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Final

Site-Specific Remedial Investigation Work Plan for Sites 6, 39, and 45 Naval Surface Warfare Center, Indian Head Division Indian Head, Maryland

Prepared for

Department of the Navy
Engineering Field Activity, Chesapeake
Naval Facilities Engineering Command

Contract No. N62470-95-D-6007
CTO-0066

March 2001

Prepared by

CH2MHILL

Baker
Environmental, Inc.

CDM
Federal Programs Corp.

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Naval Surface Warfare Center
Indian Head Division
Indian Head, Maryland

Contract Task Order 0066

February 27, 2001

Prepared for

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Under the

LANTDIV CLEAN II Program
Contract N62470-95-D-6007

Prepared by

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, Virginia 20170

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For Sites 6, 39, and 45

Naval Surface Warfare Center
Indian Head Division
Indian Head, Maryland

Contract Task Order Number – 0066
Contract Number N62470-95-D-6007
Navy CLEAN II Program

Prepared by
CH2M HILL

March 2001

Approved by: _____ Date: 2·26·01
Anthony Tomlin
Project Manager

Approved by: _____ Date: 2·26·01
Bob Root
Senior Reviewer/Activity Manager

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Abbreviations and Acronyms

Addendum	Addendum to B&RE Master Work Plans
AP	Ammonium Perchlorate
B&RE	Brown and Root Environmental
BGS	Below Ground Surface
BNA	Base Neutral Analyte
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chain of Custody
COPC	Chemical of Potential Concern
CTO	Contract Task Order
DNPOH	D-2,Di Nitro Propanol
DO	Dissolved Oxygen
DPT	Direct Push Technology
DRO	Diesel Range Organics
ERA	Ecological Risk Assessment
FOL	Field Operations Leader
HBNQ	High Bulk Density Nitroguanidine
HRS	Hazard Ranking System
IAS	Initial Assessment Study
IDW	Investigation-Derived Wastes
IHDIV-NSWC	Indian Head Division, Naval Surface Warfare Center
IR	Installation Restoration
LOAEL	Lowest Observed Adverse Effect Level
Master QAPP	Master Quality Assurance Plan
Master WP	Master Work Plan
MCL	Maximum Contaminants Levels
MDNR	Maryland Department of Natural Resources
MEK	Methyl Ethyl Ketone (2-Butanone)
NEESA	Naval Energy and Environmental Support Activity
NG	Nitroglycerin
NOAA	National Oceanographic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOS	Naval Ordnance Station
NPL	National Priorities List

Abbreviations and Acronyms (Continued)

PA	Preliminary Assessment
PCBs	Polychlorinated biphenyls
PETN	Pentaerythritol tetranitrate
PID	Photoionization Detector
PNC	Pellitized Nitrocellulose
Project Specific Work Plan	Project Specific Remedial Investigation Work Plan
QAPP	Quality Assurance Project Plan
RBCs	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SVOCs	Semivolatile Organic Compounds
SI	Site Inspection
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SW	Surface Water
TAL	Target Analyte List
TAT	Turn-Around Time
TCL	Target Compound List
TOC	Total Organic Carbon
UDMH	Unsymmetrical Dimethylhydrazine
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WP	Work Plan

Executive Summary

This Project Specific Remedial Investigation Work Plan (Project Specific Work Plan) for the Indian Head Division, Naval Surface Warfare Center (IHDIV-NSWC), Indian Head, Maryland, was prepared in response to Contract Task Order 0066, under the Comprehensive Long-term Environmental Action, Navy, contract number N62470-95-D-6007. The purpose of this Project Specific Work Plan is to present site-specific information and planned investigations for three Installation Restoration sites on IHDIV-NSWC.

The specific sites covered by this Project Specific Work Plan are listed in Table ES.1. The table includes a brief indication of the work planned for each site including the quantities of the various types of samples to be collected.

Sampling of various media is planned at all three sites. Overall, the planned field investigations comprise 9 surface soil, 4 subsurface soil, 3 surface soil from seasonally wet areas, and 2 surface water samples at Site 6; 20 surface soil and 20 subsurface soil samples at Site 39; and 4 sediment samples, 2 surface water samples, the advancement of 4 direct push technology borings and the collection of 4 surface soil, 4 subsurface soil, and 4 shallow groundwater grab samples at Site 45. One surface soil and subsurface soil sample will be collected for background at each site at an upgradient location. If warranted by the existence of confirmed soil contamination, three shallow groundwater wells will be installed at Sites 6 and 39, five shallow groundwater wells will be installed at Site 45, and shallow groundwater samples will be collected as part of the Phase 2 investigation. In total, 36 surface soil samples, 31 subsurface soil samples, 4 surface water samples, 4 sediment samples, 3 surface soil samples from seasonally wet areas, and 4 shallow groundwater grab samples will be collected from all 3 sites.

Table ES.1
Executive Summary
Indian Head, Maryland

Site Name	Work Plan Summary	Surface Soil Samples[1]	Subsurface Soil Boring Samples[1]	Shallow Groundwater Samples	Surface Water Samples	Sediment Samples	Surface Soil Samples from Seasonally Wet Area	Ecological Risk Assessment	Human Health Risk Assessment
Site 6	Conduct a thorough investigation of surface soils, subsurface soils, surface water, and shallow groundwater to determine if contaminated as result of a spent fixer spill.	10	5	3[1,2]	2	none	3	YES	YES
Site 39	Conduct a thorough investigation of surface soils, subsurface soils, and shallow groundwater to determine if contaminated as result of stack emissions from Buildings 497 and 498.	21	21	3[1,2]	none	none	none	YES	YES
Site 45	Conduct a thorough investigation of surface soils, subsurface soils, surface water, and shallow groundwater to determine if contaminated as result of possible leakage from abandoned drums.	5	5	9[1,3]	2	4	none	YES	YES

Notes: [1] = Totals include one background sample.
[2] = Shallow groundwater samples will not be collected unless contamination is detected in the soil.
[3] = Total includes four shallow groundwater grab samples that will be collected concurrently with the soil samples, and five shallow groundwater samples that will not be collected unless contamination is detected in the soil.

1. Introduction

This Project Specific Remedial Investigation Work Plan (Project Specific Work Plan) for the Indian Head Division, Naval Surface Warfare Center (IHDIV-NSWC), Indian Head, Maryland, was prepared in response to Contract Task Order (CTO) 0122, under the Navy Comprehensive Long-term Environmental Action, Navy (CLEAN) contract. The purpose of this Project Specific Work Plan is to present site-specific information and planned investigations for three Installation Restoration (IR) sites on IHDIV-NSWC (Sites 6, 39, and 45).

This Project Specific Work Plan is a supplement to the following master planning documents:

- Master Work Plan (Master WP), prepared by Brown and Root Environmental (B&RE), April 1997
- Standard Operating Procedures (SOPs), prepared by B&RE, April 1997
- Master Quality Assurance Project Plan (Master QAPP), prepared by B&RE, April 1997
- Health and Safety Guidance Document, prepared by B&RE, April 1997
- Addendum to B&RE Master Work Plans (Addendum), prepared by CH2M HILL, March 2000

The master planning documents provide the methods and procedures that will be used to perform environmental investigation work proposed at the three sites in this Project Specific Work Plan. The objective of this Project Specific Work Plan is to present historical information regarding each site, evaluate that information, and propose a plan for further investigation where needed. The specific objective for each individual site is dependent on the work previously conducted at that site. There has been minimal previous environmental investigations at these sites; therefore, the site-specific objective is in general to verify the presence or absence of contamination, to define the extent of contamination, and to evaluate the need for remediation. Unless otherwise noted, all SOPs referenced in this Project Specific Work Plan are contained in the Master WP (B&RE, April 1997). The Disposal of Waste Fluids and Solids SOP for the disposal of investigation derived wastes (IDW) is not contained in the Master WP. This SOP is included as Appendix C of this Project Specific Work Plan.

1.1 IHDIV-NSWC Description and Environmental Setting

IHDIV-NSWC is located in northwestern Charles County, Maryland, approximately 25 miles southeast of Washington, D.C. IHDIV-NSWC is a military facility consisting of two components: the main installation on the Cornwallis Neck Peninsula and the Stump Neck Annex. The main installation contains approximately 2,500 acres. The Stump Neck Annex comprises slightly less than 1,000 additional acres located across Mattawoman Creek from the main installation. The main installation is bounded by the Potomac River to the northwest, west, and south, Mattawoman Creek to the south and east, and the town of Indian Head to the northeast (Figure 1.1). The main installation includes Marsh Island and Thoroughfare Island,

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Source: USGS

HYDRO GeoLogic Inc.

Source: USGS Topographic Map
Scale = 1:100,000
Map Name: Washington West, DC-VA-MD, 1986

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Figure 1.1
Vicinity Map

which are located in Mattawoman Creek. Elevations range from sea level to 111 feet above sea level on Cornwallis Neck. Both the main installation (Cornwallis Neck Peninsula) and the Stump Neck Annex are on the National Priorities List (NPL). However, the main installation and Stump Neck Annex are separated by Mattawoman Creek (noncontiguous), have separate United States Environmental Protection Agency (USEPA) identification numbers, and perform dissimilar operations. Investigation of the Stump Neck Annex is being conducted through a Resource Conservation and Recovery Act (RCRA) Corrective Action and the IR program; therefore, only the main installation will be addressed in this Project Specific Work Plan.

IHDIV-NSWC was established in 1890 and is the Navy's oldest continuously operating ordnance station. At various times during its operation, IHDIV-NSWC has served as a gun and armor proving ground, a powder factory, a propellant plant, and a research facility. The U.S. Government purchased Stump Neck Annex in 1901. The property provided a safety buffer for the testing of larger naval guns that were tested by firing into the Potomac River or at Stump Neck.

The Indian Head installation was enlarged by another 1,160 acres of adjacent land in 1918, during World War I. This expansion included the purchase of Hopewell Farm and Hog Island, which was at that time an islet in Mattawoman Creek, and has since become contiguous to the Cornwallis Neck peninsula. When the Dahlgren Naval Proving Ground was established as a separate command in 1932, IHDIV-NSWC was redesignated the Naval Powder Factory (Parsons 2000).

The production of gunpowder and development of new explosives during the onset of World War II resulted in the construction of several new facilities at Indian Head, as well as the construction of Route 210 as a Defense Access Road in 1943. Development and improvements at Indian Head continued throughout the 1950s and 1960s, and in 1966, IHDIV-NSWC was renamed the Naval Ordnance Station (NOS). Rum Point, an 80-acre promontory in Mattawoman Creek near Stump Neck, was also acquired in this year. Bullitt Neck was obtained in five small acquisitions between 1965 and 1966, in order to meet safety and security needs arising from explosive magazines on the Indian Head station (Parsons 2000).

After the Vietnam conflict, the mission of IHDIV-NSWC shifted from primarily a production facility to a highly technical engineering support operation. In 1987, the NOS was established as a Center for Excellence to promote technological excellence in the following specialized fields: energetic chemicals; guns, rockets and missile propulsion; ordnance devices; explosives; safety and environmental protection; and simulators and training (Parsons 2000). Current military land use includes operations and training; production; maintenance and utilities; research, development, testing and evaluation; explosive storage; supply and non-explosive storage; administration; community facilities and services; housing; and open space.

Forest stands comprise approximately 47 percent or 1,603 acres of IHDIV-NSWC and include pine, pine-hardwood, and hardwood forest cover types. Recreation areas at Indian Head include approximately 1,150 acres of designated hunting areas, approximately 2 miles of shoreline fishing areas, and 1.5 miles of nature trails.

