/02
Manganese(surface water)	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/1	IRIS	07/03/02
Manganese(fish)	Chronic	1.4E-01	mg/kg/day	0.04	5.6E-03	mg/kg/day	CNS	1/1	IRIS	07/03/02
Mercury(methyl)	Chronic	1.0E-04	mg/kg/day	1	1.0E-04	mg/kg/day	CNS	10/1	IRIS	07/03/02
Mercuric chloride	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	CNS	30/1	IRIS	07/03/02
Silver	Chronic	5.0E-03	mg/kg/day	0.04	2.0E-04	mg/kg/day	Blood	3/1	IRIS	07/03/02
Thallium	Chronic	7.0E-05	mg/kg/day	1	7.0E-05	mg/kg/day	Liver	NA	IRIS	07/03/02
Zinc	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Blood	3/1	IRIS	07/03/02

Notes:
1 - EPA, 2001: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - RfDdermal = RfDoral x Oral to Dermal Adjustment Factor
3 - Dates of IRIS, HEAST, or NCEA.

Definitions:
CNS = Central Nervous System
CVS = Cardiovascular System
GS = Gastrointestinal
NA = Not Available
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NCEA = U.S. EPA National Center for Environmental Assessment (U.S. EPA Region 3 RBC Table, April 2, 2002)

TABLE 6-7

CANCER TOXICITY DATA - ORAL/DERMAL
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

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	Date (3) (MM/DD/YY)
Volatile Organic Compounds							
Benzene	1.5E-02	1	1.5E-02	$(mg/kg\text{-}day)^{-1}$	A	IRIS	07/03/02
Ethylbenzene	NA	NA	NA	NA	D	IRIS	07/03/02
Trichloroethene	4.0E-01	1	4.0E-01	$(mg/kg/day)^{-1}$	NA	IRIS	07/03/02
Semivolatile Organic Compounds							
4-Methylphenol	NA	NA	NA	NA	C	IRIS	07/03/02
Benzo(a)anthracene	7.3E-01	1	7.3E-01	$(mg/kg\text{-}day)^{-1}$	NA	EPA	7/93
Benzo(a)pyrene	7.3E+00	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	07/03/02
Benzo(b)fluoranthene	7.3E-01	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA	07/93
Bis(2-ethylhexyl)phthalate	1.4E-02	1	1.4E-02	$(mg/kg/day)^{-1}$	B2	IRIS	07/03/02
Dibenzo(a,h)anthracene	7.3E+00	1	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	EPA	7/93
Indeno(1,2,3-cd)pyrene	7.3E-01	1	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	EPA	7/93
Naphthalene	NA	NA	NA	NA	C	IRIS	07/03/02
Pesticides/PCBs							
4,4'-DDE	3.4E-01	1	3.4E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	07/03/02
Aroclor-1260	2.0E+00	1	2.0E+00	$(mg/kg\text{-}day)^{-1}$	NA	IRIS	07/03/02
Dieldrin	1.6E+01	1	1.6E+01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	07/03/02
Explosives							
1,3-Dinitrobenzene	NA	NA	NA	NA	D	IRIS	07/03/02
2-Amino-4,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA
Inorganics							
Arsenic	1.5E+00	1	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	07/03/02
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	1	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	07/03/02
Cadmium	NA	NA	NA	NA	B1	IRIS	07/03/02
Chromium	NA	NA	NA	NA	A	IRIS	07/03/02
Copper	NA	NA	NA	NA	D	IRIS	07/03/02
Cyanide	2.0E-02	1	2.0E-02	$(mg/kg\text{-}day)^{-1}$	D	IRIS	07/03/02
Iron	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	B2	IRIS	07/03/02
Manganese	NA	NA	NA	NA	D	IRIS	07/03/02
Mercury	NA	NA	NA	NA	D	IRIS	07/03/02

TABLE 6-7

CANCER TOXICITY DATA - ORAL/DERMAL
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

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	Date (3) (MM/DD/YY)
Silver	NA	NA	NA	NA	D	IRIS	07/03/02
Thallium	NA	1	NA	NA	D	IRIS	07/03/02
Zinc	NA	1	NA	NA	D	IRIS	07/03/02

Notes:
1 - EPA, 2001: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - CSFdermal = CSForal/Oral to Dermal Adjustment Factor.
3 - Dates of IRIS, HEAST or NCEA.

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

Definitions:
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
EPA 3 = U.S. EPA Region 3 RBC Table, April 2, 2002
EPA = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July, 1993, EPA/600/R-93/089.
NA = Not Available

TABLE 6-8

EXPOSURE POINT CONCENTRATION
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

Chemical	Surface Water (ug/L)	Sediment (mg/kg)	Fish Tissue (ug/kg)
Volatile Organic Compounds			
Benzene	1.55	NA	NA
Ethylbenzene	1.55	NA	NA
Trichloroethene	1.27	NA	NA
Semivolatile Organic Compounds			
4-Methylphenol	NA	NA	64(1)
Benzo(a)anthracene	NA	0.515	NA
Benzo(a)pyrene	NA	0.501	NA
Benzo(b)fluoranthene	NA	0.445	NA
Bis(2-ethylhexyl)phthalate	NA	NA	1.19 (3)
Dibenzo(a,h)anthracene	NA	0.22 (1)	NA
Indeno(1,2,3-cd)pyrene	NA	0.423 (3)	NA
Pesticide/PCB			
4,4'-DDE	NA	NA	0.083
Aroclor-1260	NA	NA	0.284
Dieldrin	NA	NA	0.002
Energetics			
1,3-Dinitrobenzene	NA	NA	0.057 (1)
2-Amino-4,6-dinitrotoluene	NA	NA	0.096 (1)
Inorganics			
Aluminum	NA	10259	NA
Antimony	NA	3.70	NA
Arsenic	2.75	13.6	0.04
Cadmium	NA	5.74	NA
Chromium	NA	26.7	1.09
Copper	NA	196	NA
Cyanide	NA	NA	0.621
Iron	474	34457	NA
Lead	2.03 (2)	1832 (2)	NA
Manganese	81.2	702	2.44
Mercury	NA	0.439	0.035
Silver	NA	17.7	NA
Thallium	NA	1.30	NA
Zinc	NA	1106	NA

Notes:

RAGS Part D Tables for the exposure point concentrations are included in Appendix D.
All values are 95% UCL for lognormal distribution unless otherwise noted.
1 - UCL is greater than maximum concentration therefore maximum concentration is used.
2 - Average concentration.
3 - 95% UCL for normal distribution.
NA - Chemical is not a COPC for this media.

TABLE 6-9

SELECTION OF EXPOSURE PATHWAYS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Sediment	Sediment	Mattawoman Creek	Construction Workers	Adult	Ingestion	On-Site	Quant	Construction workers may contact sediment during construction activities.
						Dermal	On-Site	Quant	
				Recreational Users	Adolescents	Ingestion	On-Site	Quant	Recreational users may be exposed to sediment in Mattawoman Creek.
						Dermal	On-Site	Quant	
					Adult	Ingestion	On-Site	Quant	Recreational users may be exposed to sediment in Mattawoman Creek.
						Dermal	On-Site	Quant	
				Off-Site Residents	Child	Ingestion	On-Site	None	Off-Site residents are considered to be part of the recreational user group; therefore, off-site residents are not evaluated as a separate receptor group.
						Dermal	On-Site	None	
					Adult	Ingestion	On-Site	None	
						Dermal	On-Site	None	
	Surface Water	Surface Water	Mattawoman Creek	Construction Workers	Adult	Ingestion	On-Site	None	Construction workers are not anticipated to ingested surface water.
						Dermal	On-Site	Quant	Construction workers may contact surface water during construction activities.
				Recreational Users	Adolescents	Ingestion	On-Site	Quant	Recreational users may be exposed to surface water in Mattawoman Creek.
						Dermal	On-Site	Quant	
					Adult	Ingestion	On-Site	Quant	Recreational users may be exposed to surface water in Mattawoman Creek.
						Dermal	On-Site	Quant	
				Off-Site Residents	Child	Ingestion	On-Site	None	Off-Site residents are considered to be part of the recreational user group; therefore, off-site residents are not evaluated as a separate receptor group.
						Dermal	On-Site	None	
					Adult	Ingestion	On-Site	None	
						Dermal	On-Site	None	
		Fish	Mattawoman Creek	Recreational Users	Adolescents	Ingestion	On-site	Quant	Recreational users may fish at the site.
					Adult	Ingestion	On-site	Quant	Recreational users may fish at the site.

TABLE 6-10

EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD MARYLAND

Receptors	Exposure Routes
Construction Workers (current/future land use)	• Sediment - Incidental Ingestion • Sediment - Dermal Contact • Surface Water - Dermal Contact
Dredging Workers (future land use)	• Sediment - Incidental Ingestion • Sediment - Dermal Contact • Surface Water - Dermal Contact
Adolescent and Adult Recreational Users (current/future land use)	• Sediment - Incidental Ingestion • Sediment - Dermal Contact • Surface Water - Incidental Ingestion • Surface Water - Dermal Contact • Fish - Ingestion

TABLE 6-11

SUMMARY OF EXPOSURE ASSUMPTIONS
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND
PAGE 1 OF 2

Exposure Parameter	Construction Worker		Adolesecent Recreational Users		Adult Recreational Users	
	RME	CTE	RME	CTE	RME	CTE
All Exposures						
C_{sed} (mg/kg) C_{sw} (ug/L)	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]
C_{fish} (mg/kg)	NA	NA	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]	Maximum or 95% UCL[1]
EF (days/year)	60[2]	30[2]	16[8]	8[8]	16[8]	8[8]
ED (years)	1[2]	1[2]	10[3]	10[3]	30[4]	9[4]
BW (kg)	70[4]	70[4]	43[6]	43[6]	70[4]	70[4]
AT_n (days)	365[5]	365[5]	3,650[5]	3,650[5]	10,950[5]	3,285[5]
AT_c (days)	25,550[5]	25,550[5]	25,550[5]	25,550[5]	25,550[5]	25,550[5]
Incidental Ingestion/Dermal Contact with Sediment						
IR (mg/day)	240[7]	120[7]	100[4]	50[4]	100[4]	50[4]
FI (unitless)	1[4]	1[4]	1[4]	1[4]	1[4]	1[4]
SA (cm^2/day)	4,300[9]	4,300[9]	3,720[10]	3,720[10]	6,000[11]	6,000[11]
AF (mg/cm^2)	0.2[12]	0.02[12]	0.2[12]	0.02[12]	0.2[12]	0.02[12]
ABS (unitless)	chemical-specific[12,13]	chemical-specific[12,13]	chemical-specific[12,13]	chemical-specific[12,13]	chemical-specific[12,13]	chemical-specific[12,13]
CF (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06	1E-06
Incidental Ingestion/Dermal Contact with Surface Water						
CR (L/hour)	NA	NA	0.05[14]	0.05[14]	0.05[14]	0.05[14]
ET (hours/day) and t_{event} (hours/event)	8[7]	4[7]	2[7]	1[7]	2[7]	1[7]
A (cm^2/day)	4,300[9]	4,300[9]	12,400[12]	12,400[12]	20,000[12]	20,000[12]
K_p (cm/hour)	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]
t* (hour/event), T (hour), and B (unitless)	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]	chemical-specific[12]
CF (L/cm^3)	1E-03	1E-03	1E-03	1E-03	1E-03	1E-03
Ingestion of Fish						
IRf (kg/meal)	NA	NA	0.129[6]	0.129[6]	0.129[6]	0.129[6]
EF (meals/year)	NA	NA	104[15]	62[6]	104[15]	62[6]

Notes:

$C_{sed/sw/fish}$	Exposure concentration for sediment/surface water/fish
EF	Exposure frequency
ED	Exposure duration
BW	Body weight
AT_n	Averaging time for noncarcinogenic effects
AT_c	Averaging time for carcinogenic effects
IR	Ingestion rate (soil or groundwater)
FI	Fraction ingested from contaminated source
SA	Skin surface area available for contact
AF	Soil-to-skin adherence factor
ABS	Absorption factor
CF	Conversion factor
ET	Exposure time
t_{event}	Duration of event
A	Skin surface area available for contact
EV	Event frequency
K_p	Permeability coefficient from water through skin
t*	Time it takes to reach steady-state conditions
T	Lag time
B	Bunge Model partitioning coefficient
CR	Contact rate

TABLE 6-11

SUMMARY OF EXPOSURE ASSUMPTIONS
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

1 - USEPA 1992. 95% UCL is used if the data set is of sufficient size (i.e., 10 samples or more). For smaller data sets (i.e., less than 10 samples), the 95% UCL is not appropriate and the maximum concentration is used.
2 - Assumes construction takes place two months over a one year period. CTE is assumed to be 50 percent of RME.
3 - Ages 6 to 17.
4 - USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
5 - USEPA, 1989: Risk Assessment Guidance for Superfund – Volume I – Human Health Evaluation Manual (Interim Final). EPA/540/1-86/060.
6 - USEPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.
7 - Professional judgement.
8 - Assumes one day a week during the summer months. CTE is assumed to be 50 percent of RME.
9 - Mean value for head, arms, and hands. USEPA, 2001.
10 - Assumes that 30 percent of total body surface area of (12,400 cm^2) is available for exposure. USEPA, 2001.
11 - Assumes that 30 percent of total body surface area of (20,000 cm^2) is available for exposure. USEPA, 2001.
12 - USEPA, 2001: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R99/005.
13 - USEPA Region 3, Assessing Dermal Contact With Soil, December 1995.
14 - USEPA, 1988. Superfund Exposure Assessment Manual, April. EPA/540/1-88/001.
15 - Assumes two meals a week.

TABLE 6-12

PARAMETERS FOR EVALUATION OF DERMAL CONTACT
SURFACE WATER
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Chemical	Estimated Kp (cm/hr)	FA	τ (hr)	B	t* (hr)
Volatile Organic Compounds					
Benzene	1.49E-02	1	2.92E-01	5.05E-02	7.00E-01
Ethylbenzene	4.93E-02	1	4.20E-01	1.95E-01	1.01E+00
Trichloroethene	1.16E-02	1	5.81E-01	5.13E-02	1.39E+00
Inorganics					
Arsenic	1.00E-03	NA	NA	NA	NA
Iron	1.00E-03	NA	NA	NA	NA
Lead	1.00E-03	NA	NA	NA	NA
Manganese	1.00E-03	NA	NA	NA	NA

Notes:
NA - Not applicable for inorganics.
Source: EPA, 2001: Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R99/005.

TABLE 6-13

SUMMARY OF CANCER RISKS AND HAZARD INDICES - RME
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals with HI > 1
Construction Worker	Surface Water	Dermal Contact	1.3E-08	- -	- -	- -	0.01	- -
		Total	1.3E-08	- -	- -	- -	0.01	- -
	Sediment	Ingestion	2.0E-07	- -	- -	- -	0.1	- -
		Dermal Contact	3.6E-08	- -	- -	- -	0.003	- -
		Total	2.4E-07	- -	- -	- -	0.003	- -
		Total All Media	2.5E-07				0.1	
Adolescent Recreational User	Surface Water	Ingestion	6.8E-08	- -	- -	- -	0.002	- -
		Dermal Contact	5.0E-08	- -	- -	- -	0.005	- -
		Total	1.2E-07	- -	- -	- -	0.01	- -
	Sediment	Ingestion	3.7E-07	- -	- -		0.02	- -
		Dermal Contact	1.3E-07	- -	- -		0.001	- -
		Total	5.0E-07	- -		- -	0.02	- -
	Fish	Ingestion	8.7E-05	- -	Aroclor-1260	Bis(2-ethylhexyl)phthalate, 4,4'-DDE, Dieldrin, Arsenic	13	4-Methylphenol, 2-Amino-4,6-dinitrotoluene
		Total All Media	8.8E-05				13	
Adult Recreational Users	Surface Water	Ingestion	1.2E-07	- -	- -	- -	0.001	- -
		Dermal Contact	1.5E-07	- -	- -	- -	0.005	- -
		Total	2.7E-07	- -	- -	- -	0.006	- -
	Sediment	Ingestion	6.8E-07	- -	- -	- -	0.02	- -
		Dermal Contact	1.4E-07	- -	- -	- -	0.0004	- -
		Total	8.2E-07	- -	- -	- -	0.02	- -
	Fish	Ingestion	1.6E-04	Aroclor-1260	Arsenic	Bis(2-ethylhexyl)phthalate, 4,4'-DDE, Dieldrin	8	4-Methylphenol
		Total All Media	1.6E-04				8	

TABLE 6-14

SUMMARY OF CANCER RISKS AND HAZARD INDICES - CTE
MATTAWOMAN CREEK
INDIV-NSWC, INDIAN HEAD, MARYLAND

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals with HI > 1
Construction Worker	Surface Water	Dermal Contact	3.4E-09	- -	- -	- -	0.003	- -
		Total	3.4E-09	- -	- -	- -	0.003	- -
	Sediment	Ingestion	5.1E-08	- -	- -	- -	0.03	- -
		Dermal Contact	1.8E-09	- -	- -	- -	0.0002	- -
		Total	5.3E-08	- -	- -	- -	0.03	- -
		Total All Media	5.6E-08				0.04	
Adolescent Recreational User	Surface Water	Ingestion	1.7E-08	- -	- -	- -	0.0005	- -
		Dermal Contact	1.5E-08	- -	- -	- -	0.001	- -
		Total	3.2E-08	- -	- -	- -	0.002	- -
	Sediment	Ingestion	9.2E-08	- -	- -	- -	0.006	- -
		Dermal Contact	6.7E-09	- -	- -	- -	0.00006	- -
		Total	9.9E-08	- -		- -	0.006	- -
	Fish	Ingestion	5.2E-05	- -	Aroclor-1260	Bis(2-ethylhexyl)phthalate, 4,4'-DDE, Dieldrin, Arsenic	8	4-Methlphenol
		Total All Media	5.2E-05				8	
Adult Recreational Users	Surface Water	Ingestion	9.4E-09	- -	- -	- -	0.0003	- -
		Dermal Contact	1.4E-08	- -	- -	- -	0.001	- -
		Total	2.3E-08	- -	- -	- -	0.002	- -
	Sediment	Ingestion	5.1E-08	- -	- -	- -	0.004	- -
		Dermal Contact	3.0E-09	- -	- -	- -	0.00003	- -
		Total	5.4E-08	- -	- -	- -	0.004	- -
	Fish	Ingestion	2.9E-05	- -	Aroclor-1260	4,4'-DDE, Dieldrin, Arsenic	5	4-Methylphenol
		Total All Media	2.9E-05				5	

TABLE 6-15

SUMMARY OF CONCLUSIONS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Chemical of Concern[1]	Impact on Human Receptors	Comments
SEDIMENT		
Lead	Construction Worker - More than 5 % of the fetuses born to construction workers predicted to have blood lead levels greater than 10 μg/dL	The unacceptable risks from exposure to lead in sediment were due to elevated lead concentrations in the sediment sample collected from location IS11SD01. Risks from exposures to lead in sediment by construction workers are within acceptable levels if the sample from location IS11SD01 is removed from the Area 1 dataset.
FISH TISSUE		
Aroclor-1260	Adult Recreational User ILCR = 1.3E-04 Lifelong Recreational User ILCR = 2E-04[2]	Risks assume that recreational users consume two meals per week.
4-Methylphenol	Adolescent Recreational User HI = 11 Adult Recreational User HI = 6.7	Risks assume that recreational users consume two meals per week.
2-Amino-4,6-dinitrotoluene	Adolescent Recreational User HI = 1.4	2-Amino-4,6-dinitrotoluene was detected in only one of 16 fish tisssue samples.