1.1.1 Surrounding Land Uses

IHDIV-NSWC is generally surrounded by commercial, residential, and State Park land to the east and south of the main installation and Stump Neck Annex. The town of Indian Head is

located just east of IHDIV-NSWC, and is where most residential developments are located. The Indian Head Highway (Route 210) extends eastward from the IHDIV-NSWC main gate, attracting businesses and providing access to residential areas off the main highway. The Potomac River borders the main installation to the north and west, and Stump Neck to the west. Mason Neck National Wildlife Refuge is located across the Potomac River, north of the main installation. The Mattawoman Natural Environment Area is state-owned property located along the southern edge of Mattawoman Creek east of the main installation.

The Stump Neck Annex is bordered to the north by Mattawoman Creek, to the east by General Smallwood State Park and Sweden Point Marina, and to the south by Chicamuxen Creek, agricultural lands, and low-density residential development. The Chicamuxen Wildlife Management Area is located adjacent to and south of the Stump Neck Annex.

1.1.2 Climate

IHDIV-NSWC lies in the humid temperate continental climatic zone of the eastern United States. This zone has hot, humid summers, and relatively mild winters. Due to its proximity to the Potomac River and its tributaries, IHDIV-NSWC experiences less extreme temperatures, higher precipitation, and higher humidity compared to inland areas. The average daily maximum temperature is 67.5°F and the average daily minimum temperature is 45°F. The warmest part of the year is in late July and the coldest is in late January and early February. The growing season is approximately 190 days, from mid-April through mid-October (USDA SCS 1974).

1.1.3 Soils

IHDIV-NSWC lies within the Atlantic Coastal Plain physiographic province and is underlain by unconsolidated sand, gravel, and clay from the Pleistocene Epoch and Cretaceous Period. The soils in this area consist of silty and sandy loams, with minor amounts of gravel. The soils tend to have low permeability and low shrink-swell potential. Four dominant soil associations are found at Indian Head (USDA SCS 1974):

- Beltsville-Gravelly Land-Bourne Association – The soils within this association are level to moderately sloping, moderately well-drained and loamy, and moderately deep. They also include dense, root-inhibiting fragipans and steep, gravelly soil materials.
- Beltsville-Exum-Wickham Association – This association is characterized by level to moderately sloping, moderately well-drained and well-drained loamy soils. Soils within this association are moderately deep, and include dense, root-inhibiting fragipans and steep, gravelly soil materials.
- Evesboro-Keyport-Elkton Association – This association is characterized by level to moderately sloping, excessively drained, sandy soils and moderately well-drained and poorly drained, level to gently sloping, loamy soils with clayey subsoil.
- Bibb-Tidal Marsh-Swamp Association – This association is characterized by level or nearly level, poorly drained, and generally located on floodplains and in miscellaneous unclassified wetlands.

The United States Department of Agriculture soil survey identifies 31 soil map units within the boundaries of IHDIV-NSWC. Beltsville silt loam, 2 to 5 percent slope and Croom gravelly sandy

loam, 10 to 15 percent slope, comprise just over 50 percent of the soils on IHDIV-NSWC. Beltsville silt loams are moderately well drained, strongly acidic soils that were formed in silty and moderately sandy materials. Croom gravelly sandy loams are well-drained gravelly soils that were formed in very old fluvial deposits of gravel, which contain varying level of sand and clay. They are found predominantly on upland areas and, due to their slope, have high erosion potential (Parsons 2000).

1.1.4 Hydrology

Major water bodies at Indian Head include the Potomac River, Mattawoman Creek, and Chicamuxen Creek. The Potomac River flows almost 400 miles from its headwaters in the Allegheny Mountains of West Virginia. Near Indian Head, the Potomac broadens and becomes saltier from the increasing influence of the Chesapeake Bay. Salinity ranges from 0.01 to 3.0 parts per thousand near IHDIV-NSWC, with the highest salinity values recorded during dry summer months. Mattawoman and Chicamuxen Creeks are tidal tributaries to the lower Potomac River. Chicamuxen Creek is more saline than Mattawoman Creek since it is more strongly influenced by the estuarine waters of the lower Potomac River.

The Potomac River bounds Cornwallis Neck to the north and northwest. Due to the topography of the peninsula, most of the surface water drainage on Cornwallis Neck flows into Mattawoman Creek, which forms its southeastern boundary. The Stump Neck peninsula is bounded by Mattawoman Creek to the north, the Potomac River to the northwest, and partially by Chicamuxen Creek to the southeast.

The Patapsco Formation aquifer supplies IHDIV-NSWC with the majority of groundwater required for production. It is recharged chiefly through precipitation as the water filters through the soil and is held primarily in sandy/gravelly formations (Parsons 2000). A single production well, Well 16A is screened in the deeper Patuxent aquifer.

1.1.5 Ecological Communities

Terrestrial Systems

IHDIV-NSWC comprises approximately 2,000 acres of terrestrial ecological communities on Cornwallis Neck and about 1,000 acres at Stump Neck. Terrestrial habitats in these areas are classified as forested uplands, open uplands, and terrestrial cultural uplands. The forested areas on IHDIV-NSWC are dominated by oaks, hickories, tulip tree (*Liriodendron tulipifera*) and pine. Flowering dogwood (*Cornus florida*), redbud (*Cercis canadensis*), and American holly (*Ilex opaca*) are typical of the upland understory. The forests are heavily fragmented by buildings, roads, and other structures. Terrestrial cultural uplands consist of areas that have been created, maintained, or modified by human activities. These areas are characterized as either mowed grass/landscaped areas, wildlife food plots, or successional fields and roadsides.

Wetland Systems

National Wetland Inventory maps identify approximately 290 acres of wetlands on IHDIV-NSWC. Of this acreage, tidal estuarine systems comprise 234 acres, forested wetlands comprise 42 acres, emergent marshes and shrub wetland comprise 5.5 acres, and lacustrine systems comprise the remaining acreage. Approximately 17 miles of riverine systems also occur in this area.

At Indian Head, the tidal estuarine systems are associated with the Potomac River, Mattawoman Creek, and Chicamuxen Creeks. Mattawoman Creek marshes are typically dominated by wild rice (*Zizania aquatica*), big cordgrass (*Spartina cynosuriodes*), cattail (*Typha* spp.), rose-mallow (*Hibiscus moscheutos*), tickseed sunflowers (*Bidens* spp.), pickerelweed (*Pontederia cordata*), and arrow arum (*Peltandra virginica*). Intertidal shoreline fringe marshes are extremely rare and are dominated by water willow (*Justica americana*) or American threesquare (*Scirpus pungens*). The broad expansive marsh of Chicamuxen Creek contains an extremely diverse flora. An informal survey of this marsh conducted in 1988 identified more than 80 species of plants (MDNR 1992).

1.1.6 Fauna

The diverse ecological communities at Indian Head support many wildlife species. Faunal inventories were conducted by Maryland Natural Heritage as part of the 1991- 1992 rare, threatened, and endangered species survey. IHDIV-NSWC natural resources staff has conducted additional waterfowl and amphibian surveys. Currently, an estimated 15 species of damselflies, 26 species of dragonflies, 48 species of butterflies, 29 species of mammals, 23 species of reptiles, 20 species of amphibians, and 119 species of birds utilize the available habitat at IHDIV-NSWC (MDNR 1992; Parsons 2000). Lists of these species are provided in Appendices A and B.

1.1.7 Rare, Threatened and Endangered Species

A survey of rare, threatened, and endangered species was conducted by the Maryland Natural Heritage Program in 1991 - 1992. The survey focused on areas with a high potential for supporting rare, threatened, and endangered species. Tables 1.1 and 1.2 list the rare, threatened, and endangered flora and fauna identified on IHDIV-NSWC. Of these listed species, the bald eagle (*Haliaeetus leucocephalus*) is the only known federally-listed threatened species identified on IHDIV-NSWC. The remainder of the species listed include five state-listed endangered plants, two state-listed threatened plants, one state-listed endangered invertebrate, and eighteen species of concern in the region.

Three additional rare tree species were identified during the 1995 Urban Tree Inventory including the state-threatened eastern arborvitae (*Thuja occidentalis*), state-rare shingle oak (*Quercus imbricaria*), and potentially state-rare pussy willow (*Salix discolor*).

The 1991 - 1992 survey also identified ten areas of ecological significance at Indian Head (totaling 614 acres) that have the potential to support the long-term protection of the rare, threatened, and endangered species. These protection areas include Bullitt Neck Point, Cornwallis Neck Marshes, Hog Island Cove, Thoroughfare Island, Chicamuxen Creek Marsh, Magnolia Seep, Porter Woods, Rum Point, Stump Neck Beaver Marsh, and West Stump Neck Shoreline.

Table 1.1
Rare Flora Found at NSWC Indian Head Division

Common Name	Scientific Name	Federal Status	State Status	Global/State Rank
Virginia snakeroot	Aristolochia serpentaria	NS	NS	G5/S3
Twining bartonia	Bartonia paniculata	NS	NS	G5/S3
Tickseed sunflower	Bidens coronata	NS	E	G5/S2S3
Swamp beggars-ticks	Bidens discoidea	NS	E	G5/S2S3
American bittersweet	Celastrus scandens	NS	NS	G5/SU
Virginia dayflower	Commelina virginica	NS	NS	G5/S3
Honeyvine	Cynachum leave	NS	NS	G5/S3
Pumpkin ash	Fraxinus profunda	NS	EE(1)	G4/S2S3
Narrow melicgrass	Melica mutica	NS	T	G5/S1
Creeping cucumber	Melothria pendula	NS	E	G4/S1
Large-seeded forget-me-not	Myosotis macrosperma	NS	T	G5/S1
Smallflower baby blue eyes	Nemophila aphylla	NS	NS	G5/S1
Coolwort	Pilea fontana	NS	NS	G5/S2
Wafer-ash	Ptelea trifoliata	NS	NS	G5/S3
Shingle oak (2)	Quercus imbricaria	NS	NS	G5/S3
Pussy willow (2)	Salix discolor	NS	NS	G5/SU
River bulrush	Scirpus fluviatilis	NS	NS	G5/S3S4
Red-berried greenbriar	Smilax walteri	NS	E	G5/S3
Eastern arborvitae (2)	Thuja occidentalis	NS	T	G5/S1

Source: MDNR 1992.

(1) Although listed in the State Threatened and Endangered Species List as endangered extirpated, State regulations provide that such species be afforded the same protection as an endangered species upon the discovery of a viable, naturally occurring population.

(2) Source: Virginia Tech, 1995.

Federal Codes:
E = Endangered
NS = No status

State Codes:
E = Endangered
EE = Endangered extirpated
T = Threatened

Global Ranks:
G4 = Apparently secure globally, though it may be quite rare in parts of its range.
G5 = Demonstrably secure globally, though it may be rare in parts of its range.

State Ranks:
S1 = Critically imperiled in the state because of extreme rarity, equivalent to being ranked as state rare.
S2 = Imperiled in the state because of rarity; equivalent to being ranked state rare.
S3 = Rare or uncommon in the state; equivalent to being ranked as watch list.
S4 = Apparently secure in state, with many occurrences.
SH = Of historical occurrence in the state but not verified in the past 20 years.
SU = Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the state.

Table 1.2
Rare Fauna Found at NSWC Indian Head Division

Common Name	Scientific Name	Federal Status	State Status	Global/State Rank
Birds				
Bald eagle	Haliaeetus leucocephalus	LT	E	G3/S1
Least bittern	Ixobrychus exilis	NS	I	G5/S2
Mammals				
Bobcat	Lynx rufus	NS	I	G5/S3
Southeastern shrew	Sorex longirostris	NS	NS	G5/S2
Amphibians/Reptiles				
Queen snake	Regina septemvittata	NS	NS	G5/S4
Invertebrates				
Sedge skimmer	Euphyes dion	NS	NS	G4/S3
Harvester	Feniseca tarquinius	NS	NS	G5/S4
Carolina satyr	Hermeuptychia sosybius	NS	NS	G5Q/S1S3
Frosted elfin	Incisalia irus	NS	E	G4/S1
Yellow-sided skimmer	Libellula flavida	NS	NS	G5/S4
Treetop emerald	Somatochlora provocans	NS	NS	G3G4/S1

Source: MDNR 1992.

Federal Codes:
LT = Threatened
NS = No status

State Codes:
E = Endangered
I = In need of conservation

Global Ranks:
G3 = Either very rare and local throughout its range or found locally in a restricted range.
G4 = Apparently secure globally, though it may be quite rare in parts of its range.
G5 = Demonstrably secure globally, though it may be rare in parts of its range.
Q = Indicates taxonomic uncertainty.

State Ranks:
S1 = Critically imperiled in the state because of extreme rarity, equivalent to being ranked as state rare.
S2 = Imperiled in the state because of rarity; equivalent to being ranked state rare.
S3 = Rare or uncommon in the state; equivalent to being ranked as watch list.
S4 = Apparently secure in state, with many occurrences.
SH = Of historical occurrence in the state but not verified in the past 20 years.

1.2 Document Organization

Section 1 contains introductory information, including facility history and environmental setting. Section 2 contains a description of field operations and procedures. Sections 3 through 5 contain site-specific information on the three specific sites that are addressed in this Project Specific Work Plan. Each site is described in a separate section that consists of background information and a site description, a summary of previous environmental investigations performed at the site, data assessment, investigative scoping, and a site-specific work plan summary. Section 6 contains references.

1.3 Previous Investigation and Evaluation

In June 1982, Naval Energy and Environment Support Activity (NEESA) conducted an Initial Assessment Study (IAS). Submitted in May of 1983, the report evaluated the various sites at IHDIV-NSWC to determine if a potential threat to human health or the environment existed. The report identified five sites (Sites 5, 6, 8, 12, and 25) as exhibiting a potential threat. A Confirmation Study was conducted at three of these sites (Sites 5, 8, and 12) and was published in September 1985 by CH2M HILL. Removal Actions were subsequently conducted at Sites 5 and 8. Site 12 is in need of further investigation.

A supplemental Preliminary Assessment (PA) Report was prepared by NEESA in January 1992. The report evaluated an additional 17 sites (Sites 39 to 55). All but two sites (Sites 51 and 52) were recommended for further work. As a follow-up to the supplemental PA, a Site Inspection (SI) was conducted on Sites 39 through 50, and Sites 53, 54, and 55 in two phases. Phase I focused on Site 42, Olson Landfill. Phase II focused on the remainder of the sites. Based on the results of the SI, all the sites were recommended for further study.

As required under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, the USEPA conducted a Hazard Ranking System for IHDIV-NSWC. The Activity scored a 50, which is above the 28.5 cut-off score. Therefore, IHDIV-NSWC was proposed to the NPL on February 13, 1995, and was officially placed on the list on September 29, 1995.

Limited existing data could be located for Sites 6, 39, and 45. Thus, no initial data screening was performed. Three USEPA Region III screening criteria will be used once results are obtained: Risk-Based Concentrations (RBCs), Soil Screening Levels (SSLs), and modified Biological Technical Assistance Group ecological criteria. Tables 1.3 and 1.4 show human health and ecological screening concentrations, respectively, for analytes that will be analyzed during the investigation.

1.4 Work Plan Summary

The locations of the three sites addressed by this Project Specific Work Plan are shown on Figure 1.2 and the proposed activities are summarized on Table 1.5. A summary of previous investigations performed at the sites is also included on the table. As shown on the table, additional environmental investigative work is proposed for all three sites.

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Volatiles (SW846-8260)					
Acetone	200,000,000	7,800,000	0.12	--	610
Acetonitrile	--	--	0.029	--	120
Acrolein	41,000,000	1,600,000	0.00001	--	0.042
Acrylonitrile	11,000	1,200	0.0000074	--	0.037
Allyl chloride	--	--	--	--	--
Benzene	200,000	22,000	0.0001	5	0.36
Bromodichloromethane	92,000	10,000	0.000054	80	0.17
Bromoform	720,000	81,000	0.2	80	8.50
Bromomethane	2,900,000	110,000	0.0021	--	8.5
2-Butanone (MEK)	1,200,000,000	47,000,000	0.4	--	1,900
Carbon disulfide	200,000,000	7,800,000	0.95	--	1,000
Carbon tetrachloride	44,000	4,900	0.00011	5	0.16
Chlorobenzene	41,000,000	1,600,000	0.04	100	110
Chloroethane	2,000,000	220,000	0.00096	--	8,600
Chloroform	940,000	100,000	0.000045	80	0.15
Chloromethane	440,000	49,000	0.00052	--	2.1
Chloroprene	--	--	--	--	--
Dibromochloromethane	68,000	7,600	0.000041	100	0.13
1,2-Dibromo-3-chloropropane	4,100	460	0.000044	0.2	0.047
1,2-Dibromoethane (EDB)	67	7.5	0.00000043	0.05	0.00075
Dibromomethane	--	--	--	--	61
trans-1,4-Dichloro-2-butene	--	--	--	--	--
Dichlorodifluoromethane	410,000,000	16,000,000	0.55	--	350
1,1-Dichloroethane	200,000,000	7,800,000	0.23	--	800
1,2-Dichloroethane	63,000	7,000	0.000052	5	0.12
1,1-Dichloroethene	9,500	1,100	0.000018	7	0.044
1,2-Dichloroethene (total)	18,000,000	700,000	0.019	70	55.00
1,2-Dichloropropane	84,000	9,400	0.0004	5	0.16
cis-1,3-Dichloropropene**	57,000	6,400	0.000027	--	0.440
trans-1,3-Dichloropropene**	57,000	6,400	0.000027	--	0.440
1,4-Dioxane	520,000	58,000	0.0013	--	6.1

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Ethylbenzene	200,000,000	7,800,000	0.75	700	1,300.00
Ethylmethacrylate	180,000,000	7,000,000	1	--	550
2-Hexanone	82,000,000	3,100,000	--	--	--
Iodomethane	--	--	--	--	--
Isobutanol	610,000,000	23,000,000	0.59	--	1,800
Methacrylonitrile	200,000	7,800	0.00021	--	1.0
Methylene chloride	760,000	85,000	0.00095	5	4.10
Methyl methacrylate	1,000,000,000	110,000,000	0.32	--	1,400
4-Methyl-2-pentanone	160,000,000	6,300,000	0.065	--	140
Propionitrile	--	--	--	--	--
Styrene	410,000,000	16,000,000	2.9	100	1,600.00
1,1,1,2-Tetrachloroethane	220,000	25,000	0.0002	--	0.053
1,1,2,2-Tetrachloroethane	29,000	3,200	0.000034	--	0.053
Tetrachloroethene	110,000	12,000	0.0024	5	1.10
Toluene	410,000,000	16,000,000	0.44	1,000	750
1,1,1-Trichloroethane	41,000,000	1,600,000	0.51	200	540
1,1,2-Trichloroethane	100,000	11,000	0.000039	5	0.19
Trichloroethene	520,000	58,000	0.00077	5	1.60
Trichlorofluoromethane	610,000,000	23,000,000	1.1	--	1,300
1,2,3-Trichloropropane	820,000	91	0.00000052	--	1,500
Vinyl acetate	1,000,000,000	78,000,000	0.087	--	410
Vinyl chloride (adult)	7,600	850	0.0000079	2***	0.081
Vinyl chloride (lifetime)	3,800	430	0.0000079	2***	0.04
Xylenes (total)	4,100,000,000	160,000,000	8.5	10,000	12,000
Semivolatiles (SW846-8270)					
Acenaphthene	120,000,000	4,700,000	5.2	--	370
Acenaphthylene	--	--	--	--	--
Acetophenone	200,000,000	7,800,000	0.000011		0.042
2-Acetylaminofluorene	--	--	--	--	--
4-Aminobiphenyl	--	--	--	--	--
Aniline	1,000,000	110,000	0.0068	--	12
Anthracene	610,000,000	23,000,000	23	--	1,800
Aramite	--	--	--	--	--

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Benzo(a)anthracene	7,800	870	0.073	--	0.092
Benzo(b)fluoranthene	7,800	870	0.23	--	0.092
Benzo(k)fluoranthene	78,000	8,700	23	--	0.92
Benzo(g,h,i)perylene	--	--	--	--	--
Benzo(a)pyrene	780	87	0.019	0.2	0.0092
Benzoic acid	1,000,000,000	310,000,000	--	--	150,000
Benzyl alcohol	610,000,000	23,000,000	4.4	--	11,000
4-Bromophenyl-phenylether	--	--	--	--	--
Butylbenzyl phthalate	410,000,000	16,000,000	840	--	7,300
2-sec-Butyl-4,6-dinitrophenol	--	--	--	--	--
Carbazole	290,000	32,000	0.023	--	3.30
4-Chloroaniline	8,200,000	310,000	0.048	--	150
bis-(2-Chloroethoxy)methane	--	--	--	--	--
bis-(2-Chloroethyl)ether	5,200	580	0.0000022	--	0.0096
2,2'-oxybis(1-Chloropropane)	82,000	9,100	0.000084	--	--
4-Chloro-3-methylphenol	--	--	--	--	--
2-Chloronaphthalene	160,000,000	6,300,000	1.6	--	2,900
2-Chlorophenol	10,000,000	390,000	--	--	30
4-Chlorophenyl-phenylether	--	--	--	--	--
Chrysene	780,000	87,000	7.3	--	9.2
Dibenz(a,h)anthracene	780	87	0.07	--	0.0092
Dibenzofuran	8,200,000	310,000	0.38	--	24
Di-n-butylphthalate	200,000,000	7,800,000	250	--	3,700
1,2-Dichlorobenzene	180,000,000	7,000,000	0.46	600	550
1,3-Dichlorobenzene	61,000,000	2,300,000	0.0044	--	14
1,4-Dichlorobenzene	240,000	27,000	0.00036	75	0.47
3,3'-Dichlorobenzidine	13,000	1,400	0.00025	--	0.15
2,4-Dichlorophenol	6,100,000	230,000	0.06	--	110
2,6-Dichlorophenol	--	--	--	--	--
Diethylphthalate	1,000,000,000	63,000,000	23	--	29,000