HQ = Hazard Quotient.
ILCR = Incremental Lifetime Cancer Risk
1 - Any carcinogenic chemical with an ILCR greater than 1.0E-4 or a noncarcinogenic chemical contributing to target organ hazard indices (HI) greater than 1.0.
2 - Lifelong Recreational User = Adolescent Recreational User plus Adult Recreational User.

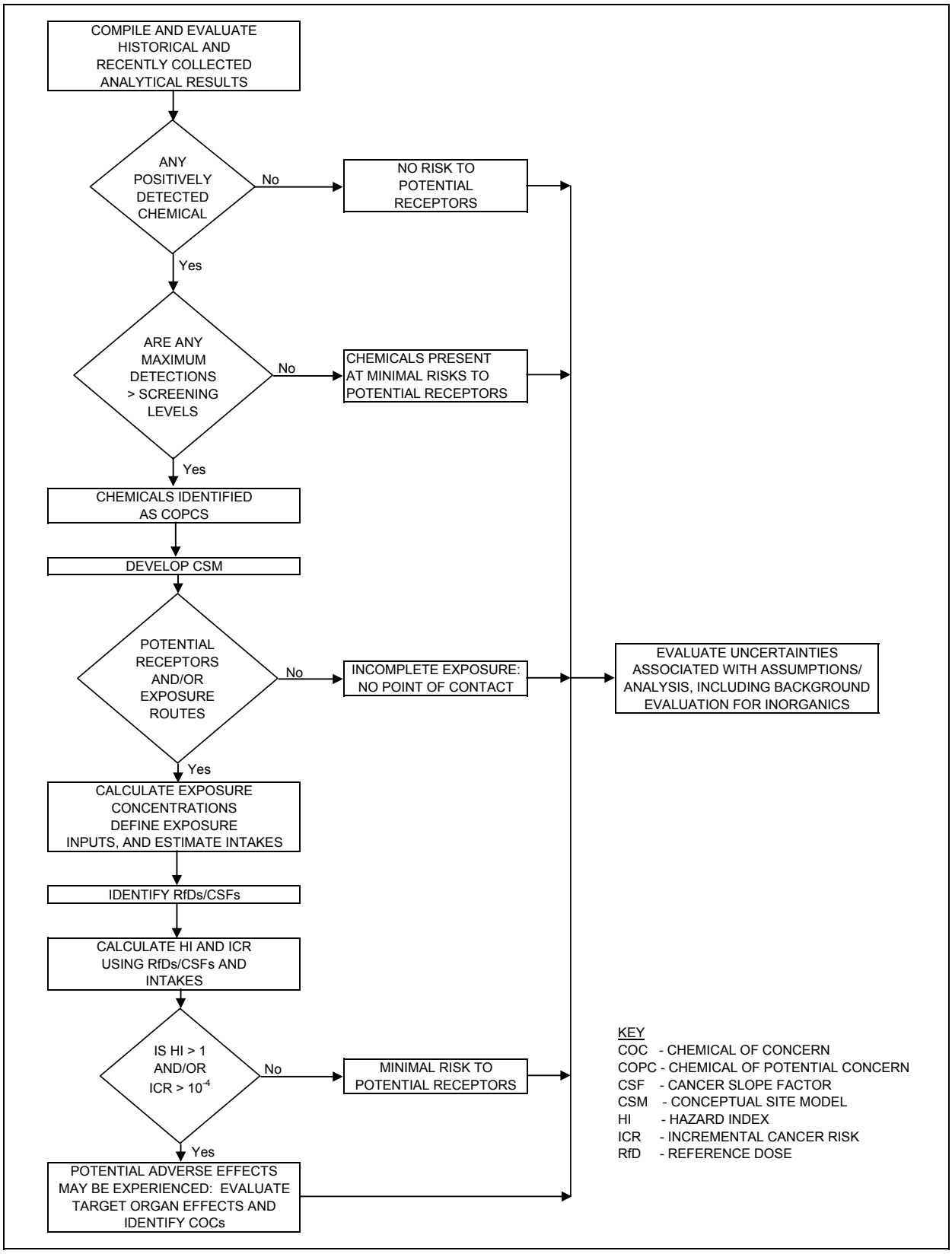


FIGURE 6-1

SUMMARY OF HUMAN HEALTH RISK ASSESSMENT PROCESS
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

7.0 CONCLUSIONS AND RECOMMENDATIONS

This section of the report presents the conclusions of the ecological and human health risk assessments and then presents the uncertainties associated with the conclusions. This section also provides recommendations for further evaluations and/or uses of the data, where appropriate.

7.1 ECOLOGICAL RISK ASSESSMENT

As part of the ecological risk assessment, several assessment endpoints were quantitatively evaluated to determine if there were potential risks to the ecological receptors from the chemicals in the surface water and sediment in Mattawoman Creek. The assessment endpoints that were quantitatively evaluated include the following:

- Piscivorous birds and mammals
- Herbivorous mammals
- Aquatic Vegetation
- Fish
- Benthic invertebrates

7.1.1 Risks to Wildlife

Facility-related chemicals have been detected in Mattawoman Creek surface water, sediments, fish, and plant tissue near the main area. Fish-eating (piscivorous) birds and mammals and plant eating (herbivorous) birds are important and sensitive portions of the food web. As a result, piscivorous birds and mammals and herbivorous birds could potentially be at risk. To assess these risks, food-chain modeling was conducted to determine the daily dose of chemicals that the receptors may be getting from consuming food collected in Mattawoman Creek. The daily dose was then compared to toxicity data to determine potential impacts to the receptors. The following indicator species were selected for the food-chain modeling:

- Piscivorous bird: great blue heron
- Piscivorous mammal: mink
- Herbivorous bird: mallard duck

Risk to piscivorous birds and mammals are low from consuming fish, sediment, and surface water from Mattawoman Creek. Risk to herbivorous birds is low from consuming vegetation, sediment, and surface

water from Mattawoman Creek. Therefore, based on the low risks, these assessment endpoints do not require further evaluation, and no chemicals were retained as final COCs for risks to wildlife.

7.1.2 Risks to Fish

There are few surface water or sediment screening values that can be used to evaluate risks specifically to fish. Surface water screening values that protect aquatic organisms, including fish, are discussed in Section 7.1.4. Therefore, fish tissue residue concentrations were used to determine if there were risks to fish.

Although there are no established fish tissue residue concentrations that can be used to evaluate risks to the fish, several databases exist that list results of toxicity tests and associated tissue concentrations from the tested animals. The data from these databases was compiled into lower effect levels (5 percent FTRVs) and higher effects levels (50 percent FTRVs), where adequate data were available.

Only one chemical was detected in the fish tissue samples at concentrations that exceeded the 5 percent and 50 percent FTRV (chromium). However, it is likely that risks to fish from chromium will be negligible for several reasons. Chromium was not retained as a COPC in sediment because its maximum concentration did not exceed the screening value. Although the screening value is not directly linked to fish tissue concentrations, sediment concentrations below the sediment screening value are not indicative of levels that would cause risks to aquatic receptors. Also, chromium was detected infrequently in the whole body fish samples (3/10) and in the fish fillet samples (3/16). Finally, there is a lot uncertainty in the FTRV for chromium because it is based on very little data, but no detections were greater than the LOAEL for mortality of 8.7 mg/kg (see Appendix C-11).

Although no tissue residue data was available for energetics in fish tissue, the energetics were detected infrequently in the fish samples. Therefore, the low frequency of detection makes it unlikely that significant populations of fish are being impacted, and no chemicals were retained as final COCs for risks to fish.

7.1.3 Risks to Hydrilla

Hydrilla was selected as the measurement endpoint to represent submerged aquatic vegetation (SAV). Because there are limited toxicity data available to evaluate risks to aquatic plants, the evaluation was somewhat qualitative and focused on uptake of chemicals in the plant tissue and the abundance of hydrilla in Mattawoman Creek.

Metals were the only parameters that were detected in the hydrilla samples, and of those, zinc was the only chemical that was detected at greater concentrations in the study area samples compared to the upgradient or reference samples. Zinc's maximum detection of 21.6 mg/kg was just slightly greater than the maximum concentration in the upgradient or reference samples (18.3 mg/kg). However, no data exists to evaluate risks to aquatic vegetation based on tissue concentrations.

Also, as can be observed from the aerial photographs of the study area, hydrilla is abundant in Mattawoman Creek. Finally, a summary of the SAV distribution and status of habitat for the Potomac River is presented on the Virginia Institute of Marine Science internet site (http://www.vims.edu/bio/sav/) (also see Appendix C-11). Mattawoman Creek has had a steady increase in SAV coverage since 1995, surpassing the Tier 1 goal in 1998, 1999, and 2000.

The weight of evidence suggests that risks to hydrilla and other aquatic vegetation in Mattawoman Creek from study area chemicals are negligible. Therefore, no chemicals were retained as final COCs for risks to aquatic vegetation.

7.1.4 Risks to Aquatic Organisms

This section summarizes risks to aquatic organisms from chemicals in the surface water. Several chemicals were retained as COPCs because either their maximum detections were greater than Region 3 screening values or the chemicals did not have screening levels. When published screening levels were not available for organic chemicals, toxicity data from other sources were used. For the energetics that did not have screening levels, their low detection frequency made it unlikely that they will cause a risk to aquatic organisms. For the filtered metals that were retained as COPCs because the maximum detected concentrations exceeded the screening levels, most of them were detected infrequently at concentrations greater than the screening level EPA WQC.

Although the concentrations of several metals in surface water exceeded the screening level, most of the exceedances were infrequent, with the exception of cadmium, which exceeded the screening value in several samples (maximum detection of 6.5 µg/L). Cadmium was detected in surface water in all five study areas. However, most of the results were only slightly higher than the detection limit, all of the positive results reported for cadmium were qualified during data validation as "biased-high" (see Section 4.1.4), and cadmium was positively detected in at least one laboratory blank. Therefore, although there may be isolated risks to aquatic receptors from cadmium in the surface water samples, there are uncertainties in the analytical data and thus uncertainties with respect to the potential risks.

7.1.5 Risks to Benthic Invertebrates

Three measurement endpoints were used to evaluate risks to benthic invertebrates:

- Sediment chemistry
- Sediment toxicity tests
- Benthic community analysis

The ERA first evaluated each of these measurement endpoints separately, and then they were combined in a weight-of-evidence approach to conclude if there are risks to the benthic community at any of the stations. Therefore, the conclusions discussed below are the results of all three lines of evidence listed in the three bullets above.

Sediments from five locations (MTCSD004, 015, 018, 019, and 023) were identified as having moderate risk, while the sediment from one location (MTCSD026) was identified as having high risk to benthic invertebrates. MTCSD004 was collected in Area 1; MTCSD015 was collected in Area 3; MTCSD018 and 019 were collected in Area 4; and MTCSD023 and 026 were collected in Area 5.

No toxicity test or benthic community samples were collected in the location of the greatest chemical concentrations in Area 1. MTCSD004 was collected closest to the area with the greatest chemical concentrations. Therefore, based on the greater chemical concentrations near MTCSD004, it is possible that moderate or high risks would occur to benthic invertebrates inhabiting the shoreline immediately upgradient of MTCSD004.

Toxicity test and benthic community samples were collected at four locations in Area 2. The chemical concentrations were relatively low in this area, as were the risks to benthic invertebrates. Therefore, risks to benthic invertebrates in locations in Area 2 where toxicity test and benthic community samples were not collected are low as well.

The one location in Area 3 that had moderate risk to benthic invertebrates (MTCSD015) was the location with the greatest silver concentration in that area. The overall chemical concentrations in Area 3 were low for the other chemicals, and for silver in the other samples (the chemical concentrations of all the other detections were below the PEC). Therefore, although the location is not well-bounded, the low chemical concentrations in this area appear to indicate that the potential risk to the invertebrates are confined to the location with the elevated silver detection, and the risks to invertebrates are not an area-wide problem.

Two of the locations with moderate risks to benthic invertebrates were in Area 4 (MTCSD108 and 019). The samples were located in the areas that had the greatest mercury and silver concentrations in that area, although the samples for the toxicity tests were not collected in locations of the maximum detections. Therefore, other locations within Area 4 may have moderate risk to benthic invertebrates.

One location in Area 5 had moderate risks to benthic invertebrates (MTCSD023), while a second location had high risks (MTCSD026). The extent of the area with high risk is not known because the contamination is not well-bounded in the upgradient direction, or out from shore. At the location of MTCSD023, the moderate risk was calculated in the duplicate sample, but a slight risk was calculated for the original sample, so there is some uncertainty regarding if the risks are actually slight or moderate. In either case, the portion of Area 5 near MTCSD023 is characterized as having relative low chemical concentrations (all detections are less than the PEC except for one silver detection). Therefore, the primary risks to benthic invertebrates in Area 5 appear to be focused near MTCSD026, which had high concentrations of several metals.

PAHS, arsenic, cadmium, copper, lead, mercury, silver, and zinc were the only chemicals that were retained as COCs for further evaluation for risks to benthic invertebrates. However, risks were not specifically linked to any one chemical because a mean quotient approach was used in the lines of evidence approach as described in Section 5.6.1.1. Therefore, the PAHs and seven metals are considered COCs for benthic invertebrates across the areas within Mattawoman Creek. An attempt was not made to determine which chemicals were causing the greatest risks in each area.

7.2 HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment for Mattawoman Creek considered current/future construction workers, adolescent recreational users, and adult recreational users exposed to surface water and sediment. Adolescent and adult recreational users were also evaluated for exposure to potentially contaminated fish. Off-site residents were considered to be part of the recreational receptor group; therefore, off-site residents were not evaluated as a separate receptor group. Both RME and CTE scenarios were evaluated.

Incremental cancer risks and hazard indices for exposures to sediment and surface water by construction workers, adolescent recreational users, and adult recreational users were within acceptable levels for the RME and CTE scenarios.

The incremental cancer risk for ingestion of fish by adult recreational users exceeded EPA's target risk range of 10^{-4} to 10^{-6} for both the RME and CTE scenarios. Aroclor-1260 was the major contributor to the incremental cancer risk for ingestion of fish from Mattawoman Creek.

The hazard indices for ingestion of fish by adolescent and adult recreational users exceeded the acceptable level of 1. 2-Amino-4,6-dinitrotoluene and 4-methylphenol were the major contributors for the adolescent recreational user under the RME scenario. 4-methylphenol was the major contributor for the adolescent recreational user under the CTE scenario and the adult recreational user under the RME and CTE scenarios.

The cancer risks and hazard indices for ingestion of fish by adolescent and adult recreational users are subject to uncertainty because only three background fish fillet samples were collected so a statistical comparison to background could not be performed during the selection of COPCs. Consequently, no chemical was eliminated as a COPC on the basis of background.

Exposures to lead in sediment by construction workers were evaluated using the adult lead model. Results of the adult lead model analysis indicate that blood-lead levels for children (fetuses of exposed woman) were above the level of concern (10 µg/dL) for lead concentrations in Area 1 sediments. The unacceptable risks from exposure to lead in sediment were due to elevated lead concentrations in the sediment sample collected from location IS11SD01. Risks from exposures to lead in sediment by construction workers are within acceptable levels if the sample from location IS11SD01 is removed from the Area 1 data set.

Lead was detected in one surface water sample at a concentration which exceeded the screening level for drinking water, but no adverse health effects are anticipated since the average lead concentration in surface water is less than the screening criteria, and surface water from Mattawoman Creek is not used as a drinking water source.

7.3 REPORT UNCERTAINTIES

Based on discussions between the Navy and the regulators, it was determined that there were four main sources of uncertainties in this report. These uncertainties are listed below and then discussed in more detail in the subsequent sections of this report. There is some overlap in the first three bullets so these uncertainties are discussed in Section 7.3.1 and 7.3.2. Section 7.3.3 discusses the uncertainties related to the last bullet.