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
p-Dimethylaminoazobenzene	--	--	--	--	--
7,12-Dimethylbenz(a)anthracene	--	--	--	--	--
3,3'-Dimethylbenzidine	620	69	--	--	0.0073
a,a-Dimethylphenethylamine	--	--	--	--	--
2,4-Dimethylphenol	41,000,000	1,600,000	0.34	--	730
Dimethylphthalate	1,000,000,000	780,000,000	--	--	370,000
1,3-Dinitrobenzene	200,000	7,800	0.0018	--	3.7
4,6-Dinitro-2-methylphenol	200,000	7,800	--	--	4
2,4-Dinitrophenol	4,100,000	160,000	--	--	73
2,4-Dinitrotoluene	4,100,000	160,000	0.029	--	73
2,6-Dinitrotoluene	2,000,000	78,000	0.012	--	37
Di-n-octylphthalate	41,000,000	1,600,000	120000	--	730
Diphenylamine	51,000,000	2,000,000	1.3	--	910
bis-(2-Ethylhexyl)phthalate	410,000	46,000	140	6	4.8
Ethyl methanesulfonate	--	--	--	--	--
Fluoranthene	82,000,000	3,100,000	310	--	1,500
Fluorene	82,000,000	3,100,000	6.8	--	2,400
Hexachlorobenzene	3,600	400	0.0026	1	0.042
Hexachlorobutadiene	73,000	8,200	0.092	--	0.86
Hexachlorocyclopentadiene	14,000,000	550,000	100	50	260
Hexachloroethane	410,000	46,000	0.018	--	4.8
Hexachlorophene	610,000	23,000	100	--	11.00
Hexachloropropene	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	7,800	870	0.64	--	0.092
Isophorone	6,000,000	670,000	0.021	--	71
Isosafrole	--	--	--	--	--
Methapyrilene	--	--	--	--	--
3-Methylcholanthrene	--	--	--	--	--
Methyl methanesulfonate	--	--	--	--	--
2-Methylnaphthalene	4,100,000	1,600,000	1.1	--	120
2-Methylphenol	100,000,000	3,900,000	--	--	1,800
3-Methylphenol	100,000,000	3,900,000	--	--	180

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
4-Methylphenol	10,000,000	390,000	--	--	180
Naphthalene	4,100,000	1,600,000	0.0077	--	65
1,4-Naphthoquinone	--	--	--	--	--
1-Naphthylamine	--	--	--	--	--
2-Naphthylamine	--	--	--	--	--
2-Nitroaniline	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--
Nitrobenzene	1,000,000	39,000	0.0012	--	3.5
2-Nitrophenol	--	--	--	--	2,300
4-Nitrophenol	16,000,000	630,000	0.087	--	290
4-Nitroquinoline-1-oxide	--	--	--	--	--
n-Nitroso-di-n-butylamine	1,100	120	0.0000014	--	0.0019
n-Nitrosodiethylamine	38	4.30	0.00000011	--	0.00045
n-Nitrosodimethylamine	110	13.00	0.00000028	--	0.0013
n-Nitrosodiphenylamine	1,200,000	130,000	0.038	--	14
n-Nitroso-di-n-propylamine	820	91	0.00000024	--	0.0096
n-Nitrosomethylethylamine	260	29	--	--	0.003
n-Nitrosomorpholine	--	--	--	--	--
n-Nitrosopiperidine	--	--	--	--	--
n-Nitrosopyrrolidine	2,700	300	--	--	0.032
5-Nitro-o-toluidine	--	--	--	--	--
Pentachlorobenzene	1,600,000	63,000	1	--	29
Pentachloroethane	--	--	--	--	--
Pentachloronitrobenzene	22,000	2,500	0.0041	--	0.26
Pentachlorophenol	48,000	5,300	--	1	0.56
Phenacetin	--	--	--	--	--
Phenanthrene		--	--	--	--
Phenol	1,000,000,000	47,000,000	6.7	--	22,000
4-Phenylenediamine	390,000,000	15,000,000	--	--	6,900
2-Picoline	--	--	--	--	--
Pronamide	--	--	--	--	--
Pyrene	61,000,000	2,300,000	34	--	180
Pyridine	2,000,000	78,000	--	--	37

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Safrole	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	610,000	23,000	0.033	--	11
2,3,4,6-Tetrachlorophenol	61,000,000	2,300,000	--	--	1,100
2-Toluidine	--	--	--	--	--
1,2,4-Trichlorobenzene	20,000,000	780,000	0.38	70	190
2,4,5-Trichlorophenol	200,000,000	7,800,000	--	--	3,700
2,4,6-Trichlorophenol	520,000	58,000	--	--	6.1
1,3,5-Trinitrobenzene	61,000,000	2,300,000	--	--	1,100
Organochlorine Pesticides (SW846-8081)					
Aldrin	340	38	0.00038	--	0.0039
alpha-BHC	910	100	0.000045	--	0.011
beta-BHC	3,200	350	0.00016	--	0.037
delta-BHC	3,200	350	0.00016	--	0.037
gamma-BHC (Lindane)	4,400	490	0.00022	0.2	0.052
alpha-Chlordane	16,000	1,800	0.046	2	0.19
gamma-Chlordane	16,000	1,800	0.046	2	0.19
Chlorobenzilate	21,000	2,400	0.0013	--	0.25
4,4'-DDD	24,000	2,700	0.56	--	0.28
4,4'-DDE	17,000	1,900	1.8	--	0.20
4,4'-DDT	17,000	1,900	0.058	--	0.20
Diallate	--	--	--	--	--
Dieldrin	360	40	0.00011	--	0.0042
Endosulfan I	12,000,000	470,000	0.98	--	220
Endosulfan II	12,000,000	470,000	0.98	--	220
Endosulfan sulfate	12,000,000	470,000	0.98	--	--
Endrin	610,000	23,000	0.27	2	11
Endrin aldehyde	--	--	--	--	--
Heptachlor	1,300	140	0.042	0.4	0.015
Heptachlor epoxide	630	70.00	0.0012	--	0.0074
Isodrin	--	--	--	--	--
Kepone	--	--	--	--	--
Methoxychlor	10,000,000	390,000	15	40	180

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Toxaphene	5,200	580	0.031	3.0	0.061
Organophosphorous Pesticides (SW846-8141)					
Dimethoate	---	--	--	--	--
Disulfoton	82,000	3,100	0.0032	--	1.5
Famphur	--	--	--	--	--
Parathion ethyl	12,000,000	470,000	0.5	--	--
Parathion methyl	12,000,000	470,000	0.5	--	--
Phorate	--	--	--	--	--
Sulfotepp	--	--	--	--	--
Thioazin	--	--	--	--	--
o,o,o-Triethylphosphorothioate	--	--	--	--	--
PCBs (SW846-8082)					
Aroclor-1016	2,900	320	0.21	0.50	0.96
Aroclor-1221	2,900	320	--	0.50	0.033
Aroclor-1232	2,900	320	--	0.50	0.033
Aroclor-1242	2,900	320	--	0.50	0.033
Aroclor-1248	2,900	320	--	0.50	0.033
Aroclor-1254	2,900	320	0.054	0.50	0.033
Aroclor-1260	2,900	320	--	0.50	0.033
PCB Congeners (NOAA)[P]	--	--	--	--	--
Herbicides (SW846-8150)					
2,4-D	20,000,000	780,000	0.45	70	370
2,4,5-T	20,000,000	780,000	0.098	--	370
2,4,5-TP (Silvex)	16,000,000	630,000	1.1	50	290
Dinoseb	2,000,000	78,000	0.0087	7	37
Dioxins					
2,3,7,8-TCDD	0.000038	0.0000043	0.00000043	3E-11	0.00000045
1,2,3,7,8-PeCDD		--	--	--	--

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
1,2,3,6,7,8-HxCDD		--	--	--	--
1,2,3,4,7,8-HxCDD		--	--	--	--
1,2,3,7,8,9-HxCDD		--	--	--	--
1,2,3,4,6,7,8-HpCDD		--	--	--	--
1,2,3,4,6,7,8,9-OCDD		--	--	--	--
2,3,7,8-TCDF		--	--	--	--
1,2,3,7,8-PeCDF		--	--	--	--
2,3,4,7,8-PeCDF		--	--	--	--
1,2,3,6,7,8-HxCDF		--	--	--	--
1,2,3,7,8,9-HxCDF		--	--	--	--
1,2,3,4,7,8-HxCDF		--	--	--	--
2,3,4,6,7,8-HxCDF		--	--	--	--
1,2,3,4,6,7,8-HpCDF		--	--	--	--
1,2,3,4,7,8,9-HpCDF		--	--	--	--
1,2,3,4,6,7,8,9-OCDF		--	--	--	--
Inorganics (ILM03)					
Aluminum	1,000,000,000	78,000,000	--	--	37,000
Antimony	820,000	31,000	0.66	6	15
Arsenic	3,800	430	0.0013	5	0.045
Barium	140,000,000	5,500,000	110	2,000	2,600
Beryllium	4,100,000	160,000	58	4	73
Cadmium	2,000,000	78,000	2.7	5	18
Calcium	--	--	--	--	--
Chromium	6,100,000	230,000	2.1	100	110
Cobalt	120,000,000	4,700,000	--	--	2,200
Copper	82,000,000	3,100,000	530	1300	1,500
Cyanide	41,000,000	1,600,000	7.4	200[c]	730
Iron	610,000,000	23,000,000	--	--	11,000
Lead	--	--	--	15[f]	--
Magnesium	--	--	--	--	--
Manganese	290,000,000	11,000,000	330	--	730
Mercury	--	--	--	2	--
Nickel	41,000,000	1,600,000	--	--	730

Table 1.3
Human Health Screening Values
For Groundwater, Soil, and Sediment

Compound	Soil and Sediment			Groundwater	
	Human Health RBC		Soil Screening Levels (SSLs)	Drinking Water	Human Health
	Industrial Soil ug/kg	Residential Soil ug/kg	mg/kg	MCLs ug/L	RBC ug/L
Potassium	--	--	--	2	--
Selenium	10,000,000	390,000	0.95	50	180
Silver	10,000,000	390,000	1.6	--	180
Sodium	--	--	--	--	--
Sulfide (EPA 376.1)	--	--	--	--	--
Thallium	160,000	6,300	0.18	2	--
Tin (SW846-6010)	1,000,000,000	310,000	--	--	22,000
Vanadium	14,000,000	550,000	260	--	260
Zinc	610,000,000	23,000,000	680	--	11,000

Notes:

MCL - Maximum Contaminant Level

(T) – These are not MCLs but action levels for tap water

* RBCs are used for screening only when MCLs are not available.

** - The sum of both cis- and trans- should not exceed the listed value.

*** - This value is listed for vinyl chloride in the Federal Drinking Water Standards.

4-Nitrophenol human health RBC value was substituted as a surrogate for 2-nitrophenol

Technical grade BHC human health RBC value was substituted as a surrogate for delta-BHC

P - PCB congeners analyzed by the NOAA method have a detection limit range of 0.07-1.84 ng/g and include the following PCB compounds: PCB 8, 18, 28, 44, 52, 66, 77, 101 128, 138, 153, 170, 180, 187, 195, 206, and 209. PCB 77 and PCB 126 are co-planer PCBs.

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Surface Water/Groundwater (Fresh)							
1,1,1,2-Tetrachloroethane		2400	ug/L	USEPA 1995			
1,1,1-Trichloroethane		9400	ug/L	USEPA 1995			
1,1,2,2-Tetrachloroethane		2400	ug/L	USEPA 1995			
1,1,2-Trichloroethane		9400	ug/L	USEPA 1995			
1,1-Dichloroethane	75-34-3	1600	ug/L	USEPA 1995 (with safety factor of 100)			
1,1-Dichloroethene	75-35-4	1160	ug/L	USEPA 1995 (with safety factor of 10)			
1,2,4,5-Tetrachlorobenzene		50	ug/L	USEPA 1995			
1,2,4-Trichlorobenzene		50	ug/L	USEPA 1995			
1,2-Dibromoethane	106-93-4	180	ug/L	USEPA 1995 (with safety factor of 100)			
1,2-Dichlorobenzene		763	ug/L	USEPA 1995			
1,2-Dichloroethane		20000	ug/L	USEPA 1995			
1,2-Dichloroethene (total)	540-59-0	1160	ug/L	USEPA 1995 (with safety factor of 10)			
1,2-Dichloropropane		5700	ug/L	USEPA 1995			
1,3-Dichlorobenzene		763	ug/L	USEPA 1995			
1,3-Dichloropropene		244	ug/L	USEPA 1995			
1,4-Dichlorobenzene		763	ug/L	USEPA 1995			
2,4,5-Trichlorophenol		63	ug/L	USEPA 1995			
2,4,6-Trichlorophenol		970	ug/L	USEPA 1995			
2,4-Dichlorophenol		365	ug/L	USEPA 1995			
2,4-Dimethylphenol	105-67-9	530	ug/L	Federal Register 59:3762 (1994)			
2,4-Dinitrophenol		150	ug/L	USEPA 1995			
2,4-Dinitrotoluene		230	ug/L	USEPA 1995			
2-Butanone	78-93-3	14000	ug/L	Suter and Tsao 1996			
2-Chloronaphthalene		620	ug/L	USEPA 1995			
2-Chlorophenol	95-57-8	97	ug/L	USEPA 1995 (with safety factor of 10)			
2-Hexanone	591-78-6	4280	ug/L	USEPA 1995 (with safety factor of 100)			
2-Methylphenol	95-48-7	13	ug/L	Suter and Tsao 1996			
2-Nitrophenol	88-75-5	150	ug/L	USEPA 1994			
4,4'-DDD	72-54-8	0.06	ug/L	USEPA 1995 (with safety factor of 10)			
4,4'-DDE	72-55-9	105	ug/L	USEPA 1995 (with safety factor of 10)			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
4,4'-DDT		0.001	ug/L	USEPA 1995			
4,6-Dinitro-2-methylphenol	534-52-1	2.3	ug/L	USEPA 1999a			
4-Bromophenyl-phenylether	101-55-3	1.5	ug/L	USEPA 1996			
4-Chloro-3-methylphenol	59-50-7	0.3	ug/L	USEPA 1999a			
4-Chloroaniline	106-47-8	50	ug/L	Buchman 1999			
4-Methyl-2-pentanone	108-10-1	4600	ug/L	USEPA 1995 (with safety factor of 100)			
4-Nitrophenol		150	ug/L	USEPA 1995			
Acenaphthene		520	ug/L	USEPA 1995			
Acetone	67-64-1	90000	ug/L	USEPA 1995 (with safety factor of 100)			
Acrolein		21	ug/L	USEPA 1995			
Acrylonitrile		2600	ug/L	USEPA 1995			
Aldrin	309-00-2	0.3	ug/L	USEPA 1995 (with safety factor of 10)			
alpha-BHC	319-84-6	2.2	ug/L	Suter and Tsao 1996			
alpha-Chlordane	5103-71-9	0.17	ug/L	Suter and Tsao 1996			
Aluminum	7429-90-5	87	ug/L	USEPA 1999b			
Ammonia		17	ug/L	USEPA 1995			
Anthracene	120-12-7	0.73	ug/L	Suter and Tsao 1996			
Antimony		30	ug/L	USEPA 1995			
Aroclor-1016		0.014	ug/L	USEPA 1995			
Aroclor-1221	11104-28-2	0.28	ug/L	Suter and Tsao 1996			
Aroclor-1232	11141-16-5	0.58	ug/L	Suter and Tsao 1996			
Aroclor-1242	53469-21-9	0.053	ug/L	Suter and Tsao 1996			
Aroclor-1248	12672-29-6	0.081	ug/L	Suter and Tsao 1996			
Aroclor-1254	11097-69-1	0.033	ug/L	Suter and Tsao 1996			
Aroclor-1260	11096-82-5	94	ug/L	Suter and Tsao 1996			
Arsenic	7440-38-2	150	ug/L	USEPA 1999b			
Barium	7440-39-3	1000	ug/L	USEPA 1995 (with safety factor of 10)			
Benzene	71-43-2	530	ug/L	USEPA 1995 (with safety factor of 10)			
Benzo(a)anthracene		6.3	ug/L	USEPA 1995			
Benzo(a)pyrene	50-32-8	0.014	ug/L	Suter and Tsao 1996			
Benzoic Acid		42	ug/L	Suter and Tsao 1996			
Beryllium		5.3	ug/L	USEPA 1995			
beta-BHC	319-85-7	2.2	ug/L	Suter and Tsao 1996			
bis(2-Chloroethoxy)methane	111-91-1	1100	ug/L	USEPA 1995 (with safety factor of 10)			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
bis(2-Chloroethyl)ether	111-44-4	2380	ug/L	USEPA 1999a			
bis(2-Ethylhexyl)phthalate		30	ug/L	USEPA 1995			
Bromochloromethane	74-97-5	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Bromodichloromethane	75-27-4	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Butylbenzylphthalate	85-68-7	22	ug/L	USEPA 1999a			
Cadmium	7440-43-9	0.83	ug/L	USEPA 1999b	25		
Carbon disulfide		2	ug/L	USEPA 1995			
Carbon tetrachloride	56-23-5	3520	ug/L	USEPA 1995 (with safety factor of 10)			
Chlordane	57-74-9	0.17	ug/L	Suter and Tsao 1996			
Chlorobenzene	108-90-7	130	ug/L	USEPA 1996			
Chloroform		1240	ug/L	USEPA 1995			
Chloromethane	74-87-3	5500	ug/L	USEPA 1999a			
Chromium	7440-47-3	11.4	ug/L	USEPA 1999b			
cis-1,2-Dichloroethene	156-59-2	1160	ug/L	USEPA 1995 (with safety factor of 10)			
cis-1,3-Dichloropropene		244	ug/L	USEPA 1995			
Cobalt	7440-48-4	23	ug/L	Suter and Tsao 1996			
Copper	7440-50-8	2.9	ug/L	USEPA 1999b	25		
Cyanide		5.2	ug/L	USEPA 1995			
delta-BHC	319-86-8	2.2	ug/L	Suter and Tsao 1996			
Dibenzofuran	132-64-9	20	ug/L	USEPA 1996			
Dibromochloromethane	124-48-1	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Dibromomethane	74-95-3	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Dichlorodifluoromethane	75-71-8	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Dieldrin	60-57-1	0.056	ug/L	USEPA 1999b			
Diethylphthalate	84-66-2	220	ug/L	USEPA 1996			
Dimethyl phthalate	131-11-3	330	ug/L	USEPA 1999a			
Di-n-butylphthalate	84-74-2	33	ug/L	USEPA 1996			
Dinitrophenol		150	ug/L	USEPA 1995			
Di-n-octyl phthalate	117-84-0	3	ug/L	Buchman 1999			
Endosulfan		0.056	ug/L	USEPA 1995			
Endosulfan I		0.056	ug/L	USEPA 1995			
Endosulfan II		0.056	ug/L	USEPA 1995			
Endosulfan sulfate		0.056	ug/L	USEPA 1995			
Endrin	72-20-8	0.036	ug/L	USEPA 1999b			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Endrin aldehyde	7421-93-4	0.036	ug/L	USEPA 1996			
Endrin ketone	53494-70-5	0.036	ug/L	USEPA 1996			
Ethylbenzene	100-41-4	3200	ug/L	USEPA 1995 (with safety factor of 10)			
Fluoranthene	206-44-0	398	ug/L	USEPA 1995 (with safety factor of 10)			
Fluorene		430	ug/L	USEPA 1995			
Fluoride		2000	ug/L	USEPA 1995			
gamma-BHC (Lindane)		0.08	ug/L	USEPA 1995			
gamma-Chlordane	5103-74-2	0.17	ug/L	Suter and Tsao 1996			
HCH-Technical		10	ug/L	USEPA 1995 (with safety factor of 10)			
Heptachlor	76-44-8	0.0069	ug/L	USEPA 1996			
Heptachlor epoxide	1024-57-3	0.0069	ug/L	Suter and Tsao 1996			
Hexachlorobenzene		3.68	ug/L	USEPA 1995			
Hexachlorobutadiene		9.3	ug/L	USEPA 1995			
Hexachlorocyclopentadiene		5.2	ug/L	USEPA 1995			
Hexachloroethane		540	ug/L	USEPA 1995			
Iron		320	ug/L	USEPA 1995			
Isophorone	78-59-1	11700	ug/L	USEPA 1995 (with safety factor of 10)			
Lead	7439-92-1	0.5	ug/L	USEPA 1999b	25		
Manganese	7439-96-5	120	ug/L	Suter and Tsao 1996			
Mercury	7439-97-6	0.91	ug/L	USEPA 1999b			
Methoxychlor		0.03	ug/L	USEPA 1995			
Methyl bromide	74-83-9	110	ug/L	USEPA 1999a			
Methylene chloride	75-09-2	2200	ug/L	Suter and Tsao 1996			
Naphthalene		100	ug/L	USEPA 1995			
Nickel	7440-02-0	16.1	ug/L	USEPA 1999b	25		
Nitrobenzene	98-95-3	2700	ug/L	USEPA 1995 (with safety factor of 10)			
n-Nitrosodiphenylamine	86-30-6	585	ug/L	USEPA 1995 (with safety factor of 10)			
Parathion		0.013	ug/L	USEPA 1995			
Pentachlorobenzene		50	ug/L	USEPA 1995			
Pentachloroethane		1100	ug/L	USEPA 1995			
Pentachlorophenol	87-86-5	15.0	ug/L	USEPA 1999b		7.8	
Phenanthrene		6.3	ug/L	USEPA 1995			
Phenol	108-95-2	256	ug/L	USEPA 1999a			
Polychlorinated biphenyls (PCBs)	1336-36-3	0.14	ug/L	Suter and Tsao 1996			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Selenium		5	ug/L	USEPA 1995			
Silver	7440-22-4	0.36	ug/L	Suter and Tsao 1996			
Tetrachloroethene		840	ug/L	USEPA 1995			
Thallium		40	ug/L	USEPA 1995			
Toluene	108-88-3	1700	ug/L	USEPA 1995 (with safety factor of 10)			
Toxaphene	8001-35-2	0.011	ug/L	USEPA 1996			
trans-1,2-Dichloroethene	156-60-5	1160	ug/L	USEPA 1995 (with safety factor of 10)			
trans-1,3-Dichloropropene		244	ug/L	USEPA 1995			
Tribromomethane	75-25-2	320	ug/L	USEPA 1996			
Tributyltin		0.063	ug/L	USEPA 1999b			
Trichlorobenzene		50	ug/L	USEPA 1995			
Trichloroethene		21900	ug/L	USEPA 1995			
Trichlorofluoromethane	75-69-4	1100	ug/L	USEPA 1995 (with safety factor of 10)			
Vanadium		10000	ug/L	USEPA 1995			
Vinyl chloride	75-01-4	1160	ug/L	USEPA 1995 (with safety factor of 10)			
Xylene, total	1330-20-7	130	ug/L	USEPA 1995			
Zinc	7440-66-6	37	ug/L	USEPA 1999b	25		
Surface Water/Groundwater (Marine)							
1,1,1,2-Tetrachloroethane	630-20-6	623	ug/L	USEPA 1995 (with safety factor of 10)			
1,1,1-Trichloroethane	71-55-6	3120	ug/L	USEPA 1995 (with safety factor of 10)			
1,1,2,2-Tetrachloroethane	79-34-5	623	ug/L	USEPA 1995 (with safety factor of 10)			
1,1,2-Trichloroethane	79-00-5	3120	ug/L	USEPA 1995 (with safety factor of 10)			
1,1-Dichloroethane	75-34-3	3200	ug/L	USEPA 1995 (with safety factor of 100)			
1,1-Dichloroethene	75-35-4	22400	ug/L	USEPA 1995 (with safety factor of 10)			
1,2,4,5-Tetrachlorobenzene		129	ug/L	USEPA 1995			
1,2,4-Trichlorobenzene		129	ug/L	USEPA 1995			
1,2-Dichlorobenzene		129	ug/L	USEPA 1995			
1,2-Dichloroethane	107-06-2	1130	ug/L	USEPA 1995 (with safety factor of 100)			
1,2-Dichloroethene (total)	540-59-0	22400	ug/L	USEPA 1995 (with safety factor of 10)			
1,2-Dichloropropane		3040	ug/L	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
1,3-Dichlorobenzene	541-73-1	28.5	ug/L	USEPA 1999a			
1,3-Dichloropropene	542-75-6	79	ug/L	USEPA 1995 (with safety factor of 10)			
1,4-Dichlorobenzene		129	ug/L	USEPA 1995			
2,4,5-Trichlorophenol		11	ug/L	USEPA 1995			
2,4-Dimethylphenol	105-67-9	110	ug/L	Federal Register 59:3762 (1994)			
2,4-Dinitrophenol	51-28-5	485	ug/L	USEPA 1995 (with safety factor of 10)			
2,4-Dinitrotoluene		370	ug/L	USEPA 1995			
2-Chloronaphthalene	91-58-7	0.75	ug/L	USEPA 1995 (with safety factor of 10)			
2-Methylnaphthalene	91-57-6	30	ug/L	USEPA 1995 (with safety factor of 10)			