- The extent of facility-related chemicals in sediment across the Mattawoman Creek study area is not fully characterized.

- The impact of sediment transport on the distribution of contamination in study area sediments is not fully understood.The fate and extent of the sediment contamination associated with facility-related releases has not been defined near some IR locations.

- The lack of correlation between sediment toxicity tests and sediment chemistry leads to uncertainty regarding some risk determinations.

7.3.1 Nature and Extent

As can be observed from Figure 3-3, the majority of the sediment samples were collected adjacent to the north Mattawoman Creek shoreline, with few samples collected along the south shoreline of in the middle of Mattawoman Creek. This was done because the greatest concentrations of chemicals in Mattawoman Creek were expected to occur along the north shore for those chemicals that originated from IHDIV-NSWC. Based on the available data, it appears that the greatest concentrations of facility-related chemicals were found in the samples adjacent to IHDIV-NSWC.

Elevated levels of chemicals (primarily metals) were detected in several areas along the Mattawoman Creek shoreline. The primary areas were Area 1, adjacent to Sites 11 and 17, and Area 5, adjacent to Site 28. In Area 1, the extent of metals contamination appears to be bounded parallel to the shoreline. However, it is not bounded perpendicular to the shoreline toward the middle of the creek. In Area 5, the extent of metals contamination is somewhat bounded along the shoreline in the downstream direction, however, they are not bounded along the shoreline in the upstream direction or out from the shoreline toward the middle of the creek.

7.3.2 Sediment Dynamics/Transport

Chemicals have been released to Mattawoman Creek from IHDIV-NSWC through a variety of mechanisms such as through outfalls, spills, storm water runoff, groundwater discharge, etc. The released chemicals may have moved from their point of release by dissolving in the water column and moving with the current. Also, sediment containing chemicals can be transported to other parts of Mattawoman Creek and even the Potomac River by the force of currents in the creek. This typically occurs for the fine-grained sediments (i.e., silts, clays), which are more easily transported than the coarse-grained sediments (i.e., gravel, sand). Also, fine-grained sediments tend to bind greater concentrations of chemicals than coarse-grained sediment, given the same conditions. Once the sediments are suspended in the water column, they may be carried to other locations in the creek. Often they will be deposited in what are termed “depositional areas.” These depositional areas are typically in lower hydraulic energy areas such as bends in the creek, or in areas where SAV is present to trap the fine-grained sediments.

As discussed in Section 7.3.1, a majority, though not all, of the sediment samples were collected along the shoreline adjacent to IHDIV-NSWC. Therefore, although the greatest chemical concentrations occurred in the samples collected closest to the source, the possibility remains that sediments with

chemical concentrations greater than risk-based levels may have been transported to other parts of the creek, especially to depositional areas. Also, the possibility remains that the areas receiving the transported/deposited contaminated sediment may be subjected to more intense recreational activity than the shoreline adjacent to IHDIV-NSWC.

Figure 7-1 is a recent aerial photograph of the Mattawoman Creek study area showing sediment sample locations, areas of recreational activity, and serves as an aid in identifying depositional areas. Note that the sediment in the depositional areas may be heterogeneous and range in grain size values. Based on the locations of the sediment samples collected to date, it is apparent that some of the depositional areas and the recreational areas that are frequented by humans have not been fully characterized.

7.3.3 Toxicity Test Data

As discussed in Section 5.0 of this report, and presented on Figures 5-4 through 5-16, there was little correlation between chemical concentrations and the results of the toxicity tests. There is a correlation between low DO and survival however, it is not clear that low DO was the sole cause of the toxicity for the reasons presented in Section 5.6.1.2. Because of the uncertainties in the results of the toxicity tests, the toxicity tests were given less weight than the sediment chemistry data or the benthic invertebrate data in the overall weight of evidence approach.

Although the collected data (sediment chemistry, toxicity tests, and biological survey) are sufficient to determine that there are risks to benthic invertebrates, the data are insufficient to develop risk-based levels based for protecting benthic invertebrates. This is primarily because of the lack or correlation between chemical concentrations and the sediment toxicity, and the fact that there were sediment samples that had greater levels of chemical concentrations than most of the ones tested. Therefore, risks to benthic invertebrates from the levels of chemicals in those sediments are not known.

7.4 RECOMENDATIONS

Based on the results of this Mattawoman Creek Study, it is recommended that consideration be given to the following:

- Sediment sampling to define Navy-related contaminant concentrations in additional depositional locations within the study area.

- Surface water and sediment sampling in locations of high recreational activity to better define potential human health risks resulting from Navy activity.

- In areas where potential risks to benthic macroinvertebrates from chemicals in the sediment have been identified (Areas 1, 4, and 5), collect additional data necessary to reduce the uncertainties in the risk determinations.

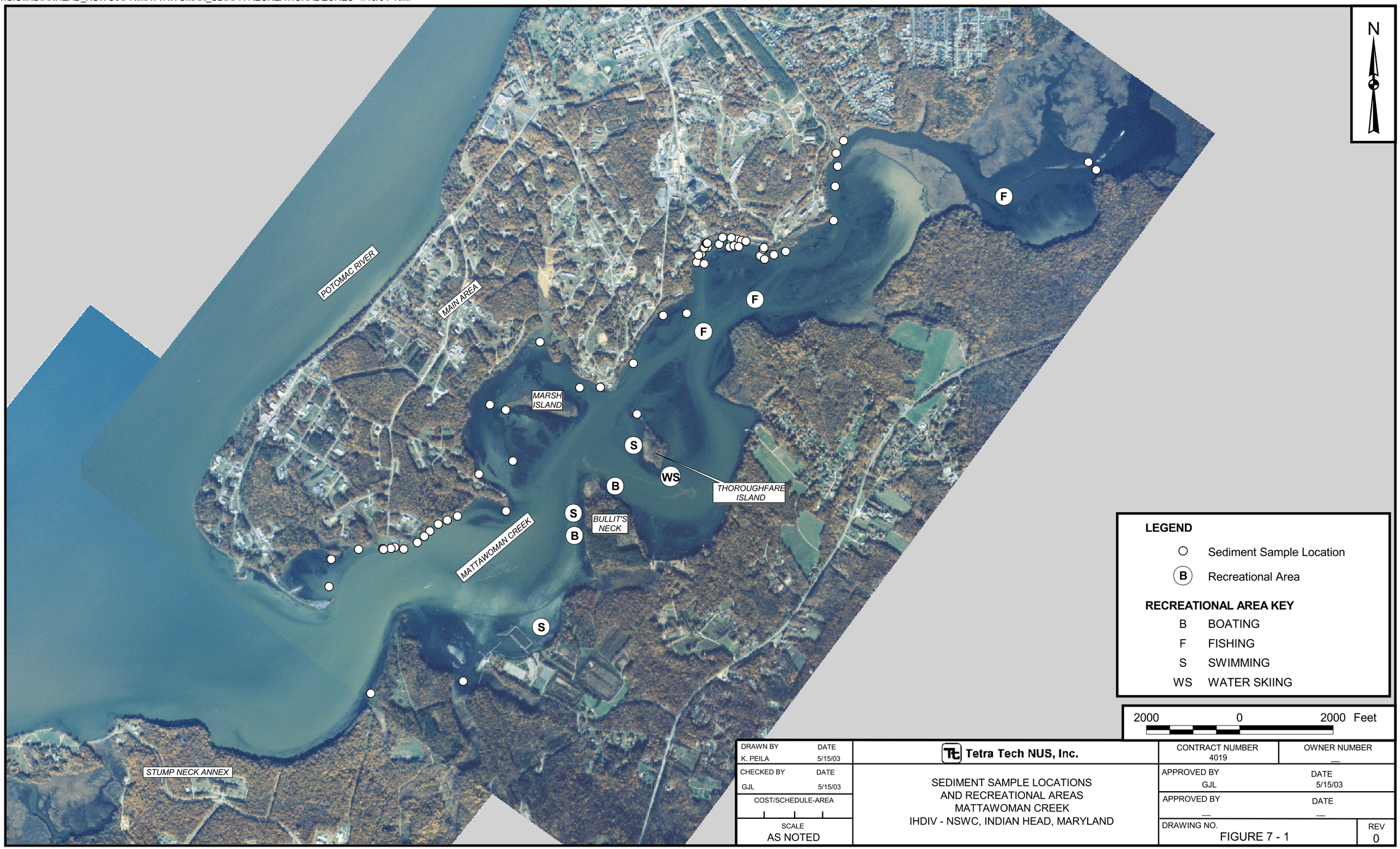
- Human health and environmental risks should be reevaluated after accepted perchlorate reference doses become available.

TABLE 7-1

SUMMARY OF ECOLOGICAL RISKS FOR EACH ASSESSMENT ENDPOINT
MATTAWOMAN CREEK
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Assessment Endpoint	Area	Risk Summary
Benthic macroinvertebrates	Area 1	Moderate to High Risk
	Area 2	Low Risk
	Area 3	Low to Moderate Risk
	Area 4	Moderate Risk
	Area 5	Moderate to High Risk
Piscivorous bird and mammals	All Areas	Low Risk
Herbivorous bird	All Areas	Low Risk
Aquatic vegetation	All Areas	Negligible Risk
Aquatic organisms	All Areas	Possible risk from cadmium in surface water
Fish	All Areas	Low Risk

P:\GIS\INDIANHEAD_NSWC\APR\MATTAWOMAN_SD.APR RECREATIONAL ZONES 1/19/04 KMP



DRAWN BY K. PEILA	DATE 5/15/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER —
CHECKED BY GJL	DATE 5/15/03	SEDIMENT SAMPLE LOCATIONS AND RECREATIONAL AREAS MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY GJL / DATE 5/15/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 7 - 1 / REV 0

8.0 REFINEMENTS TO CONCEPTUAL SITE MODEL

This section of the report presents the refined CSM. The results of the ecological and human health risk assessments are presented in Sections 5.0 and 6.0, respectively. Section 7.0 presents the uncertainties and recommendations associated with the study. The objective of this section is to summarize and refine the pre-study CSM discussed in Section 2.0 using data and information collected as part of the Mattawoman Creek Study. Therefore, this refined CSM builds on the earlier CSM and will set the stage for any additional work that may be completed in Mattawoman Creek.

8.1 POTENTIAL RECEPTORS

8.1.1 Mattawoman Creek Description

Although discussed previously in Section 2.1, a summary description of Mattawoman Creek is presented here for ease of reference. Mattawoman Creek drains a 79-square-mile area in northern Charles County and southern Prince George's County, Maryland. The first 25 miles of the creek are free flowing, and the last 5 miles are a tidal embayment. Tidal amplitude in the lower reaches of Mattawoman Creek averages about 1.6 feet but fluctuates considerably depending on weather, season, and moon phase (Lippson et al., 1979). The lower portion of the creek is classified as a tidal freshwater stream throughout most of the year. During low freshwater flow periods (usually late summer and early fall), salinity near the mouth of the creek can reach 3 to 4 parts per thousand. When salinity is present, stratification can occur, mainly near the mouth of the creek.

The main area of IHDIV-NSWC is located along the northern shoreline of Mattawoman Creek from its confluence with the Potomac River upgradient for approximately 3 miles. Stump Neck Annex of IHDIV-NSWC is located along the southern shoreline from the Potomac River confluence approximately 1 mile upgradient. Land use in the Mattawoman Creek drainage basin is mostly rural but includes a rapidly developing suburban area in northern Charles County, the town of Indian Head, and IHDIV-NSWC. The Indian Head Waste Water Treatment Plant (WWTP) discharges to a small creek known as Harrison Cut, which empties into Mattawoman Creek approximately 1,000 feet upgradient of the main area boundary.

The width of Mattawoman Creek increases as it approaches IHDIV-NSWC (Figure 8-1). A defined creek channel is present in the stretch of the creek near the eastern main area boundary. Depths in the channel ranging from approximately 9 to 17 feet were measured in this area by project biologists during an August 2000 site visit. This clearly defined channel continues past the Scrap Yard area (Site 41) then becomes more diffuse. The width of the creek becomes shallower near Thoroughfare Island and Marsh Island. Depths in these areas ranged from 2 to 6 feet in August 2000. A large flat is present in the area

south of Thoroughfare Island. From Bullit's Neck to the mouth of the Potomac, Mattawoman Creek becomes broad and open, with depths ranging from 3 to 8 feet. Highly variable depths to 14 feet were present in this broad area in August 2000. A diffuse channel is present in the middle of this final stretch of lower Mattawoman Creek.

8.1.2 Potential Ecological Receptors

Mattawoman Creek provides habitat and feeding grounds for a variety of ecological species. The identified ecological receptors in and surrounding Mattawoman Creek are as follows:

- Fish - As discussed in more detail in Section 2.1.2, at least 33 species of fish inhabit Mattawoman Creek or adjacent areas, including several anadromous and semi-anadromous species. The fish species present in Mattawoman Creek include marine species that use Mattawoman Creek as a nursery and several freshwater species of gamefish. Risks to fish present in Mattawoman Creek were evaluated by comparing fish tissue concentrations to fish tissue residue values from literature (see Section 5.6.3). Conclusions from this risk evaluation indicated that risks from chemicals are negligible or unlikely.

- Benthic macroinvertebrates – These lower-level receptors are present in Mattawoman Creek sediments. A benthic Biotic Index was calculated for each study area in Mattawoman Creek to evaluate risks to these receptors. The sediments in five sample locations were identified as having moderate risk, and sediment from one location was identified as having high risk. Other evaluated locations presented negligible risks to benthic invertebrates. Areas 1, 4, and 5 were identified as causing the greatest risks (see Section 5.6.1.4). Specific chemicals were not identified as causing risks, although metals were elevated in those areas. Conclusions from the risk evaluation indicated that it is likely the benthic community has been impacted in Areas 1, 4, and 5.

- Piscivorous and herbivorous birds and mammals – These upper-level receptors feed in Mattawoman Creek and include species such as the bald eagle, osprey, and great blue heron, among others, along with waterfowl such as ducks. Risks to wildlife were evaluated by food-chain modeling (see Section 5.6.2). Conclusions from the risk evaluation indicated that risks to piscivorous and herbivorous wildlife were low.

- Reptiles and amphibians - Numerous turtles, aquatic snakes, and amphibians (such as frogs) are regularly observed in the creek. Risks to these receptors were not quantitatively evaluated in the ERA due to a lack of available toxicity information. Rather, fish were evaluated as surrogates for amphibians, and terrestrial mammals and birds were evaluated as surrogates for reptiles. Uncertainty associated with this approach is discussed in Section 5.7.1.

- Aquatic Vegetation - Extensive aquatic vegetation is found throughout Mattawoman Creek. In the middle and upper reaches of the creek, some wooded swamps are present. In middle and lower Mattawoman Creek, extensive beds of the macrophyte spatterdock are present, and the emergent pickerel weed is common, especially throughout Marsh Island. Emergent vegetation is less abundant from Bullit's Neck to the mouth of Mattawoman Creek. The creek also contains abundant submerged aquatic vegetation (SAV) dominated by hydrilla and wild celery. Riparian vegetation is also present along the margins of the creek. Zinc was the only chemical detected in the vegetation samples at a concentration slightly greater than the upgradient concentration. No data exists to evaluate risks to aquatic vegetation based on tissue concentrations. However, due to the fact that hydrilla (the aquatic vegetation sampled for this study) is abundant in Mattawoman Creek, risks to aquatic vegetation are expected to be negligible.

- Several rare, threatened, and endangered species of flora and fauna have been reported in Mattawoman Creek. Protected species are listed in the Mattawoman Creek Study (TtNUS, 2003). These species were qualitatively evaluated by the use of surrogate species (see Section 5.7.1). Based on this qualitative evaluation, risks to protected species from chemicals in Mattawoman Creek are not expected.

In summary, potential risks exist for benthic invertebrates exposed to chemicals in the sediment with risks being greatest in Areas 1, 4, and 5. Risks to other ecological receptors such as birds, mammals, reptiles, amphibians, fish, and aquatic vegetation are negligible to low.

8.1.3 Potential Human Receptors

Potential human receptors have been identified under both current and future land use conditions. These receptors were identified by evaluating the interaction of current and anticipated future uses of the Mattawoman Creek and the identified sources of contamination. These human receptors are as follows:

- **Construction Worker** – Potential receptor under current and future land uses. This receptor class includes adult, civilian personnel involved in a short-term, one-time construction project at the site. Incremental cancer risks and hazard indices for exposure of construction workers to sediment and surface water were within acceptable levels for all COCs (see Section 6.4.3.1).

- **Adolescent Recreational User** - Potential receptor under current and future land uses. This receptor group includes off-site, adolescent individuals who use the creek for recreational activities. Incremental cancer risks and hazard indices for ingestion of fish by adolescent recreational users and

to the HI were 2-amino-4,6-dinitrotoluene (HI=1.4) and 4-methylphenol (HQ=11((see Section 6.4.3.2).

- **Adult Recreational User** – Potential receptor under current and future land uses. This receptor group includes off-site, adult individuals who use Mattawoman Creek for recreational activities. Incremental cancer risks was 1.6E-04 under the RME scenario, connected almost exclusively with fish consumption and primarily due to aroclor-1260. The incremental cancer risk was within the acceptable levels for all COCs under the CTE scenario. The hazard indices were 8 and 5 for the RME and CTE scenarios respectively primarily due to fish ingestion. The major contributor was 4-Methylphenol (see Section 6.4.3.3).

8.2 SOURCES OF COC CONTAMINATION

This section reiterates the COCs identified during the Mattawoman Creek Study then proceeds to a broad discussion of potential sources of those COCs.