2-Nitrophenol	88-75-5	485	ug/L	USEPA 1994			
4,4'-DDD	72-54-8	0.025	ug/L	USEPA 1999a			
4,4'-DDE	72-55-9	1.4	ug/L	USEPA 1995 (with safety factor of 10)			
4,4'-DDT		0.001	ug/L	USEPA 1995			
4-Chloroaniline	106-47-8	129	ug/L	Buchman 1999			
4-Nitrophenol	100-02-7	485	ug/L	USEPA 1995 (with safety factor of 10)			
Acenaphthene		710	ug/L	USEPA 1995			
Acenaphthylene	208-96-8	30	ug/L	USEPA 1995 (with safety factor of 10)			
Aldrin	309-00-2	0.13	ug/L	USEPA 1995 (with safety factor of 10)			
alpha-BHC	319-84-6	0.034	ug/L	USEPA 1995 (with safety factor of 10)			
alpha-Chlordane		0.004	ug/L	USEPA 1995			
Ammonia		17	ug/L	USEPA 1995			
Anthracene	120-12-7	30	ug/L	USEPA 1995 (with safety factor of 10)			
Antimony		500	ug/L	USEPA 1995			
Aroclor-1016		0.03	ug/L	USEPA 1995			
Aroclor-1221		0.03	ug/L	USEPA 1995			
Aroclor-1232		0.03	ug/L	USEPA 1995			
Aroclor-1242		0.03	ug/L	USEPA 1995			
Aroclor-1248		0.03	ug/L	USEPA 1995			
Aroclor-1254		0.03	ug/L	USEPA 1995			
Aroclor-1260		0.03	ug/L	USEPA 1995			
Arsenic	7440-38-2	36	ug/L	USEPA 1999b			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Barium	7440-39-3	1000	ug/L	USEPA 1995 (with safety factor of 10)			
Benzene		700	ug/L	USEPA 1995			
Benzo(a)anthracene		8.13	ug/L	USEPA 1995			
Benzo(a)pyrene	50-32-8	0.021	ug/L	USEPA 1995 (with safety factor of 10)			
Benzo(b)fluoranthene	205-99-2	30	ug/L	USEPA 1995 (with safety factor of 10)			
Benzo(g,h,i)perylene	191-24-2	30	ug/L	USEPA 1995 (with safety factor of 10)			
Benzo(k)fluoranthene	207-08-9	30	ug/L	USEPA 1995 (with safety factor of 10)			
Beryllium		1500	ug/L	USEPA 1995			
beta-BHC	319-85-7	0.034	ug/L	USEPA 1995 (with safety factor of 10)			
bis(2-Chloroethoxy)methane		6400	ug/L	USEPA 1995			
bis(2-Ethylhexyl)phthalate		360	ug/L	USEPA 1995			
Bromochloromethane		6400	ug/L	USEPA 1995			
Bromodichloromethane		6400	ug/L	USEPA 1995			
Butylbenzylphthalate	85-68-7	29.4	ug/L	USEPA 1999a			
Cadmium	7440-43-9	9.4	ug/L	USEPA 1999b			
Carbon disulfide		2	ug/L	USEPA 1995			
Carbon tetrachloride	56-23-5	5000	ug/L	USEPA 1995 (with safety factor of 10)			
Chlordane		0.004	ug/L	USEPA 1995			
Chlorobenzene	108-90-7	105	ug/L	USEPA 1999a			
Chloroform	67-66-3	815	ug/L	USEPA 1999a			
Chloromethane	74-87-3	2700	ug/L	USEPA 1999a			
Chromium	7440-47-3	50.4	ug/L	USEPA 1999b			
Chrysene	218-01-9	30	ug/L	USEPA 1995 (with safety factor of 10)			
cis-1,2-Dichloroethene	156-59-2	22400	ug/L	USEPA 1995 (with safety factor of 10)			
cis-1,3-Dichloropropene	10061-01-5	79	ug/L	USEPA 1995 (with safety factor of 10)			
Copper	7440-50-8	3.7	ug/L	USEPA 1999b			
Cyanide		1	ug/L	USEPA 1995			
delta-BHC	319-86-8	0.034	ug/L	USEPA 1995 (with safety factor of 10)			
Dibenz(a,h)anthracene	53-70-3	30	ug/L	USEPA 1995 (with safety factor of 10)			
Dibromochloromethane		6400	ug/L	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Dibromomethane		6400	ug/L	USEPA 1995			
Dichlorodifluoromethane		6400	ug/L	USEPA 1995			
Dieldrin		0.0019	ug/L	USEPA 1995			
Diethylphthalate	84-66-2	75.9	ug/L	USEPA 1999a			
Dimethyl phthalate	131-11-3	580	ug/L	USEPA 1999a			
Di-n-butylphthalate		3.4	ug/L	USEPA 1995			
Dinitrophenol	25550-58-7	485	ug/L	USEPA 1995 (with safety factor of 10)			
Di-n-octyl phthalate		3.4	ug/L	USEPA 1995			
Endosulfan		0.0087	ug/L	USEPA 1995			
Endosulfan I		0.0087	ug/L	USEPA 1995			
Endosulfan II		0.0087	ug/L	USEPA 1995			
Endosulfan sulfate		0.0087	ug/L	USEPA 1995			
Endrin		0.0023	ug/L	USEPA 1995			
Endrin aldehyde		0.0023	ug/L	USEPA 1995			
Endrin ketone		0.0023	ug/L	USEPA 1995			
Ethylbenzene	100-41-4	43	ug/L	USEPA 1995 (with safety factor of 10)			
Fluoranthene		16	ug/L	USEPA 1995			
Fluorene	86-73-7	30	ug/L	USEPA 1995 (with safety factor of 10)			
gamma-BHC (Lindane)	58-89-9	0.016	ug/L	USEPA 1995 (with safety factor of 10)			
gamma-Chlordane		0.004	ug/L	USEPA 1995			
HCH-Technical		0.034	ug/L	USEPA 1995 (with safety factor of 10)			
Heptachlor		0.0036	ug/L	USEPA 1995			
Heptachlor epoxide		0.0036	ug/L	USEPA 1995			
Hexachlorobenzene		129	ug/L	USEPA 1995			
Hexachlorobutadiene	87-68-3	3.2	ug/L	USEPA 1995 (with safety factor of 10)			
Hexachlorocyclopentadiene	77-47-4	0.7	ug/L	USEPA 1995 (with safety factor of 10)			
Hexachloroethane	67-72-1	94	ug/L	USEPA 1995 (with safety factor of 10)			
Indeno(1,2,3-cd)pyrene	193-39-5	30	ug/L	USEPA 1995 (with safety factor of 10)			
Isophorone	78-59-1	1290	ug/L	USEPA 1995 (with safety factor of 10)			
Lead	7439-92-1	8.5	ug/L	USEPA 1999b			
Manganese		10	ug/L	USEPA 1995			
Mercury	7439-97-6	1.1	ug/L	USEPA 1999b			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
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Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Methoxychlor		0.03	ug/L	USEPA 1995			
Methyl bromide	74-83-9	120	ug/L	USEPA 1999a			
Methylene chloride		6400	ug/L	USEPA 1995			
Naphthalene	91-20-3	230	ug/L	USEPA 1995 (with safety factor of 10)			
Nickel		8.3	ug/L	USEPA 1995			
Nitrobenzene	98-95-3	668	ug/L	USEPA 1995 (with safety factor of 10)			
n-Nitrosodiphenylamine	86-30-6	330000	ug/L	USEPA 1995 (with safety factor of 10)			
PAH (total)	PAH	30	ug/L	USEPA 1994			
Pentachlorobenzene		129	ug/L	USEPA 1995			
Pentachloroethane		281	ug/L	USEPA 1995			
Pentachlorophenol		7.9	ug/L	USEPA 1995			
Phenanthrene		4.6	ug/L	USEPA 1995			
Phenol	108-95-2	580	ug/L	USEPA 1995 (with safety factor of 10)			
Polychlorinated biphenyls (PCBs)		0.03	ug/L	USEPA 1995			
Pyrene	129-00-0	30	ug/L	USEPA 1995 (with safety factor of 10)			
Selenium	7782-49-2	71	ug/L	USEPA 1999b			
Silver	7440-22-4	0.23	ug/L	USEPA 1999a			
Tetrachloroethene		450	ug/L	USEPA 1995			
Thallium	7440-28-0	213	ug/L	USEPA 1995 (with safety factor of 10)			
Toluene	108-88-3	37	ug/L	USEPA 1999a			
Toxaphene	8001-35-2	0.21	ug/L	USEPA 1996			
trans-1,2-Dichloroethene	156-60-5	22400	ug/L	USEPA 1995 (with safety factor of 10)			
trans-1,3-Dichloropropene	10061-02-6	79	ug/L	USEPA 1995 (with safety factor of 10)			
Tribromomethane	75-25-2	640	ug/L	USEPA 1999a			
Tributyltin	56573-85-4	0.01	ug/L	USEPA 1999b			
Trichlorobenzene		129	ug/L	USEPA 1995			
Trichloroethene	79-01-6	200	ug/L	USEPA 1995 (with safety factor of 10)			
Trichlorofluoromethane		6400	ug/L	USEPA 1995			
Vanadium		10000	ug/L	USEPA 1995			
Vinyl chloride	75-01-4	22400	ug/L	USEPA 1995 (with safety factor of 10)			
Xylene, total	1330-20-7	135	ug/L	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Zinc	7440-66-6	86	ug/L	USEPA 1999b			
Sediment (Fresh and Marine)							
1,1,1-Trichloroethane		31	ug/kg	USEPA 1995			
1,1,2-Trichloroethane		31	ug/kg	USEPA 1995			
1,2,4-Trichlorobenzene		40	ug/kg	USEPA 1995			
1,2-Dichlorobenzene		35	ug/kg	USEPA 1995			
1,4-Dichlorobenzene		110	ug/kg	USEPA 1995			
2,4-Dimethylphenol		29	ug/kg	USEPA 1995			
2-Methylnaphthalene		70	ug/kg	USEPA 1995			
2-Methylphenol		63	ug/kg	USEPA 1995			
4,4'-DDD		16	ug/kg	USEPA 1995			
4,4'-DDE		2.2	ug/kg	USEPA 1995			
4,4'-DDT		1.58	ug/kg	USEPA 1995			
4-Methylphenol		670	ug/kg	USEPA 1995			
Acenaphthene		16	ug/kg	USEPA 1995			
Acenaphthylene		44	ug/kg	USEPA 1995			
alpha-BHC	319-84-6	6	ug/kg	Ontario Ministry of the Environment 1993			
Anthracene		85.3	ug/kg	USEPA 1995			
Antimony		150	mg/kg	USEPA 1995			
Aroclor-1016		22.7	ug/kg	USEPA 1995			
Aroclor-1221		22.7	ug/kg	USEPA 1995			
Aroclor-1232		22.7	ug/kg	USEPA 1995			
Aroclor-1242		22.7	ug/kg	USEPA 1995			
Aroclor-1248		22.7	ug/kg	USEPA 1995			
Aroclor-1254		22.7	ug/kg	USEPA 1995			
Aroclor-1260		22.7	ug/kg	USEPA 1995			
Arsenic		8.2	mg/kg	USEPA 1995			
Benzo(a)anthracene		261	ug/kg	USEPA 1995			
Benzo(a)pyrene		430	ug/kg	USEPA 1995			
Benzo(b)fluoranthene		3200	ug/kg	USEPA 1995			
Benzo(g,h,i)perylene		670	ug/kg	USEPA 1995			
Benzoic Acid		65	ug/kg	USEPA 1995			
Benzyl Alcohol		57	ug/kg	USEPA 1995			
beta-BHC	319-85-7	5	ug/kg	Ontario Ministry of the Environment 1993			
bis(2-Ethylhexyl)phthalate		1300	ug/kg	USEPA 1995			
Butylbenzylphthalate		63	ug/kg	USEPA 1995			
Cadmium		1.2	mg/kg	USEPA 1995			
Chromium	7440-47-3	81	mg/kg	Long et al. 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Chrysene		384	ug/kg	USEPA 1995			
Copper		34	mg/kg	USEPA 1995			
Cyanide	57-12-5	0.1	mg/kg	Ontario Ministry of the Environment 1993			
Dibenz(a,h)anthracene		63.4	ug/kg	USEPA 1995			
Dibenzofuran		540	ug/kg	USEPA 1995			
Diethylphthalate		200	ug/kg	USEPA 1995			
Dimethyl phthalate		71	ug/kg	USEPA 1995			
Di-n-butylphthalate		1400	ug/kg	USEPA 1995			
Di-n-octyl phthalate		6200	ug/kg	USEPA 1995			
Ethylbenzene		10	ug/kg	USEPA 1995			
Fluoranthene		600	ug/kg	USEPA 1995			
Fluorene		19	ug/kg	USEPA 1995			
Heptachlor	76-44-8	0.3	ug/kg	Buchman 1999			
Heptachlor epoxide	1024-57-3	5	ug/kg	Ontario Ministry of the Environment 1993			
Hexachlorobenzene		22	ug/kg	USEPA 1995			
Hexachlorobutadiene		11	ug/kg	USEPA 1995			
Indeno(1,2,3-cd)pyrene		600	ug/kg	USEPA 1995			
Lead		46.7	mg/kg	USEPA 1995			
Mercury		0.15	mg/kg	USEPA 1995			
Naphthalene		160	ug/kg	USEPA 1995			
Nickel		20.9	mg/kg	USEPA 1995			
n-Nitrosodiphenylamine		28	ug/kg	USEPA 1995			
PAH (total)	PAH	4022	ug/kg	Long et al. 1995			
Parathion		31	ug/kg	USEPA 1995			
Pentachlorophenol		360	ug/kg	USEPA 1995			
Phenanthrene		240	ug/kg	USEPA 1995			
Phenol		420	ug/kg	USEPA 1995			
Polychlorinated biphenyls (PCBs)		22.7	ug/kg	USEPA 1995			
Pyrene		665	ug/kg	USEPA 1995			
Selenium	7782-49-2	1	mg/kg	Buchman 1999			
Silver		1	mg/kg	USEPA 1995			
Tetrachloroethene		57	ug/kg	USEPA 1995			
Trichlorobenzene		40	ug/kg	USEPA 1995			
Trichloroethene		41	ug/kg	Buchman 1999			
Vanadium		57	mg/kg	Buchman 1999			
Xylene, total		40	ug/kg	USEPA 1995			
Zinc		150	mg/kg	USEPA 1995			
Sediment (Fresh)							

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Aldrin	309-00-2	2	ug/kg	Ontario Ministry of the Environment 1993			
alpha-Chlordane	5103-71-9	7	ug/kg	Ontario Ministry of the Environment 1993			
Aluminum	7429-90-5	25500	mg/kg	Buchman 1999			
Barium	7440-39-3	500	mg/kg	Beyer 1990			
Benzo(k)fluoranthene	207-08-9	240	ug/kg	Ontario Ministry of the Environment 1993			
Chlordane	57-74-9	7	ug/kg	Ontario Ministry of the Environment 1993			
Cobalt	7440-48-4	50	mg/kg	Ontario Ministry of the Environment 1993			
Dieldrin	60-57-1	2	ug/kg	Ontario Ministry of the Environment 1993			
Endrin	72-20-8	3	ug/kg	Ontario Ministry of the Environment 1993			
gamma-BHC (Lindane)	58-89-9	3	ug/kg	Ontario Ministry of the Environment 1993			
gamma-Chlordane	5103-74-2	7	ug/kg	Ontario Ministry of the Environment 1993			
Iron	7439-89-6	188400	mg/kg	Buchman 1999			
Manganese	7439-96-5	460	mg/kg	Ontario Ministry of the Environment 1993			
Sediment (Marine)							
Aldrin	309-00-2	9.5	ug/kg	Buchman 1999			
alpha-Chlordane	5103-71-9	0.5	ug/kg	Long and Morgan 1990			
Aluminum	7429-90-5	18000	mg/kg	Buchman 1999			
Barium	7440-39-3	48	mg/kg	Buchman 1999			
Benzo(k)fluoranthene	207-08-9	1800	ug/kg	Buchman 1999			
Chlordane	57-74-9	0.5	ug/kg	Long and Morgan 1990			
Cobalt	7440-48-4	10	mg/kg	Buchman 1999			
Dieldrin	60-57-1	0.715	ug/kg	Buchman 1999			
Endrin	72-20-8	0.02	ug/kg	Long and Morgan 1990			
gamma-BHC (Lindane)	58-89-9	0.32	ug/kg	Buchman 1999			
gamma-Chlordane	5103-74-2	0.5	ug/kg	Long and Morgan 1990			
Iron	7439-89-6	220000	mg/kg	Buchman 1999			
Manganese	7439-96-5	260	mg/kg	Buchman 1999			
Surface Soil							
1,1,1,2-Tetrachloroethane		300	ug/kg	USEPA 1995			
1,1,1-Trichloroethane		300	ug/kg	USEPA 1995			
1,1,2,2-Tetrachloroethane		300	ug/kg	USEPA 1995			
1,1,2-Trichloroethane		300	ug/kg	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
1,1-Dichloroethane		300	ug/kg	USEPA 1995			
1,2,4,5-Tetrachlorobenzene		100	ug/kg	USEPA 1995			
1,2,4-Trichlorobenzene	120-82-1	1270	ug/kg	Efroymson et al. 1997b			
1,2-Dibromoethane		5000	ug/kg	USEPA 1995			
1,2-Dichlorobenzene		100	ug/kg	USEPA 1995			
1,2-Dichloroethane	107-06-2	401	ug/kg	MHSPE 1994			2
1,2-Dichloroethene (total)		300	ug/kg	USEPA 1995			
1,2-Dichloropropane	78-87-5	38800	ug/kg	Efroymson et al. 1997b			
1,3-Dichloropropene		300	ug/kg	USEPA 1995			
1,4-Dichlorobenzene	106-46-7	1280	ug/kg	Efroymson et al. 1997b			
2,3,4,6-Tetrachlorophenol		100	ug/kg	USEPA 1995			
2,4,5-Trichlorophenol	95-95-4	430	ug/kg	Efroymson et al. 1997a			
2,4,6-Trichlorophenol	88-06-2	580	ug/kg	Efroymson et al. 1997b			
2,4-Dichlorophenol	120-83-2	13400	ug/kg	Efroymson et al. 1997b			
2,4-Dimethylphenol		100	ug/kg	USEPA 1995			
2,4-Dinitrophenol	51-28-5	20000	ug/kg	Efroymson et al. 1997a			
2,6-Dichlorophenol		100	ug/kg	USEPA 1995			
2-Chloronaphthalene	91-58-7	1033	ug/kg	MHSPE 1994			2
2-Chlorophenol		100	ug/kg	USEPA 1995			
2-Methylphenol		100	ug/kg	USEPA 1995			
4,4'-DDD		100	ug/kg	USEPA 1995			
4,4'-DDE		100	ug/kg	USEPA 1995			
4,4'-DDT		100	ug/kg	USEPA 1995			
4-Methyl-2-pentanone	108-10-1	10000	ug/kg	USEPA 1995 (with safety factor of 10)			
4-Methylphenol		100	ug/kg	USEPA 1995			
4-Nitrophenol	100-02-7	380	ug/kg	Efroymson et al. 1997b			
Acenaphthene	83-32-9	2500	ug/kg	Efroymson et al. 1997a			
Acenaphthylene		100	ug/kg	USEPA 1995			
Aldrin		100	ug/kg	USEPA 1995			
alpha-BHC		100000	ug/kg	USEPA 1995			
alpha-Chlordane		100	ug/kg	USEPA 1995			
Aluminum	7429-90-5	50	mg/kg	Efroymson et al. 1997a			
Anthracene	120-12-7	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Antimony	7440-36-0	5	mg/kg	Efroymson et al. 1997a			
Aroclor-1016		100	ug/kg	USEPA 1995			
Aroclor-1221		100	ug/kg	USEPA 1995			
Aroclor-1232		100	ug/kg	USEPA 1995			
Aroclor-1242		100	ug/kg	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Aroclor-1248		100	ug/kg	USEPA 1995			
Aroclor-1254		100	ug/kg	USEPA 1995			
Aroclor-1260		100	ug/kg	USEPA 1995			
Arsenic	7440-38-2	60	mg/kg	Efroymson et al. 1997b			
Barium	7440-39-3	500	mg/kg	Efroymson et al. 1997a			
Benzene	71-43-2	105	ug/kg	MHSPE 1994			2
Benzo(a)anthracene	56-55-3	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Benzo(a)pyrene	50-32-8	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Benzo(b)fluoranthene		100	ug/kg	USEPA 1995			
Benzo(g,h,i)perylene	191-24-2	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Benzo(k)fluoranthene	207-08-9	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Beryllium	7440-41-7	10	mg/kg	Efroymson et al. 1997a			
beta-BHC		100000	ug/kg	USEPA 1995			
Bromochloromethane	74-97-5	300000	ug/kg	USEPA 1995 (with safety factor of 10)			
Bromodichloromethane	75-27-4	45000	ug/kg	USEPA 1995 (with safety factor of 10)			
Cadmium	7440-43-9	4	mg/kg	Efroymson et al. 1997a			
Carbon tetrachloride	56-23-5	1000000	ug/kg	Efroymson et al. 1997b			
Chlordane		100	ug/kg	USEPA 1995			
Chlorobenzene	108-90-7	2400	ug/kg	Efroymson et al. 1997b			
Chloroform	67-66-3	1000	ug/kg	MHSPE 1994			2
Chromium	7440-47-3	0.4	mg/kg	Efroymson et al. 1997b			
Chrysene	218-01-9	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
cis-1,2-Dichloroethene		300	ug/kg	USEPA 1995			
cis-1,3-Dichloropropene		300	ug/kg	USEPA 1995			
Cobalt		100	mg/kg	USEPA 1995			
Copper	7440-50-8	50	mg/kg	Efroymson et al. 1997b			
Cyanide	57-12-5	0.06	mg/kg	Eisler 1991			
delta-BHC		100000	ug/kg	USEPA 1995			
Dibenz(a,h)anthracene		100	ug/kg	USEPA 1995			
Dieldrin		100	ug/kg	USEPA 1995			
Diethylphthalate	84-66-2	13400	ug/kg	Efroymson et al. 1997a			
Dimethyl phthalate	131-11-3	10640	ug/kg	Efroymson et al. 1997b			
Di-n-butylphthalate	84-74-2	200000	ug/kg	Efroymson et al. 1997a			
Dinitrophenol		100	ug/kg	USEPA 1995			
Endrin		100	ug/kg	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Endrin aldehyde		100	ug/kg	USEPA 1995			
Endrin ketone		100	ug/kg	USEPA 1995			
Ethylbenzene	100-41-4	5005	ug/kg	MHSPE 1994			2
Fluoranthene	206-44-0	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Fluorene	86-73-7	1700	ug/kg	Efroymson et al. 1997b			
Fluoride		1	mg/kg	USEPA 1995			
gamma-BHC (Lindane)		100	ug/kg	USEPA 1995			
gamma-Chlordane		100	ug/kg	USEPA 1995			
HCH-technical		100000	ug/kg	USEPA 1995			
Heptachlor epoxide		100	ug/kg	USEPA 1995			
Hexachlorocyclopentadiene	77-47-4	1000	ug/kg	Efroymson et al. 1997a			
Indeno(1,2,3-cd)pyrene	193-39-5	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Iron	7439-89-6	200	mg/kg	Efroymson et al. 1997b			
Lead	7439-92-1	50	mg/kg	Efroymson et al. 1997a			
Magnesium		4400	mg/kg	USEPA 1995			
Manganese	7439-96-5	500	mg/kg	Efroymson et al. 1997a			
Mercury	7439-97-6	0.1	mg/kg	Efroymson et al. 1997b			
Methoxychlor		100	ug/kg	USEPA 1995			
Methylene chloride	75-09-2	1001	ug/kg	MHSPE 1994			2
Naphthalene	91-20-3	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Nickel	7440-02-0	30	mg/kg	Efroymson et al. 1997a			
Nitrobenzene	98-95-3	2260	ug/kg	Efroymson et al. 1997b			
n-Nitrosodiphenylamine	86-30-6	1090	ug/kg	Efroymson et al. 1997b			
PAH (total)	PAH	4100	ug/kg	MHSPE 1994			2
Pentachlorobenzene	608-93-5	1150	ug/kg	Efroymson et al. 1997b			
Pentachlorophenol	87-86-5	3000	ug/kg	Efroymson et al. 1997a			
Phenanthrene	85-01-8	see PAH, total; 100	ug/kg	MHSPE 1994; USEPA 1995			
Phenol	108-95-2	1880	ug/kg	Efroymson et al. 1997b			
Pyrene		100	ug/kg	USEPA 1995			
Selenium		1.8	mg/kg	USEPA 1995			
Silver	7440-22-4	2	mg/kg	Efroymson et al. 1997a			
Styrene	100-42-5	10010	ug/kg	MHSPE 1994			2
Tetrachloroethene	127-18-4	401	ug/kg	MHSPE 1994			2
Thallium	7440-28-0	1	mg/kg	Efroymson et al. 1997a			
Toluene	108-88-3	13005	ug/kg	MHSPE 1994			2
trans-1,2-Dichloroethene		300	ug/kg	USEPA 1995			
trans-1,3-Dichloropropene		300	ug/kg	USEPA 1995			