8.2.1 Chemicals of Concern for Mattawoman Creek

As described in Section 5.6.1.6, arsenic, cadmium, copper, lead, mercury, silver, and zinc and PAHs in sediment were retained as COCs for Mattawoman Creek. These PAHs and metals are considered COCs for benthic invertebrates across all the study areas within Mattawoman Creek. Specific COCs were not identified on a per-area basis. Discussions of chemicals in this CSM will be limited to the identified COCs. The spatial distribution of these contaminants is shown in Figures 8-2 through 8-9 (see Section 4.2 for a description of the color coding on the figures.).

Figures 8-2 and 8-9 are eight color-coded figures that were generated to present the concentrations of select chemicals (total PAHs, arsenic, cadmium, copper, lead, mercury, silver, and zinc). These figures include data from samples that were collected during the SPAWAR sampling event (indicated as the screening locations), along with the all of the data that was used in the risk assessment from the main sampling event (indicated as the fixed-base locations) (see Section 4.2 for more details on the data that are included on the figures).

Sample points on the figures are shown using different colors based on their concentrations. A sample is white if it is below the TEC; it is blue if it is between the TEC and the PEC; and green if it is greater than the PEC. Because there is not a TEC or PEC for silver, the ER-L and ER-M values were used in place of the TEC and PEC, respectively. Yellow, orange, and red colors were used in the sample figures to indicate greater concentrations of the chemicals in the sediment samples. Section 5.6.1.1 of the ecological risk assessment portion of this report describes the significance of these values in the risk assessment.

As described in Section 3, the study areas were selected based on information gathered during past environmental investigations, the locations of IRP sites, habitat information, and/or discussions/site visits with the IHIRT and BTAG. The primary reason utilizing smaller areas was to break down the data collected from the creek to smaller segments in order to better understand the potential impact of detected contaminants on Mattawoman Creek. Having smaller data sets representing smaller portions of the creek helped to ensure that "hot spots" would not be missed by mixing the data from all locations. This approach also enabled the linking of some chemicals detected in the sediment to adjacent on-shore sites.

8.2.2 IHDIV-NSWC Potential Sources of Contamination

IHDIV-NSWC has been in continuous operation since 1890. Since that time, a wide variety of operations have occurred at a variety of locations throughout the facility, primarily on the Main Area. Over time, the locations for specific operations have changed, operations have been discontinued, and new operations initiated. Initially, the facility manufactured gunpowder and propellants in addition to performing weapons testing. At various times, manufactured products included gunpowder, energetics, propellants, and explosives. Associated activities involved firing, exploding, and burning the manufactured products as part of development, testing, and waste disposal programs. Laboratory activities, along with the associated chemicals, were also part of the development and testing functions at the facility. Other routine activities and general maintenance efforts were also potential sources of contamination, such as the use of pesticides and herbicides and fuel leakage and spills.

Some of the many activities conducted at IHDIV-NSWC have contributed to the migration of chemicals into Mattawoman Creek. Sites contributing contaminants through indirect transport may include landfills and disposal areas, open burn/open detonation facilities, spill sites, and roadways adjacent to or proximate to Mattawoman Creek. More spatially distributed potential sources include the use of Powerhouse clinker (contaminated with metals) along railroad tracks, and the use of arsenic-containing herbicide along railroad tracks and fences. Additionally, the Mattawoman Creek basin is mostly rural but includes a rapidly developing suburban area in northern Charles County, the Town of Indian Head, and IHDIV-NSWC. The Indian Head WWTP discharges to a small creek known as Harrison Cut, which empties into Mattawoman Creek approximately 1,000 feet upgradient of the main area boundary.

In many instances, it is difficult, if not impossible, to relate contamination within Mattawoman Creek to a particular site. Processes at the facility have changed over time and therefore, a current source of contamination to a particular study area may not have been a source in the past and vice versa. Also, the creek channel may have transported some chemicals upstream or downstream depending on the tidal flow or the occurrence of storms. However, there are some instances in which the contamination in Mattawoman Creek may be directly linked to an on-shore source.

For the purpose of this study, Mattawoman Creek was divided into six study areas designated as Area 1 through Area 6. The study areas are shown on Figure 8-1 and are repeated on Figures 8-2 through 8-9 for ease of reference. The creek was divided into study areas in an effort to group possible sources of contamination according to their potential for releasing contamination to specific areas. The following sub-sections discuss the potential sources of contamination (i.e., the previously identified COCs) in Mattawoman Creek for each of these study areas. The discussions are limited to potential sources of the select metals and PAHs determined to be COCs in Mattawoman Creek.

Figures 8-1 through 8-9 identify locations that may be (or may have been) sources of contamination to Mattawoman Creek. Figures 8-2 through 8-9 are color-coded representations of the spatial distribution of each COC determined to be present in Mattawoman Creek.

In the sections that follow, each study area is discussed by first presenting the COCs determined to be present in the area then describing locations that may be sources of the COCs in that study area. Each COC discussion first compares the sediment chemical concentrations in the area to the chemical concentrations detected in the reference area sediment samples (from Nanjemoy Creek) and the concentrations in sediment samples from the upgradient area (Area 6). The locations and descriptions of the reference and upgradient samples were presented in Section 3.1.2.5. The maximum concentration of each COC in a given area was compared to the maximum background concentration and also to two times the maximum background concentration. Additionally, the average COC concentration was compared to the average background concentration. These comparisons were made in an effort to more easily identify which chemicals are of greatest concern within a given area and to focus the identification of potential contaminant sources located on IHDIV-NSWC (see Table 8-1). The subsequent sections then discuss the individual potential sources of the chemicals in Mattawoman Creek, how the chemicals may have migrated from each source to Mattawoman Creek, and if the source appears to be historic and/or continuing.

Table 8-1 presents a summary of the Mattawoman Creek COC concentrations by area. As indicated in Table 8-1, COC concentrations in each study area exceeded the corresponding maximum background concentration, with the exception of cadmium in Areas 3 and 4. Overall, COC concentrations were greatest, as compared to the background concentrations, in Areas 1 and 5 for metals and in Areas 2 and 4 for PAHs. All COC concentrations in Areas 1 and 5 exceeded both maximum background concentrations and two times background concentrations.

8.3 SITE-SPECIFIC POTENTIAL SOURCES OF COC CONTAMINATION

This section describes site-specific potential sources of COC contamination on an area-by-area basis.

8.3.1 Area 1

COC concentrations in Area 1 sediment were elevated compared to background concentrations (see Table 8-1). Maximum detected concentrations of all COCs exceeded two times maximum background concentrations, and average COC concentrations also exceeded average background concentrations. Area 1 maximum copper and lead concentrations, at 757 mg/kg and 76,400 mg/kg, respectively, were the greatest concentrations in all Mattawoman Creek samples.

As indicated in Table 8-2, five IHDIV-NSWC sites have been identified as potentially contributing sources of contamination in Area 1 Mattawoman Creek sediments (see Section 2). Strauss Avenue Thermal Treatment Point, Site 11, and Site 17 are located along the shoreline of Mattawoman Creek. Sites 5, 6, and 42 are located inland on IHDIV-NSWC. Surface runoff from these sites may have carried contaminants to Mattawoman Creek. The following paragraphs discuss the five sites in more detail.

8.3.1.1 Site 5 – X-Ray Building 731

Site 5 is located on the southwestern side of Building 731, which is located on Voegeli Road on the IHDIV-NSWC. The site consists of two drainage swales emanating from the southeast (Swale No. 1) and southwest (Swale No. 2) corners of Building 731 that flow into Mattawoman Creek. (The drainage path is shown on Figure 8-1.) Between 1953 and 1965, silver-laden photographic processing wastewaters were discharged from Building 731 into the two drainage swales. This discharge deposited silver into the soils of the two swales.

A removal action was completed on Swale No. 1 in January 1993 that included the excavation and treatment of soil and sediment containing silver at concentrations exceeding the identified action level of 10 mg/kg. The silver-contaminated soil in the swale was removed, solidified, stabilized, and placed in an earthen berm. The results of the removal action were documented in the Removal Action Findings Report (ABB, May 1993).

A removal action that consisted of excavating approximately 1,750 cubic yards of soil containing elevated levels of silver was also performed at Swale No. 2. The removal action construction activities began in November 1994 and were completed in January 1995. The objective of the removal action was to eliminate the potential for future release of silver into the downstream environment by removing the source of silver.

Although photographic operations continue in Building 731, the spent fixer is now collected and the silver is recovered. For this reason, Site 5 is not considered a continuing source of contamination to

Mattawoman Creek. Rather, historical discharges are potentially responsible for the elevated levels of silver in Area 1 sediments.

8.3.1.2 Site 6 – Hypo Spill, Radiographic Facility Accelerator

Site 6 is located downgradient of Site 5 and is similar to Site 5 with respect to operations and the fact that discharges potentially drained to Mattawoman Creek (see Figure 8-1). From 1965 to 1977, fixer and developer were used at Site 6 in developing x-ray film (IHDIV-NSWC, 2003). Spent fixer was released to a drainage pathway that joins with the same drainage pathways that served Site 5 and discharges to Mattawoman Creek.

8.3.1.3 Site 11 - Caffee Road Landfill

Site 11 is discussed in more detail in Section 2.2.1, but is summarized here for reference. The Mattawoman Creek shoreline next to Site 11 is characterized by concrete, debris, and other fill material. It is unknown when the landfill was first used; however, it was used as late as the early 1960s for the disposal of bulk metal items and trash, rocket motor casings, exploded building debris, rifles, demilitarized ordnance, propellant grains residue, and open burning residue. Thermally treated materials also included cardboard containers that formerly contained propellants composed, in part, of copper and lead. Historical aerial photographs indicate that past filling activities extended the shoreline of Mattawoman Creek as much as 150 feet south of its earlier position (CH2M Hill, 2001). Debris was observed in a wooded swale northwest of the site. The debris consisted of bricks, metal parts, a washing machine, and the end of a fiberglass tank and appeared to be deposited on the surface only (i.e., not buried). Additionally, materials related to x-ray processing were potentially disposed at Site 11. In 1980, IHDIV-NSWC removed 5,000 to 6,000 cubic yards of flashed metal parts from the wetland at Site 11. Flashed metal refers to metal debris that was burned to remove trace amounts of energetics residue.

The surface of the landfill is now used as the Decontamination Burn Point, and a large collection of flashed metal parts formerly located on the surface of the landfill has since been removed. A contractor periodically removes the metal parts for sale off site. The eastern portion of the site was used for drum storage and waste segregation. Building 1550 (Cooling Tower), Building 1551 (Tank Farm Area), and Building 1549 (Chemical Incinerator) are located east of Site 11.

Because Site 11 is immediately adjacent to Mattawoman Creek, the most likely current pathway for contaminants to migrate to Mattawoman Creek surface water and sediment is via surface runoff from the site. Site 11 is potentially a current contributing source of metals contamination in Area 1 sediments.

8.3.1.4 Site 17 – Discarded Metal Parts Area

Site 17 is discussed in more detail in Section 2.2.2, but is summarized here for reference. Site 17 was originally defined as a 1,000-foot section of shoreline along Mattawoman Creek where metal parts were discarded from the 1960s until the early 1980s. The discarded materials included rocket motor casings, shipping containers, empty drums, and various metal parts. Large metal items along the shoreline were removed in 1989 (CH2M Hill, 2001). The site area was expanded in 1997 to include the forested area 100 feet from the shoreline where dozens of rusted drums were identified. The drum contents were subsequently determined to be wax that is safe to handle (i.e., not explosive) although the wax may contain residual levels of explosives.

Because Site 17 is immediately adjacent to Mattawoman Creek, the most likely current pathway for contaminants to migrate to Mattawoman Creek surface water and sediment is via surface runoff from the site. Site 17 is potentially a current contributing source of metals contamination in Area 1 sediments.

8.3.1.5 Site 42 – Olsen Road Landfill

The Olsen Road Landfill occupies approximately 2 acres south and southwest of Building 1866. Disposed material includes construction rubble, empty cans and drums, wooden pallets, and branches.

A supplemental preliminary site assessment completed by NEESA (NEESA, 1992) concluded that unauthorized disposal occurred at the site over a 5-year period ending in 1987; however, the report also noted that there was no record of hazardous waste disposal nor was such disposal recalled by facility personnel.

The Site 42 slopes generally to the south and southwest. Surface water flows to the unnamed stream located south and southwest of the site. That stream also receives flows from the upgradient Site 5 and the downgradient Site 6, and then conveys the total flow to Mattawoman Creek.

In 1997, an RI was performed at Site 42. Contaminants detected above background during that investigation included cadmium, lead, silver, and zinc in subsurface soil and the same contaminants plus arsenic and copper in the sediments of the unnamed stream.

The RI for Site 42 was completed in 1997, and the FS for the site was completed in December 2003. A remediation design is underway as of January 2004.

8.3.1.6 Strauss Avenue Thermal Treatment Point

The Strauss Avenue Thermal Treatment Point is located downgradient from Building 881 along the Mattawoman Creek shoreline. Historically, materials were openly burned on the ground potentially contributing metals (primarily lead) and PAHs to Mattawoman Creek via surface runoff. The treated materials included propellants composed, in part, of copper and lead. Burning of materials still occurs but is now controlled in pans. Contaminant migration to Mattawoman Creek is still possible via air deposition.

8.3.1.7 Area 1 Summary

Several locations were identified as potentially contributing contaminants to Mattawoman Creek Area 1 sediments. Detected concentrations of silver are possibly attributable to past releases from Sites 5 and 6. Sites 11 and 17 are potential sources of metals in Mattawoman Creek because metal items and trash were disposed at these sites along the edge of Mattawoman Creek. The Strauss Avenue Thermal Treatment Pont is another potential source of the elevated lead and PAH concentrations in Mattawoman Creek. The Strauss Avenue Thermal Treatment Point is located along the shoreline of Mattawoman Creek in an area that is tidally influenced.

As seen in Figures 8-5 and 8-6, the greatest concentrations of copper (i.e., greater than 300 mg/kg) and lead (i.e., greater than 257 mg/kg) were found in samples collected along the shoreline of Sites 11 and 17, primarily Site 11. As noted earlier, Site 11 is a potential source of metals contamination in Area 1 due to the historical burial of bulk metal items there.

Although the study-wide maximum silver concentration was not detected in Area 1, elevated levels of silver were detected in Area 1 sediment samples. Sites 5 and 6 have been identified as potentially contributing silver to Mattawoman Creek via the same drainage path; however, the greatest silver concentrations detected in Area 1 were found in sediment samples collected offshore from Site 11. Therefore, it is unclear whether the elevated levels are attributable to discharge from Sites 5 and 6 or are associated with the possible disposal of silver contaminated items at Site 11, Caffee Road Landfill.

8.3.2 <u>Area 2</u>

COC concentrations in Area 2 were elevated compared to background concentrations (see Table 8-1), although concentrations were not as great in Area 2 sediments as in Area 1. All Area 2 COC maximum detected concentrations exceeded maximum detected background concentrations. Only arsenic exceeded two times the maximum detected background concentration. Mercury and PAHs were also detected in Area 2 but not in background samples. Average Area 2 concentrations exceeded average

detection background concentrations for every COC except cadmium. The Area 2 total PAHs concentration of 22 mg/kg was the maximum concentration detected in Mattawoman Creek samples.

As indicated in Table 8-2, six IHDIV-NSWC sites were identified that could have potentially contributed contaminants to Area 2 sediments. The Small Motor Test Area (SMTA) and Site 18 are located along the shoreline of Mattawoman Creek. Site 12 is located further inland on IHDIV-NSWC adjacent to the Town Gut Pond that discharges to Mattawoman Creek. Additionally Sites 8, 19, and 56 are inland on IHDIV-NSWC but potentially contribute contaminants to Mattawoman Creek via discharge to the Town Gut Pond. These areas are discussed in more detail below.

8.3.2.1 Site 18 – Hog Island

Hog Island was formed as an extension into Mattawoman Creek by depositing grit/sludge in a marshy area. Cadmium-contaminated sand blast grit and mercury-contaminated sludge (drying bed residue) from the sewage treatment plant were the primary contaminants associated with Hog Island (IHDIV-NSWC, 2003). Additionally, waste flows from the Lab Area included in the sewage treatment plant sludge may be contributing mercury. The concentrations of contaminants in the material used to form Hog Island are unknown. Because Hog Island forms part of the Mattawoman Creek shoreline, the contaminated material used to connect Hog Island with the Indian Head mainland may represent a continuing source of contamination to Area 2 sediments via erosion and surface water runoff.

8.3.2.2 Town Gut Pond

The Town Gut Pond is located in the southwestern side of the facility (see Figure 8-1). It actually includes two ponds connected by a culvert under Atkins Road Extension. The upgradient pond is oriented in a predominantly east-west direction and bisects the Town Gut Landfill into northern and southern portions. The downgradient pond is oriented in a predominantly north-south direction and borders the western side of the Town Gut Landfill. The downgradient pond drains to Mattawoman Creek via a culvert under West Noble Road. Until 1994, the ponds were tidally influenced (from the Potomac River to Mattawoman Creek to the ponds). In 1994 a weir was installed on the inlet end of the culvert. With the weir in place, the ponds are no longer tidally influenced. Sediments (contaminated or not) carried to the ponds are prevented from migrating to Mattawoman Creek and are forced to settle out in the ponds. In September 2002, the weir was temporarily removed for the duration of remedial construction activities at Site 12. The weir was replaced following the remedial construction activities (approximately July 2003). In addition to the Town Gut Landfill from which surface runoff drains to both the Town Gut Ponds, the drainage paths for several other sites discharge to Town Gut Ponds (see Figure 8-1). Site 13, Paint Solvents Disposal Dumping Ground, and Site 19, Catch Basin at Chip Collection House, drain to the

upgradient pond. Site 8, Mercury Contamination from Building 766, and Site 56, IW87 Lead Contamination, drain to the lower pond.

8.3.2.3 Site 12 – Town Gut Landfill

Site 12 is comprised of approximately 4 acres of undeveloped land located on the southwestern side of the facility. As described in Section 8.3.2.2, the upgradient Town Gut Pond bisects the landfill into northern and southern portions, and the downgradient pond forms the western border of the landfill. Between 1968 and 1980, the landfill was used for disposal of landscaping waste, fill material, and rubble. Material from outside the facility was also deposited at this site until 1972. Reportedly, other unauthorized materials such as paints, varnishes, and other chemicals may have been disposed in the landfill. A remedial investigation report for the site (TtNUS, 1999) was completed in 1999, and a feasibility study (TtNUS, 2001) was completed in 2001. Site remediation activities consisting of placing a 2-foot-deep soil cover over the landfill were completed in 2003. Site 12 is no longer considered a potential continuing source of contaminated sediment (via surface runoff).

8.3.2.4 Site 19 – Catch Basins at Chip Collection Houses

Wastewater contaminated with lead and copper salts was historically generated at the Chip Collection Houses (Buildings 1051 and 785). These lead and copper salts were washed to nearby catch basins (EFACHES, 2003). The drainage path from the site runs for over 1,300 feet, generally toward the west (see Figure 8-1) through a series of pipes and ditches to the Town Gut Landfill. The drainage path includes several flat segments offering opportunities for sediment to settle, minimizing the quantity of sediment that might migrate from Site 19 to the Town Gut Ponds and to Mattawoman Creek. However, the possibility of contaminant migration to Mattawoman Creek cannot be totally discounted.

8.3.2.5 Site 56 - IW87 Lead Contamination

Building 790 contains several spent acid tanks, which contain mixed nitric and sulfuric acids. The fumes from these acids adhere to the walls and floor inside the building, requiring periodic washdown. The fumes from the strong acids dissolved the lead from the flooring, and the washdown provided a route for the dissolved lead to discharge from the building, through IW87 to the Town Gut Pond, and finally discharging to Mattawoman Creek. A pit and the pipe connecting Building 790 to IW87 became heavily contaminated with lead. A removal action was conducted in late 1996 and included removing and cleaning the pipe leading to IW87, excavating the outfall area, treating contaminated water on the site, and relining the pipe. For this reason, Site 56 is not considered a continuing source of contamination to Mattawoman Creek.

8.3.2.6 Small Motor Test Area

The SMTA is located along the shoreline of Mattawoman Creek between samples MTC11 and MTC12. Testing at the site involved firing rocket motors positioned so the motor exhaust was expelled toward Mattawoman Creek. The large amounts of ash generated were washed to Mattawoman Creek. The SMTA possibly contributed arsenic, lead, and PAHs to Area 2 sediments. Although the wash water is now collected, the SMTA is still a potential contributing source of these contaminants to Mattawoman Creek via air deposition as evidenced by MTC012 (see Figure 8-2), which had the maximum detected PAH concentration.

8.3.2.7 Site 8 – Nitroglycerin Plant Office

Site 8 is located in the central portion of the main area of IHDIV-NSWC (see Figure 8-1). During laboratory operation, mercury was inadvertently released in small amounts from sink and floor drains in Building 766. The actual quantity of mercury released is unknown. Site 8 consists of Building 766 (Nitroglycerin Plant Office), a 3-inch drain pipe from Building 766 to a manhole (Manhole A), and a 36-inch concrete pipe that conveys water from Manhole A under railroad tracks along approximately 1,300 feet of an unnamed stream to the Town Gut Pond. The Town Gut Pond is discussed in Section 8.3.2.2.

Previous investigations determined that sediments and surface waters of the unnamed stream, the Town Gut Pond, and a marsh connected with the pond contained elevated concentrations of mercury (ABB, 1993; 1992).

An Initial Removal Action was performed at Site 8 in 1984 and 1985. That work was followed by an Engineering Evaluation/Cost Analysis (EE/CA) (Halliburton NUS, 1993) recommending removal of mercury-contaminated (above 10 mg/kg) soil and sediment from the upper section of the Site 8 stream. The second removal action was completed in 1995 (Halliburton NUS, 1995). Site 8 is not considered a continuing source of mercury contamination.

8.3.2.8 Area 2 Summary

Several sources at IHDIV-NSWC were identified that have possibly contributed contaminants to Mattawoman Creek Area 2 sediments. The most notable of these is Site 18 (Hog Island). Hog Island was created as an extension of IHDIV-NSWC into Mattawoman Creek by filling with cadmium-contaminated sand blast grit and mercury-contaminated sludge (drying bed residue) from the sewage treatment plant. Other possible sources of metals include the SMTA and Sites 19, 12, and 56 (see Table 8-2). The Town Gut Pond is the common segment for the drainage paths from multiple IHDIV-NSWC

sites including Sites 19 and 56. The SMTA is an area along the shoreline of Mattawoman Creek potentially contributing PAHs to Mattawoman Creek via air deposition.

Cadmium and mercury, although elevated, were not detected at maximum concentrations in sample MTC010 (see Figures 8-4 and 8-7, respectively), despite direct deposition of these COCs in Mattawoman Creek during the formation of Hog Island. Sample MTC010 was collected at a location close to where the Town Gut Pond discharges to Mattawoman Creek. COCs were detected in MTC010, concentrations were low compared to other detections in Mattawoman Creek.

As noted, the SMTA is a possible source of PAHs in Area 2 sediments as indicated by MTC012 (see Figure 8-2), which had the maximum detected total PAH concentration. This sample was located nearest to the SMTA (no samples were collected immediately adjacent to the SMTA). Because this sample was collected along the shoreline, the extent of contamination into Mattawoman Creek is not known.

8.3.3 Area 3

COC concentrations in Area 3 sediment were similar in range to Area 2 sediment concentrations. These COC concentrations were elevated in comparison to background concentrations (see Table 8-1), although concentrations were not as great as in Area 1 sediments. Maximum detected concentrations in Area 3 sediment exceeded maximum background concentrations for all COCs except cadmium. Concentrations of arsenic and silver exceeded two times the maximum background concentrations. Average Area 3 concentrations exceeded average background concentrations for every COC except cadmium. No COCs had study-wide maximum detected concentrations in Area 3.

As noted in Table 8-2, only Sites 23 and 25 were identified as potentially contributing contaminants to Area 3 sediments. These sites are located along the shoreline of Mattawoman Creek in Area 3 (see Figure 8-1) and are discussed in greater detail below.

8.3.3.1 Site 23 – Extrusion Plant

Site 23 consists of the Extrusion Plant and all press buildings (i.e., Buildings 561 through 566). Wastewater containing hydraulic oil was generated during the operation of cooling pumps and press dies. Discharged wastewater containing hydraulic oil migrated to Mattawoman Creek via outfall IW18, which was hard-piped and discharged directly to Mattawoman Creek under an NPDES permit. Also, an oil/water separator periodically overflowed releasing oil to Mattawoman Creek through the same outfall. Discharges reportedly occurred from 1943 until 1981 during operation of the press lines, presenting a potential source of PAHs, copper, lead, and zinc to Area 3 sediments. The amount of material discharged is unknown. Surface soil contaminated with oil was removed in the mid-1980s. During

operation, trolleyways were used to move extruded propellant between operations located in different buildings. To facilitate propellant movement, the trolleyways were lubricated with used oil which dripped to the ground under the trolleyways. In approximately 1988, the oil contaminated soil was remediated in-place by mixing lime with the contaminated soil. The Extrusion Plant no longer discharges via IW18, since the press line drains have been sealed. The oil/water separator that previously released oil to Mattawoman Creek through IW18 has since been closed, and inlet and exit valves were locked in 2002.

8.3.3.2 Site 25 – X-Ray Building No. 2

Site 25 consists of X-Ray Building No. 2 (Building 588), which was used to develop x-rays from the 1940s through the 1960s. During the development of x-rays, both a fixer and a developer are used. Some of the silver, which is on the film, becomes "fixed" to the x-ray, and the remainder of the silver is washed off. Both the fixer and developer containing silver were discharged into two drainage swales behind Building 588 that flow to Mattawoman Creek through outfall IW46 (CH2M Hill, 2001). Additionally, some amounts of silver were disposed in the toilets and sinks that were hard-piped to Mattawoman Creek through these drainage swales, eventually discharging via outfall IW46. Silver is no longer discharged at Site 25 or disposed in toilets and sinks. The draft remedial investigation report that included Site 25 (CH2M Hill, 2001) indicated that there is a low surface transport potential from the site to Mattawoman Creek. That document also recommended that future work connected with the site be limited to groundwater. However, subsequent investigations resulted in a no-action determination for the site. Site 25 is not viewed as a continuing source of contaminant migration to Mattawoman Creek.

8.3.3.3 Area 3 Summary

Two IHDIV-NSWC sites have been identified as potentially contributing contaminants to Area 3 sediments. Site 23 is the Extrusion Plant and includes all press buildings. During operation, the oil/water separator overflowed so that oil releases discharged to Mattawoman Creek via outfall IW18. Site 25 may have been a past source of elevated silver concentrations in Area 3 sediments but is unlikely to be a continuing source since silver is no longer discharged at that location. In the past, spent silver from x-ray processing may have been transported to Mattawoman Creek via outfall IW46.

Figure 8-8 presents the silver concentrations in sediment samples from Mattawoman Creek. As noted in the figure, sample MTC015, collected adjacent to Site 23, had the maximum silver detection in Area 3 sediments. Although silver is not believed to have been produced or used at Site 23, accidental historical releases of silver from Site 25 are recorded. Site 25 is just upstream of Site 23, and it is possible that past contamination from Site 25 could be associated with MTC015.

Several COCs were detected in MTC016, the sample offshore from Site 25. Concentrations in MTC016 were low when compared to other detections in Mattawoman Creek, indicating that Site 23 and Site 25 are not significant contributors of COC contamination compared to other sources.

8.3.4 Area 4

COC concentrations in Area 4 were elevated compared to background concentrations (see Table 8-1), although concentrations were not as great as in Area 1 sediments. Notable exceptions are the maximum detections of mercury and silver, which are the highest detections of these COCs in all sampled areas of Mattawoman Creek at 8.7 mg/kg and 308 mg/kg, respectively. All maximum detected COC concentrations exceeded the corresponding maximum detected background concentrations except cadmium. All COCs exceeded two times the maximum detected background concentrations except cadmium and zinc. Average Area 4 concentrations exceeded average detected background concentrations for every COC except cadmium.

As noted in Table 8-2, three sites and the Lab Area were identified as areas potentially contributing contaminants to Area 4 sediments. Sites 39 and 41 are located along the shoreline of Mattawoman Creek, and Site 57 and the Lab Area are inland on IHDIV-NSWC. These areas are discussed in further detail below.

8.3.4.1 Site 39 – Organics Plant

Site 39 generally includes the area surrounding Building 497. Operations conducted in Building 497 from 1961 to 1965 included formulating the propellant binder bis-2,2-dinitropropanol acetal/formal. Silver nitrate was used as a catalyst in producing the acetal/formal, and one stage of the process utilized silver in its elemental form. Operations included discharging process water and floor washes via IW05 after passing through a settling tank. Additional discharges passing through IW05 included non-contact cooling water and area storm drainage. Ultimately, IW05 flows discharged via pipe, down the embankment below Building 497, to Mattawoman Creek. (Note that IW05 was removed from the NPDES permit in 1998.) Historically, acetal/formal and silver have been among the contaminants accidentally released from Building 497 to Mattawoman Creek. However, although other operations are currently conducted at Building 497, acetal formal production is no longer conducted there, and it is not considered a continuing source of contamination to Mattawoman Creek sediments (see also Section 2.2.4).

8.3.4.2 Site 41 – Scrap Yard

Site 41 is a fenced scrap yard located adjacent to Mattawoman Creek. The area is flat and surface storm water tends to pond and infiltrate, although in some areas, storm water tends to run off toward

Mattawoman Creek. Early (i.e., 1900's) use of the Scrap Yard included storing coal for the powerhouse with the attendant potential for metals contamination resulting from storm runoff from the coal piles. From the 1960's until 1988, the scrap yard was used to store lead-acid batteries and PCB-containing transformers. The scrap yard is currently used to store a wide variety of metal materials and scraps but no longer stores batteries or transformers. The materials are eventually sold for recycle or reuse (see also Section 2.2.4.).

In the past, the scrap yard was served by railroad tracks that are still in place (although sections are located just below the ground surface). Historically, arsenic-containing herbicide was used for controlling weeds along railroad tracks on the facility.

8.3.4.3 Site 57 – TCE Building 292 Area

Site 57 has been identified in the past as the Former Drum Loading Area. It encompasses the area located south of Building 292. Although Site 57 is located approximately 1,300 feet north of Mattawoman Creek, a storm sewer (the same sewer that serves the Laboratory Area discussed in Section 8.3.4.4) runs through the site area and discharges to Mattawoman Creek via IW80 (see Figure 8-1). Surface drainage from Site 57 flows to a lined channel located southwest of Building 292, then along a natural stream that roughly parallels the storm sewer before discharging to Mattawoman Creek via IW40.

Previous operations from the mid-1960s until 1989 involved the use of trichloroethene (TCE) for vapor degreasing and general cleaning. During the 1970s and 1980s, spent TCE was transferred from a tank inside Building 292 into drums via a pipe that passes through the exterior wall near the southern corner of the building. Spillage occurred and ultimately contaminated the groundwater with TCE and its break-down products. (See also Section 2.2.5).

Arsenic contamination detected in soil at Site 57 was associated with railroad tracks that run toward the building from the southeast then turn to parallel the eastern side of the building.

8.3.4.4 Lab Area – Sites 14, 15, 16, 49, 50, 53, 54, and 55

The Lab Area is located in the northeastern area of IHDIV-NSWC. Sites 14, 15, 16, 49, 50, 53, 54, and 55 are collectively referred to as the Lab Area based on similar historic usage, the sharing of sewer utilities, and overlapping field investigations for the several sites. The sites are described in more detail in the remedial investigation report (CH2M Hill, 2003), and are summarized in Section 2.2.6 in this document. Mercury is the contaminant of greatest concern in the Lab Area. The initial laboratory operations discharged mercury to the ground surface as early as 1909. Later, discharges from some of the buildings flowed via sewers through IW06 (later redesignated as IW80) to discharge to Mattawoman

Creek (See Figure 8-1) (Carson, 1989). By 1986, the combined sewers had been separated, and the mercury was being disposed into sanitary sewers that conveyed the wastewater to the facility's sewage treatment plant. Currently, a storm sewer flows from the Lab Area to Mattawoman Creek, along the way passing first through Site 57 (see Section 8.4.6.3 and Figure 8-1), then IW06. The Lab Area is discussed in more detail in Section 2.2.6.

8.3.4.5 Area 4 Summary

Three sites and the Lab Area, which is comprised of many buildings, were identified as potentially having contributed contaminants to Area 4 sediments. Site 39, the Organics Plant, is an obvious source of elevated silver because silver was historically discharged via the storm drainage system. Site 41 and Site 57 are potential sources of metals contamination. Site 41 is a fenced scrap yard where metal materials are held pending disposal. Arsenic has been detected in soil outside the fenced scrap yard as well as in Site 57 soil as a result of weed control efforts along railroad tracks. Mercury contamination throughout the Lab Area has been historically recorded.

As indicated on Figure 8-7, the maximum mercury detection was found in a sample collected adjacent to Site 41. However, the sample is also located near IW40 and IW80. As a result, it is unclear whether the source of mercury contamination is Site 41 or the Lab Area via IW40 and IW80. Additionally, no samples were collected extending from the shoreline in this area, so it is unclear how far the mercury contamination extends into Mattawoman Creek.

Similar to mercury, the maximum detections of silver were also found in Area 4 sediments. The maximum silver concentration was detected in a sample adjacent to Site 39. Site 39 is a known source of silver contamination.

8.3.5 Area 5

COC concentrations in Area 5 were elevated compared to background concentrations (see Table 8-1). Area 5 sediments exhibited study-wide maximum concentrations for arsenic, cadmium, and zinc. Additionally, maximum detected Area 5 concentrations exceeded both maximum detected background concentrations and two times maximum detected background concentrations for all COCs. Average concentrations also exceeded average detected background concentrations for every COC.

As noted in Table 8-2, three locations were identified as potentially contributing contaminants to Area 5 sediments including Site 28, former Building 133, and the Herbicide Mixing Area. All three areas are located along the shoreline of Mattawoman Creek and are discussed in more detail below.

8.3.5.1 Site 28 – Original Burning Ground

Site 28, Original Burning Ground, also referred to as the Slavins Dock Area and Wildlife Area, encompasses the former site of a zinc recovery furnace, Artesian Well #14, and the former Shoreline Burning Cage. The 1.8-acre site was used as a burning ground from the 1890s to 1942. There were no records on the types of materials that were burned; however, it was concluded that smokeless powder was burned at the site based on the materials manufactured when the site was in operation. Additionally, various contaminated wastes were also destroyed via open burning. Surface debris was removed from the site in 1990.

Because Site 28 is immediately adjacent to Mattawoman Creek, the most likely current pathways for contaminants to migrate to Mattawoman Creek surface water and sediment are via groundwater seeps and surface runoff from the site (see also Section 2.2.3).

8.3.5.2 Building 133

Building 133, the Old Acid Plant, was formerly located near sediment sample location MCSD022. Building 133, built in 1907, has been destroyed and since replaced by Building 1770. Nitric and sulfuric acid were manufactured at Building 133. Metals were by-products of this process. Due to the close proximity of the former building to Mattawoman Creek, contaminants associated with Building 133 activities may have migrated to Mattawoman Creek via surface runoff.

8.3.5.3 Herbicide Mixing Area

The former Herbicide Mixing Area was located near current Building 1770. Herbicides containing arsenic were mixed and applied to fences, railroad lines, and magazines along the shoreline of Mattawoman Creek in Area 5 and throughout the remainder of the facility. Runoff from the railroad line and surrounding surface soils may have entered Mattawoman Creek contributing to arsenic concentrations in sediment of that area. Herbicides are no longer mixed or used in the area; however, arsenic is potentially present in surface soils.

8.3.5.4 Area 5 Summary

Three IHDIV-NSWC sites were identified as potentially contributing contaminants to Area 5 sediments including Site 28, former Building 133, and the Herbicide Mixing Area. Site 28 is the former site of a zinc recovery furnace and is a potential source of zinc and PAHs to Mattawoman Creek. The former Building 133 is the Old Acid Plant where nitric and sulfuric acids were manufactured. Building 133 is a potential past source of metals to Mattawoman Creek. The Herbicide Mixing Area was located near to current

Building 1770 and Mattawoman Creek and is a potential source of arsenic because arsenic was once used in the manufacture of the herbicides that were both mixed and applied here.

Maximum concentrations of arsenic, cadmium, and zinc were detected in sample MTC026 in Area 5 (see Figures 8-3, 8-4, and 8-9, respectively). MTC026 is located along the shoreline of Mattawoman Creek adjacent to Site 28. High levels of most other COCs were also detected in MTC026. These concentrations are likely attributable to Site 28. Sample MTC022 was collected in an area between Building 133 and the Herbicide Mixing Area along the shoreline in Mattawoman Creek. Some COCs were detected in this sample; however, concentrations were low in comparison to other detections in Mattawoman Creek, indicating that Building 133 and the Herbicide Mixing Area are less significant contributors of COC contamination to Area 5 sediments than Site 28.

8.4 SUMMARY

In summary, the presence of elevated (i.e., greater than background levels) levels of metals and PAHs in the sediment in Mattawoman Creek may be related to various sites at IHDIV-NSWC. Some of the sites are no longer sources of contamination but have contaminated the creek in the past, while some sites may be continuing sources of contamination to Mattawoman Creek via surface water runoff, soil erosion, etc. As discussed in Section 8.3, for some areas and for some contaminants, it is relatively straightforward to identify the source of the contamination. However, in most cases, it is difficult to identify the specific source of contamination in a particular area. There are several reasons for this. There may be multiple sources of the same contaminant, so it is not possible to distinguish which source or sources are responsible for the contamination. Also, the contamination may be present in one area because of sediment transport from another area, although it is difficult to determine this as well.

Chemicals within Mattawoman Creek may move by dissolving in the water column and moving with the current. Also, sediment containing chemicals can be transported to other parts of Mattawoman Creek and even the Potomac River by the force of currents in the creek. Figure 4-21 presents percent silt in sediment within Mattawoman Creek. As can be observed from the figure, the samples with the greatest percent silt are typically located within bends, adjacent to SAV beds, while the samples in the less protected areas have less percent silt. This is what is expected because sediments deposit along bends in creeks which are typically in lower hydraulic energy, as well as within SAV beds which tend to trap fine-grained sediment. Area 2 is a good example where the combination of the bend in the creek and the SAV beds are causing the fine grained-sediment to deposit. On the other hand, most of the samples in Area 5 have relatively low amounts of silt because the creek channel decreases in width in this area which increases the water velocity and thus scouring of fine-grained sediment.

Since many of the samples were collected along the shoreline in order to identify the locations that are expected to have the greatest chemical concentrations, the extent of contamination into Mattawoman Creek in some of the areas is not known. Therefore, although the greatest chemical concentrations occurred in the samples collected closest to the source, the possibility remains that sediments with chemical concentrations greater than risk-based levels may have been transported to other parts of the creek, especially to depositional areas. However, in general, the chemical concentrations would be expected to decrease away from the shoreline because the contaminated sediment would be mixed with less-contaminated and/or clean sediment.

TABLE 8-1

MATTAWOMAN CREEK CHEMICALS OF CONCERN BY AREA
REFINED CONCEPTUAL SITE MODEL
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Area	Mattawoman Creek COC	Number of Samples	Maximum Detection (mg/kg)	Maximum Background Concentration (mg/kg)	2X Maximum Background Concentration (mg/kg)	Average Concentration (mg/kg)[1]	Average Background Concentration (mg/kg)
1	Arsenic	17	32.7	4.1	8.2	10.1	2.3
	Cadmium		18.7	3.5	7	2.8	2.2
	Copper		757	22.7	45.4	172	12.3
	Lead		76,400	30.7	61.4	4,774	17.4
	Mercury		0.53	ND	ND	0.14	ND
	Silver		10.9	0.76	1.52	2.9	0.3
	Zinc		1,910	142	284	415	84.7
	Total PAHs	11[2]	2.40	ND	ND	0.97	ND
2	Arsenic	7	14.6	4.1	8.2	6.4	2.3
	Cadmium		4.1	3.5	7	2	2.2
	Copper		36.3	22.7	45.4	23.6	12.3
	Lead		54.2	30.7	61.4	36.2	17.4
	Mercury		0.54	ND	ND	0.2	ND
	Silver		1.4	0.76	1.52	0.9	0.3
	Zinc		148	142	284	90.6	84.7
	Total PAHs		22.01	ND	ND	4.55	ND
3	Arsenic	4	9.6	4.1	8.2	4.3	2.3
	Cadmium		1.5	3.5	7	1	2.2
	Copper		37.1	22.7	45.4	22.7	12.3
	Lead		45.8	30.7	61.4	29	17.4
	Mercury		0.24	ND	ND	0.13	ND
	Silver		4.8	0.76	1.52	2.4	0.3
	Zinc		204	142	284	93.7	84.7
	Total PAHs		0.68	ND	ND	0.43	ND
4	Arsenic	13	16.6	4.1	8.2	6.6	2.3
	Cadmium		1.7	3.5	7	0.59	2.2
	Copper		120	22.7	45.4	25.8	12.3
	Lead		87.9	30.7	61.4	35.5	17.4
	Mercury		8.7	ND	ND	0.98	ND
	Silver		308	0.76	1.52	32.1	0.3
	Zinc		273	142	284	113	84.7
	Total PAHs		15.10	ND	ND	3.81	ND
5	Arsenic	5	70.7	4.1	8.2	16.4	2.3
	Cadmium		116	3.5	7	17.1	2.2
	Copper		229	22.7	45.4	45.5	12.3
	Lead		3,010	30.7	61.4	459	17.4
	Mercury	4[3]	0.34	ND	ND	0.16	ND
	Silver	5	5.9	0.76	1.52	1.4	0.3
	Zinc		71,000	142	284	12,463	84.7
	Total PAHs		0.96	ND	ND	0.86	ND

1 Average of all results.
2 Only 11 samples were collected for Total PAHs during the Mattawoman Creek Investigation; six additional samples analyzed for metals during the Site 11/17 Remedial Investigation were also included in the statistical calculations at Area 1.
3 One mercury sample result was rejected during validation.

TABLE 8-2

EVALUATION OF SIGNIFICANT SITES CONTRIBUTING CONTAMINATION TO MATTAWOMAN CREEK BY AREA
REVISED CONCEPTUAL SITE MODEL
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Site	Description	Migration Pathways to Mattawoman Creek	Contaminants of Concern Potentially Released to Mattawoman Creek	Comments
AREA 1				
Site 5	-X-Ray Building 731 -Silver-laden photo processing wastewaters were discharged from Bldg 731	-Two drainage swales (No. 1 and 2) emanating from the SE and SW and flow to MC via outfall IW21	Silver	-Removal actions in 1993 and 1994 in swales; action level set at 10 mg/kg
Site 6	-Hypo Spill, Radiographic Facility Accelerator -Similar operation as Site 5	-Two drainage swales (No. 1 and 2) -Discharges to same drainage ditch as Site 5, just further downstream	Silver	-Currently in Draft RI Stage
Site 11	-Caffee Road Landfill -Used until early 1960s -Debris includes bulk metal items and trash -Now used as Decontamination Burn Point -Flashed metal periodically removed -Eastern portion used for drum storage and waste segregation	-Surface soil to surface water and sediment by surface runoff	Metals	-BERA being conducted
Site 17	-Discarded Metal Parts Area -Used from 1960s to early 1980s	-Surface soil to surface water and sediment by surface runoff	Metals	-BERA being conducted -Large metal items removed in 1989 -An EE/CA has been proposed in connection with the removal of contaminated soil
Site 42	-Olsen Road Landfill -Unauthorized drainaing between 1982 and 1967 -Damaged material includes construction rubble, empty cans and drums, wooden pallets, and branches	-Runoff drains to same drainage ditch as Site 5 and Site 6, then to MC	Arsenic Cadmium Copper Lead Silver Zinc	-RI and FS completed -Remediation design underway as of January 2004
Strauss Ave Thermal Treatment Point	-Downgradient from Building 881 -Historic burning on ground; burning is now controlled in pans	-Air deposition (historic and current) -Surface runoff (historic)	Metals (primarily lead)	-Currently sampling for RCRA permit
AREA 2				
Small Motor Test Area	-Located between samples MTC11 and MTC12 (Figure 8-2) -Tested involved firing rocket motors -Ash historically washed down to MC	-Air deposition -Surface runoff	Arsenic, Lead, PAHs	
Site 8	-Nitroglycerin Plant Lab -Mercury was released in small amounts from sink and floor drains	-Flow to MC thru Site 12 pond, then to Mattawoman Creek	Mercury	
Site 18	-Hog Island -Created by filling with cadmium contaminated sand blast grit and mercury contaminated sludge (drying bed residue) from the sewage treatment plant	-Direct contact	Cadmium, Chromium Lead, Mercury	-Waste from the lab area may be included in STP sludge
Site 19	-Catch basins of the Chip Collection Houses (Buildings 1051 and 785) -Discharge of wastewater contaminated with lead and copper salts	-Outfall discharged to Site 12 pond, then to Mattawoman Creek	Copper, Lead	

TABLE 8-2

EVALUATION OF SIGNIFICANT SITES CONTRIBUTING CONTAMINATION TO MATTAWOMAN CREEK BY AREA
REVISED CONCEPTUAL SITE MODEL
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Site	Description	Migration Pathways to Mattawoman Creek	Contaminants of Concern Potentially Released to Mattawoman Creek	Comments
Site 12	-Town Gut Landfill -Sites discharge to Town Gut Pond, including Site 8, Site 13, Site 19, Site 47, and Site 56	-Flow to MC thru unknown culvert under road thru drainage ditch to MC	Metals, PAHs	
Site 56	-Lead floor tiles were washed and wash water was discharged to outfall IW87 that flowed to Site 12 pond, then to MC	-Outfall discharged to Site 12 pond, then to Mattawoman Creek	Lead, Mercury	
AREA 3				
Site 23	-Extrusion plant -Discharge of wastewater containing hydraulic oil from 1943 until 1981 -Includes all press builidngs (i.e., Buildings 561 thru 566) -Oil/water separator overflowed in the past so that oil releases discharged thru IW18	-IW18 is hard-piped and discharges directly to MC	Copper, Lead, Zinc PAHs	-Continues to discharge to IW18 under an NPDES permit -Oil found in surface soil was removed in mid 1980s
Site 25	-X-Ray Building No. 2 -Silver was disposed in toilet/sinks that were hard-piped to MC thru an old overland drainage ditch (IW46)	-Hardpiped to Outfall IW46	Silver	-Waste initially discharged to a drainage swale -Silver no longer discharged at this location
AREA 4				
Site 39	-Organics Plant -Discharge from Bldg 497 consisted of process water and storm drainage -Operations include formulating propellant binder bis-2,2-dinitropropanol and acetal/formal	-Outfall IW05 discharged to MC	Silver	-Past accidental discharges of silver to MC
Site 41	-Scrap Yard -Active storage of metal matl/scraps, drums, and office furniture -Lead-acid batteries and transformers formerly stored at the site	-Surface soil to surface water and sediment by surface runoff -Surface soil near railroad track to surface water and sediment via surface runoff	Metals, PAHs	
Site 57	-TCE Building 292 Area -Located approximately 1,300 feet north of MC -TCE used for vapor degreasing and general cleaning, mid 1960s to 1989	-Two discharges directly to MC: Outfalls IW40 and IW80 -Unidentified stream flows thru Site 57 into MC	Arsenic, Lead, PAHs	
Lab Area	-Sites 15, 16, 49, 50, 53, 54, and 55 -Site 15, mercury deposits in manhole, fluorine lab -Site 16, lab chemical disposal -Site 49, chemical disposal pit (removed in 2001) -Site 50, Bldg 103 crawl space -Site 53, mercury contamination in storm sewer -Site 54, Bldg 101 mercury contamination -Site 55, Bldg 102, mercury containing equipment	-Past discharges flowed to pipes, and via pipes through IW06 to MC -Later discharges were piped to MC passing through IW80	Lead, Mercury, PAHs	-Current discharges flow to the sewage treatment plant

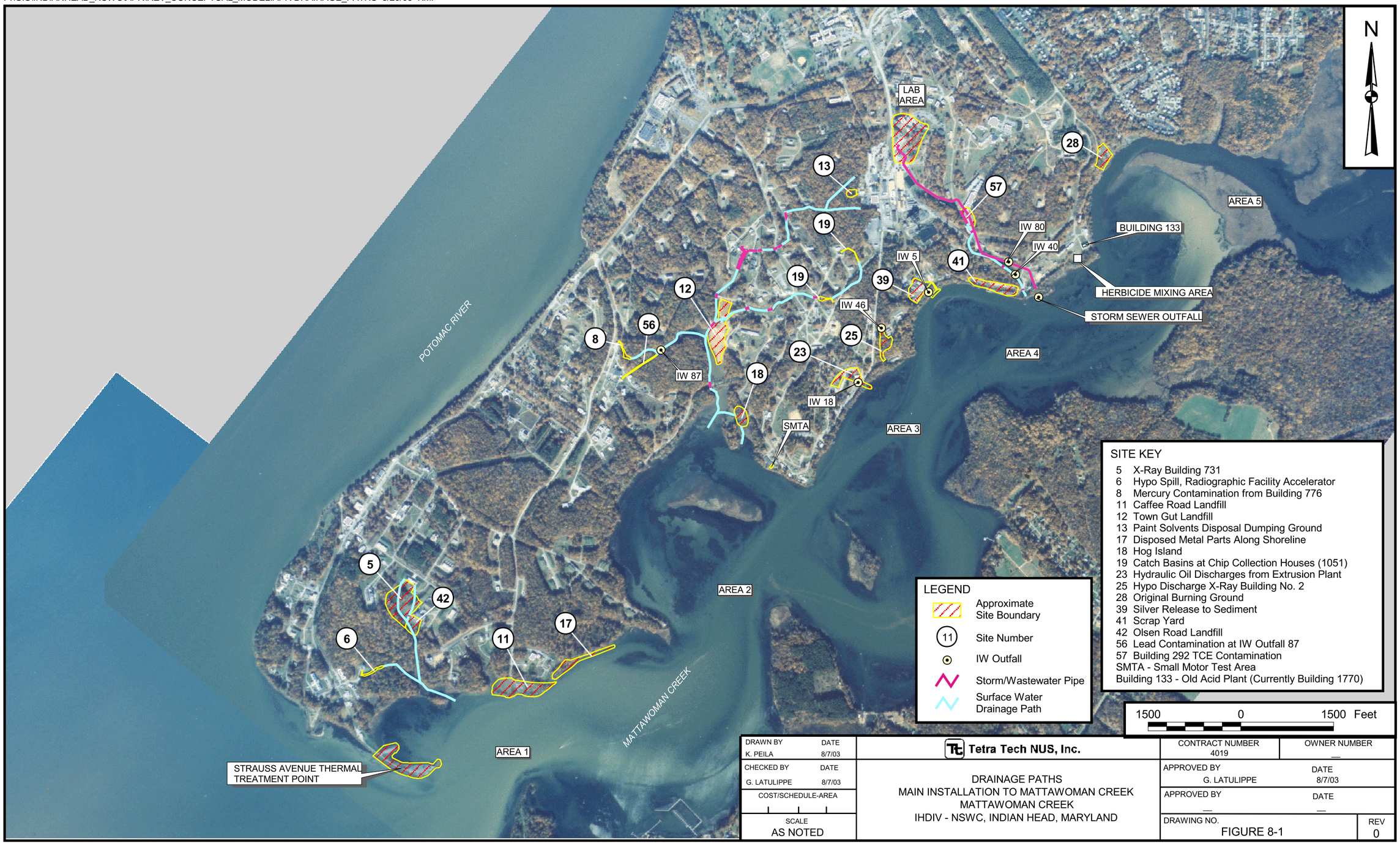
TABLE 8-2

EVALUATION OF SIGNIFICANT SITES CONTRIBUTING CONTAMINATION TO MATTAWOMAN CREEK BY AREA
REVISED CONCEPTUAL SITE MODEL
IHDIV-NSWC, INDIAN HEAD, MARYLAND

Site	Description	Migration Pathways to Mattawoman Creek	Contaminants of Concern Potentially Released to Mattawoman Creek	Comments
AREA 5				
Site 28	-Original Burning Ground -Former site of a zinc recovery furnace, Artesian Well #14, and Shoreline Burning Cage -Used as a burning ground 1890s to 1942 -No record of burned material other than smoke-less powder (identified as a result of the period of operation) -Surface debris removed in 1990	-Surface soil to subsurface soil and groundwater by infiltration -Surface soil to surface water and sediment by surface runoff -Groundwater discharge to surface water and sediment -Surface runoff via swales	Zinc, PAHs	-BERA being conducted -RI being conducted
Building 133	-Old Acid Plant -Located near MCSD022 -Manufacture of nitric and sulfuric acid -Building 133, built in 1907, now destroyed; Building 1770 is the existing building	-Surface soil to surface water and sediment by surface runoff	Metals	
Herbicide Mixing Area	-Herbicides contained arsenic -Herbicide applied to railroad lines and magazines which runs next to MC near Areas 4 and 5 -Nearest to Building 1770	-Runoff from the railroad line may have entered MC	Arsenic	

BERA = Baseline Environmental Risk Assessment
MC = Mattawoman Creek
RI = remedial investigation
RCRA = Resource Conservation and Recovery Act
PAHs = polyaromatic hydrocarbons
NPDES = National Pollution Discharge Elimination System

P:\GIS\INDIANHEAD_NSWC\APR\REV_CONCEPTUAL_MODEL.APR DRAINAGE_PATHS 8/20/03 KMP



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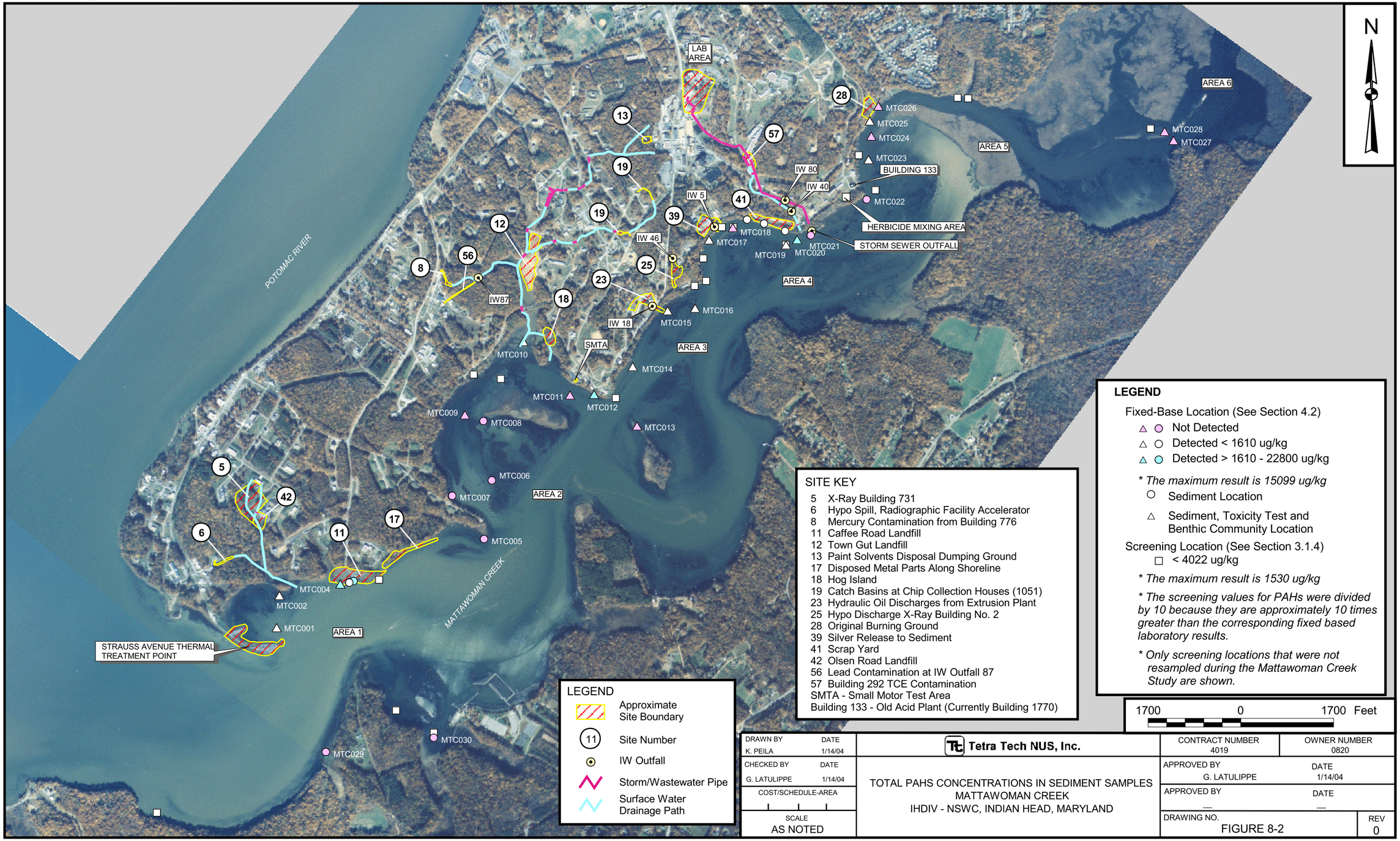
CHECKED BY G. LATULIPPE	DATE 8/7/03	DRAINAGE PATHS MAIN INSTALLATION TO MATTAWOMAN CREEK MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-1 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\REV_CONCEPTUAL_MODEL.APR TOTAL PAHS IN SEDIMENT 1/19/04 KMP



SITE KEY

5 X-Ray Building 731
6 Hypo Spill, Radiographic Facility Accelerator
8 Mercury Contamination from Building 776
11 Caffee Road Landfill
12 Town Gut Landfill
13 Paint Solvents Disposal Dumping Ground
17 Disposed Metal Parts Along Shoreline
18 Hog Island
19 Catch Basins at Chip Collection Houses (1051)
23 Hydraulic Oil Discharges from Extrusion Plant
25 Hypo Discharge X-Ray Building No. 2
28 Original Burning Ground
39 Silver Release to Sediment
41 Scrap Yard
42 Olsen Road Landfill
56 Lead Contamination at IW Outfall 87
57 Building 292 TCE Contamination
SMTA - Small Motor Test Area
Building 133 - Old Acid Plant (Currently Building 1770)

DRAWN BY K. PEILA	DATE 1/14/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 1/14/04	TOTAL PAHS CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE	DATE 1/14/04
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-2	REV 0

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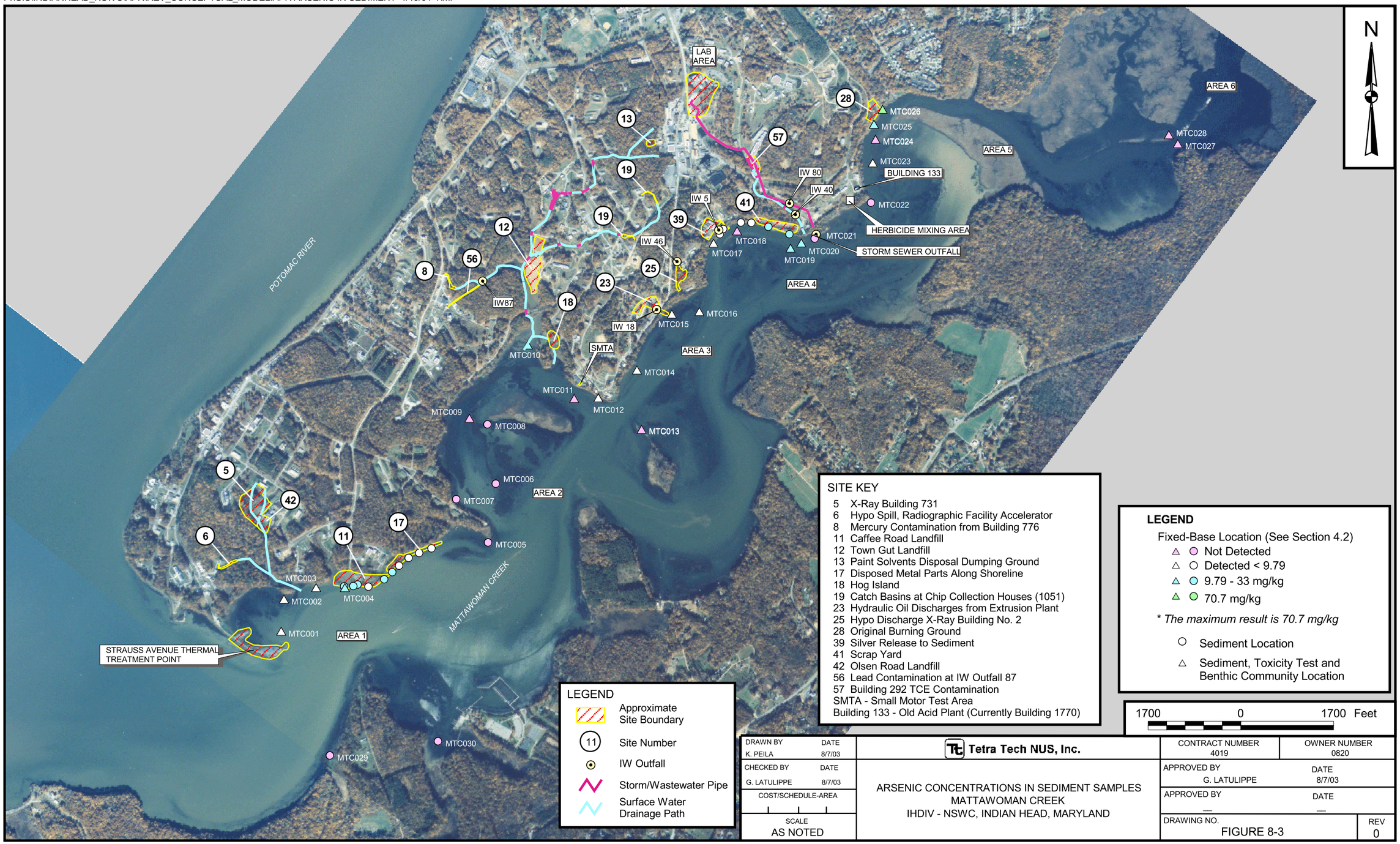

SITE KEY

5 X-Ray Building 731
6 Hypo Spill, Radiographic Facility Accelerator
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56 Lead Contamination at IW Outfall 87
57 Building 292 TCE Contamination
SMTA - Small Motor Test Area
Building 133 - Old Acid Plant (Currently Building 1770)

LEGEND

Fixed-Base Location (See Section 4.2)
- Not Detected
- Detected < 9.79
- 9.79 - 33 mg/kg
- 70.7 mg/kg

** The maximum result is 70.7 mg/kg*

- Sediment Location
- Sediment, Toxicity Test and Benthic Community Location

1700 0 1700 Feet

DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	ARSENIC CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-3 / REV 0

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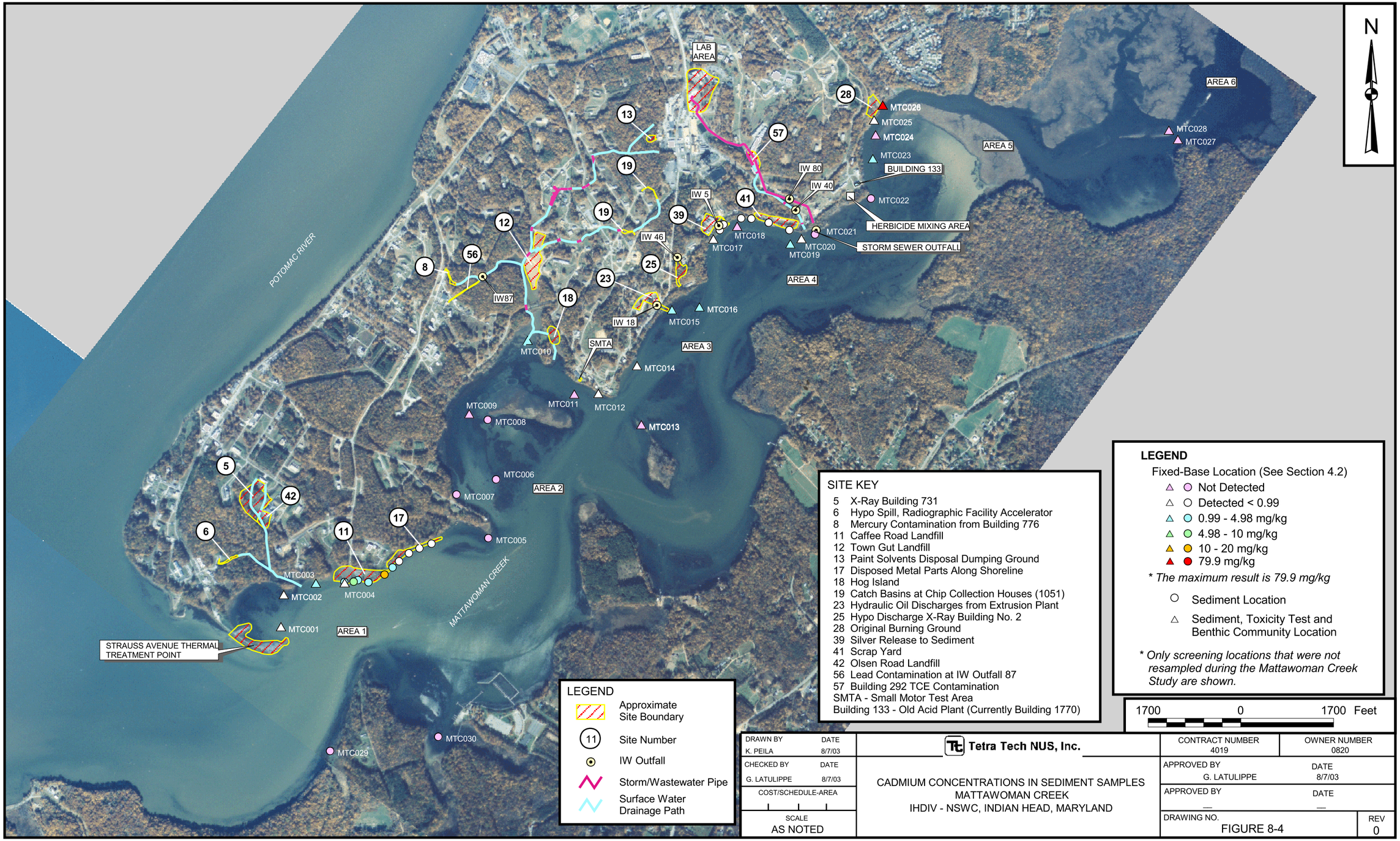

DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	CADMIUM CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-4 / REV 0

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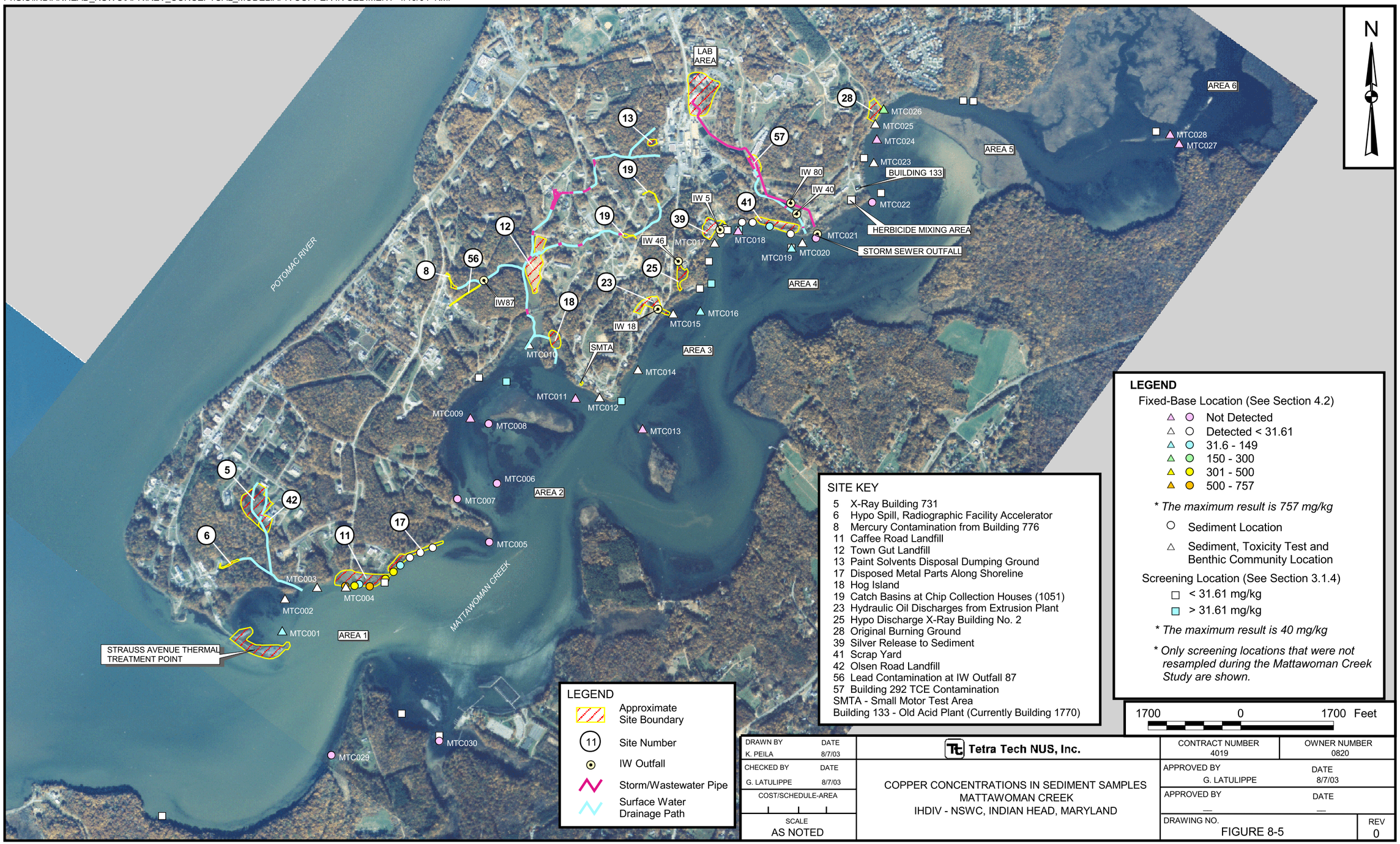

SITE KEY

5 X-Ray Building 731
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8 Mercury Contamination from Building 776
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42 Olsen Road Landfill
56 Lead Contamination at IW Outfall 87
57 Building 292 TCE Contamination
SMTA - Small Motor Test Area
Building 133 - Old Acid Plant (Currently Building 1770)

DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	COPPER CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-5 / REV 0

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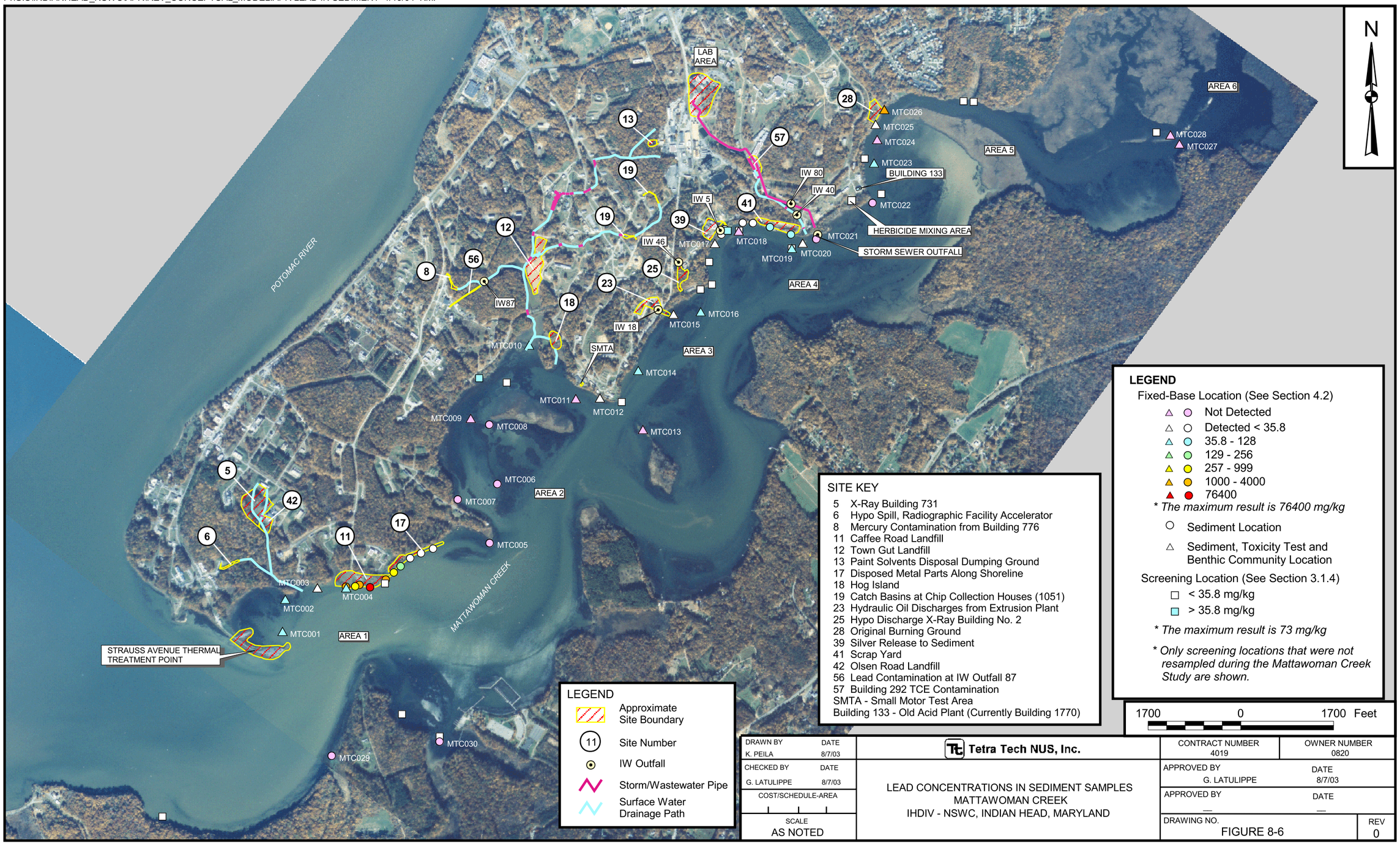

SITE KEY

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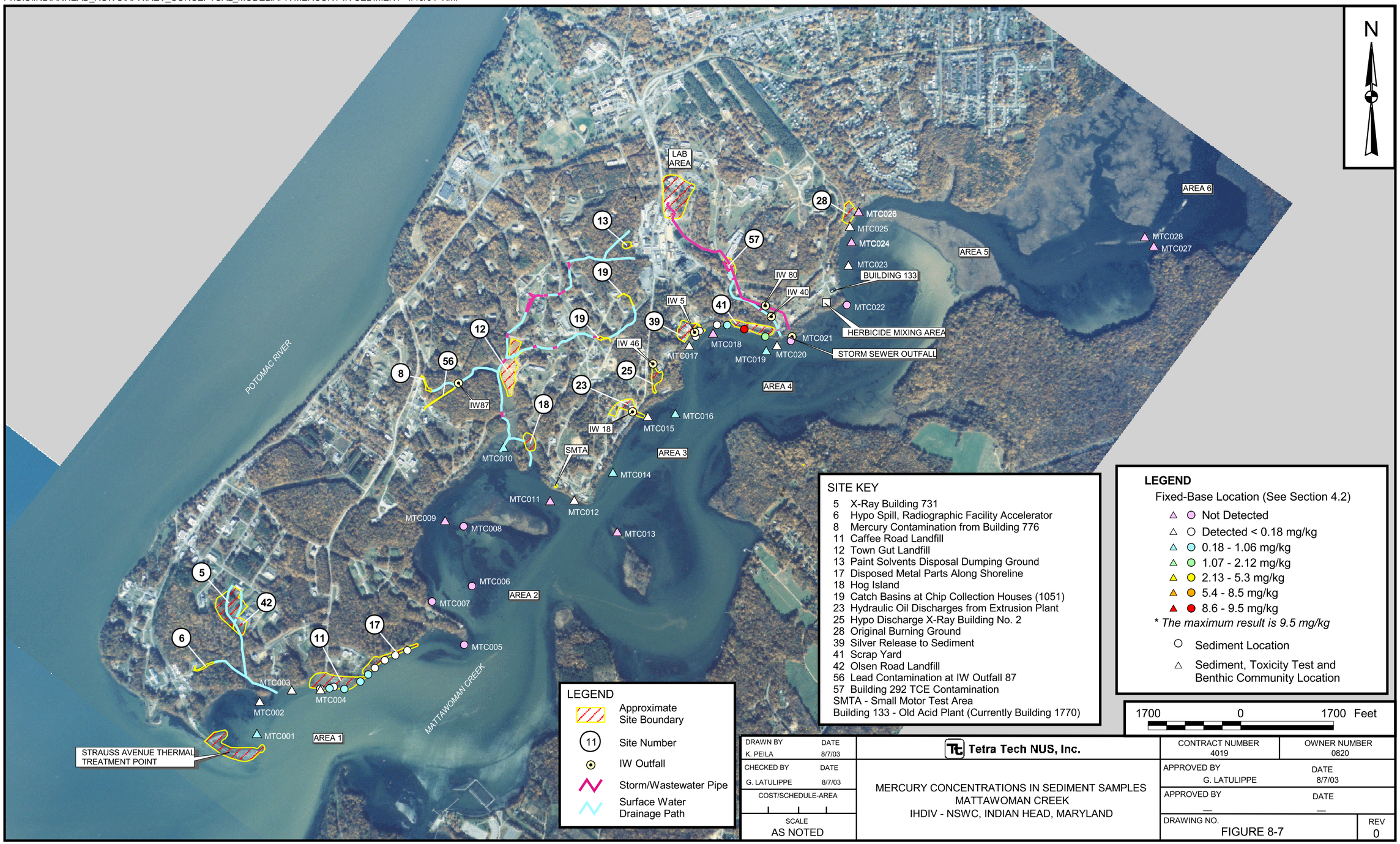
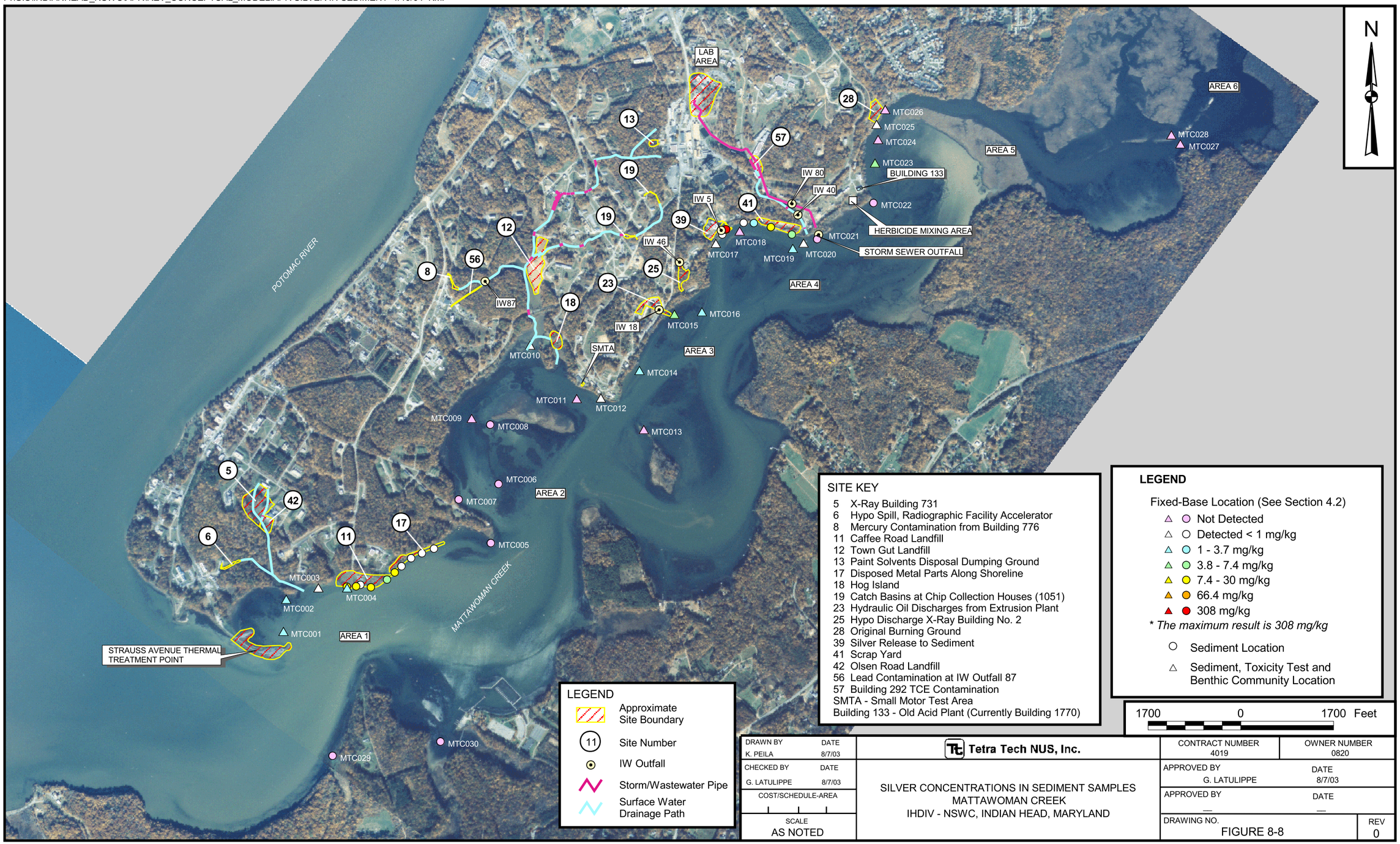
DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	LEAD CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-6 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\REV_CONCEPTUAL_MODEL.APR MERCURY IN SEDIMENT 1/19/04 KMP



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019	OWNER NUMBER 0820
K. PEILA	8/7/03			
CHECKED BY	DATE	MERCURY CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY	DATE
G. LATULIPPE	8/7/03		G. LATULIPPE	8/7/03
COST/SCHEDULE-AREA			APPROVED BY	DATE
			—	—
SCALE			DRAWING NO.	REV
AS NOTED			FIGURE 8-7	0

P:\GIS\INDIANHEAD_NSWC\APR\REV_CONCEPTUAL_MODEL.APR SILVER IN SEDIMENT 1/19/04 KMP



SITE KEY

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SMTA - Small Motor Test Area
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LEGEND

Fixed-Base Location (See Section 4.2)
- Not Detected
- Detected < 1 mg/kg
- 1 - 3.7 mg/kg
- 3.8 - 7.4 mg/kg
- 7.4 - 30 mg/kg
- 66.4 mg/kg
- 308 mg/kg

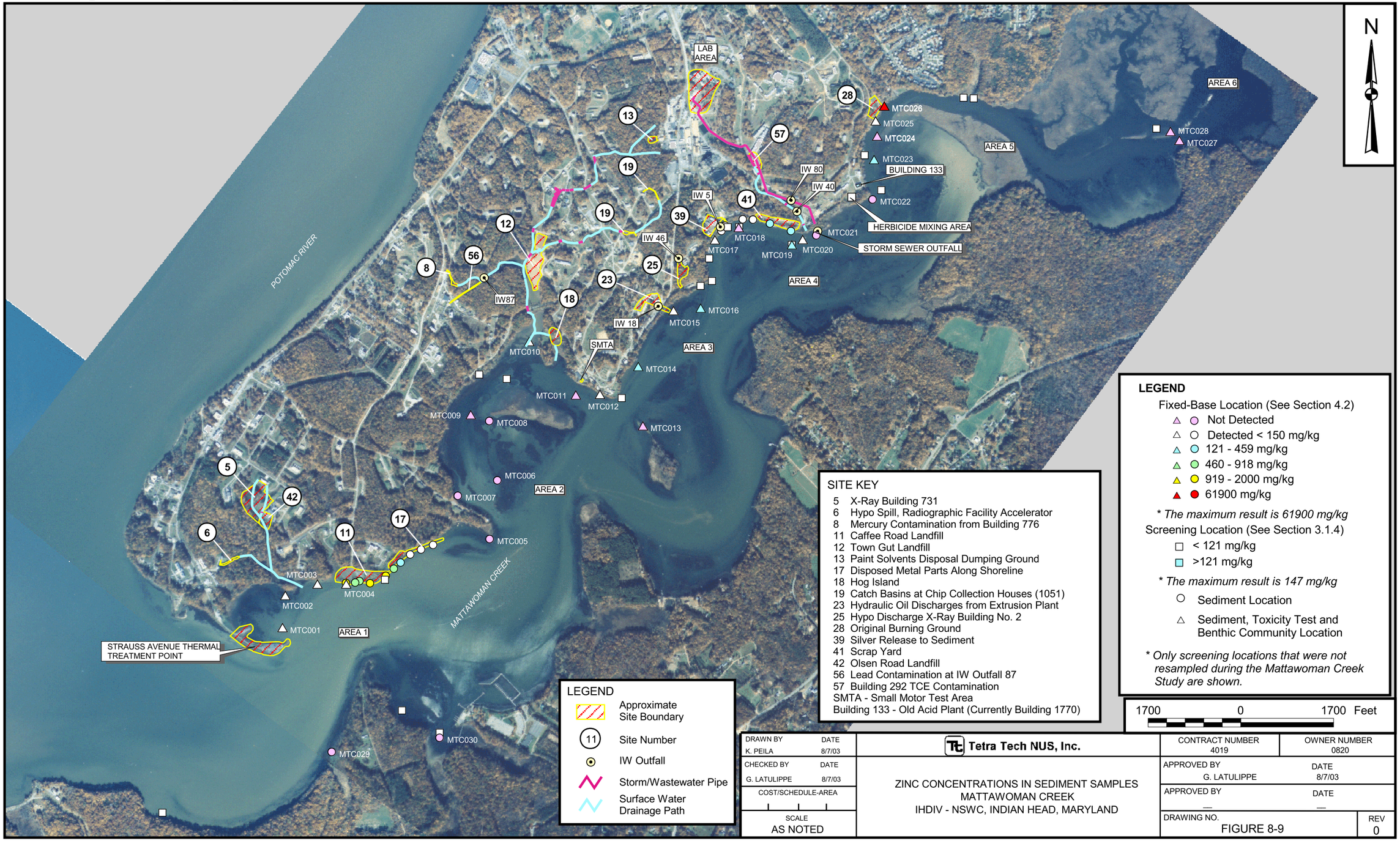
** The maximum result is 308 mg/kg*

- Sediment Location
- Sediment, Toxicity Test and Benthic Community Location

1700 0 1700 Feet

DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	SILVER CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-8 / REV 0

P:\GIS\INDIANHEAD_NSWC\APR\REV_CONCEPTUAL_MODEL.APR ZINC IN SEDIMENT 1/19/04 KMP



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SMTA - Small Motor Test Area
Building 133 - Old Acid Plant (Currently Building 1770)

DRAWN BY K. PEILA	DATE 8/7/03	Tetra Tech NUS, Inc.	CONTRACT NUMBER 4019 / OWNER NUMBER 0820
CHECKED BY G. LATULIPPE	DATE 8/7/03	ZINC CONCENTRATIONS IN SEDIMENT SAMPLES MATTAWOMAN CREEK IHDIV - NSWC, INDIAN HEAD, MARYLAND	APPROVED BY G. LATULIPPE / DATE 8/7/03
COST/SCHEDULE-AREA			APPROVED BY — / DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 8-9 / REV 0

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