Table 1.4
Medium Specific Screening Values for Screening Ecological Risk Assessments
NSWC Indian Head

Chemical	CAS Number	Screening Value	Units	Reference	Hardness (mg/L)	pH	TOC (%)
Tribromomethane	75-25-2	114700	ug/kg	USEPA 1995 (with safety factor of 10)			
Trichlorobenzene		100	ug/kg	USEPA 1995			
Trichloroethene	79-01-6	6000	ug/kg	MHSPE 1994			2
Vanadium	7440-62-2	2	mg/kg	Efroymson et al. 1997a			
Vinyl chloride		300	ug/kg	USEPA 1995			
Xylene, total	1330-20-7	2505	ug/kg	MHSPE 1994			2
Zinc	7440-66-6	50	mg/kg	Efroymson et al. 1997a			

Note: Screening values are based on either Region 3 BTAG screening values (USEPA 1995) or on alternate screening values approved for use at Virginia bases by part of the Region 3 BTAG (CH2M HILL 2000). Where more than one final screening value was available for a specific medium and chemical (e.g., one value for soil fauna and one value for soil flora), the lowest of these values was selected. Screening values can be adjusted based on modifying factors such as hardness or total organic carbon (TOC). Fresh surface water screening values for several divalent metals are presented based on a water hardness of 25 mg/L. Surface soil screening values based on Dutch soil standards for certain organic chemicals are presented based on a TOC value of two percent. Two percent is the minimum default value for these screening values.

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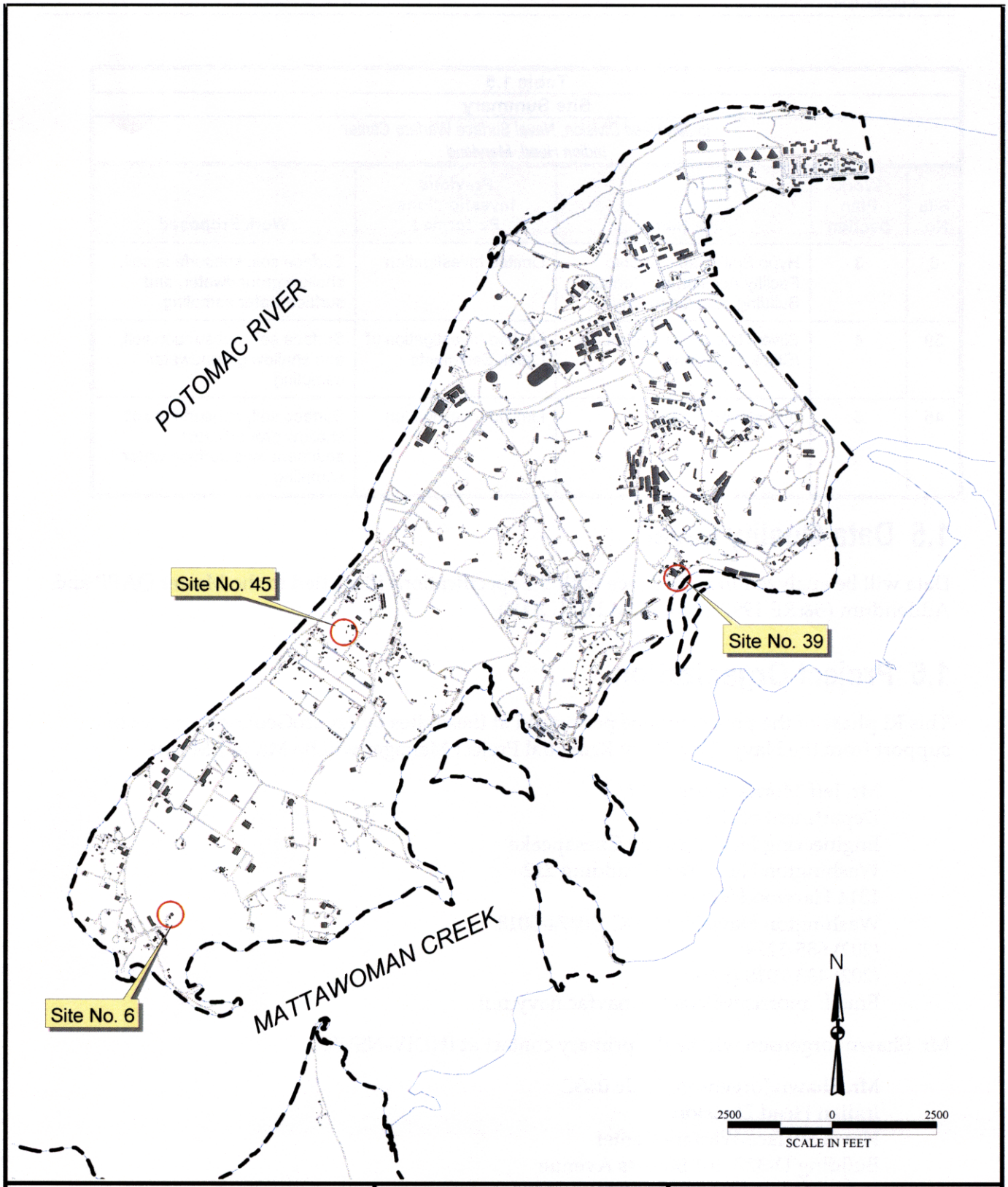

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HYDRO GeoLogic Inc.

Legend

Base Boundary

Figure 1.2
Locations of Sites 6, 39 and 45
NSWC, Indian Head Division
Indian Head, Maryland

00665BB2Y

Table 1.5 Site Summary *Indian Head Division, Naval Surface Warfare Center* *Indian Head, Maryland*				
Site No.	**Work Plan Section**	**Site Name**	**Previous Investigations Performed**	**Work Proposed**
6	3	Hypo Spill, Radiographic Facility Accelerator Control Building, and Open Drain	Limited Investigation	Surface soil, subsurface soil, shallow groundwater, and surface water sampling
39	4	Silver Release to Sediments /Stack Emissions	Limited Investigation of Creek Sediments	Surface soil, subsurface soil, and shallow groundwater sampling
45	5	Abandoned Drums	Limited Investigation	Surface soil, subsurface soil, shallow groundwater, sediment, and surface water sampling

1.5 Data Quality Level

Data will be analyzed in accordance with the specifications identified in the Master QAPP and Addendum (B&RE 1997 and CH2M HILL 2000).

1.6 Project Organization

This RI phase of the project will be performed at these sites by HydroGeoLogic, Inc. with support from the Navy. The Navy Remedial Project Manager will be Mr. Jeff Morris.

Mr. Jeff Morris, Code 1810
Department of the Navy
Engineering Field Activity Chesapeake
Washington Navy Yard, Building 212
1314 Harwood Street SE
Washington Navy Yard, DC 20374-5018
(202) 685-3279
(202) 433-7018 (FAX)
Email: morrisjw@efaches.navfac.navy.mil

Mr. Shawn Jorgensen will be the primary contact at IHDIV-NSWC.

Mr. Shawn Jorgensen, Code 046C
Indian Head Division
Naval Surface Warfare Center
Building D-327, 101 Strauss Avenue
Indian Head, MD 20640-5035
(301) 744-2263
(301) 744-6749 (FAX)
Email: jorgensensa@ih.navy.mil

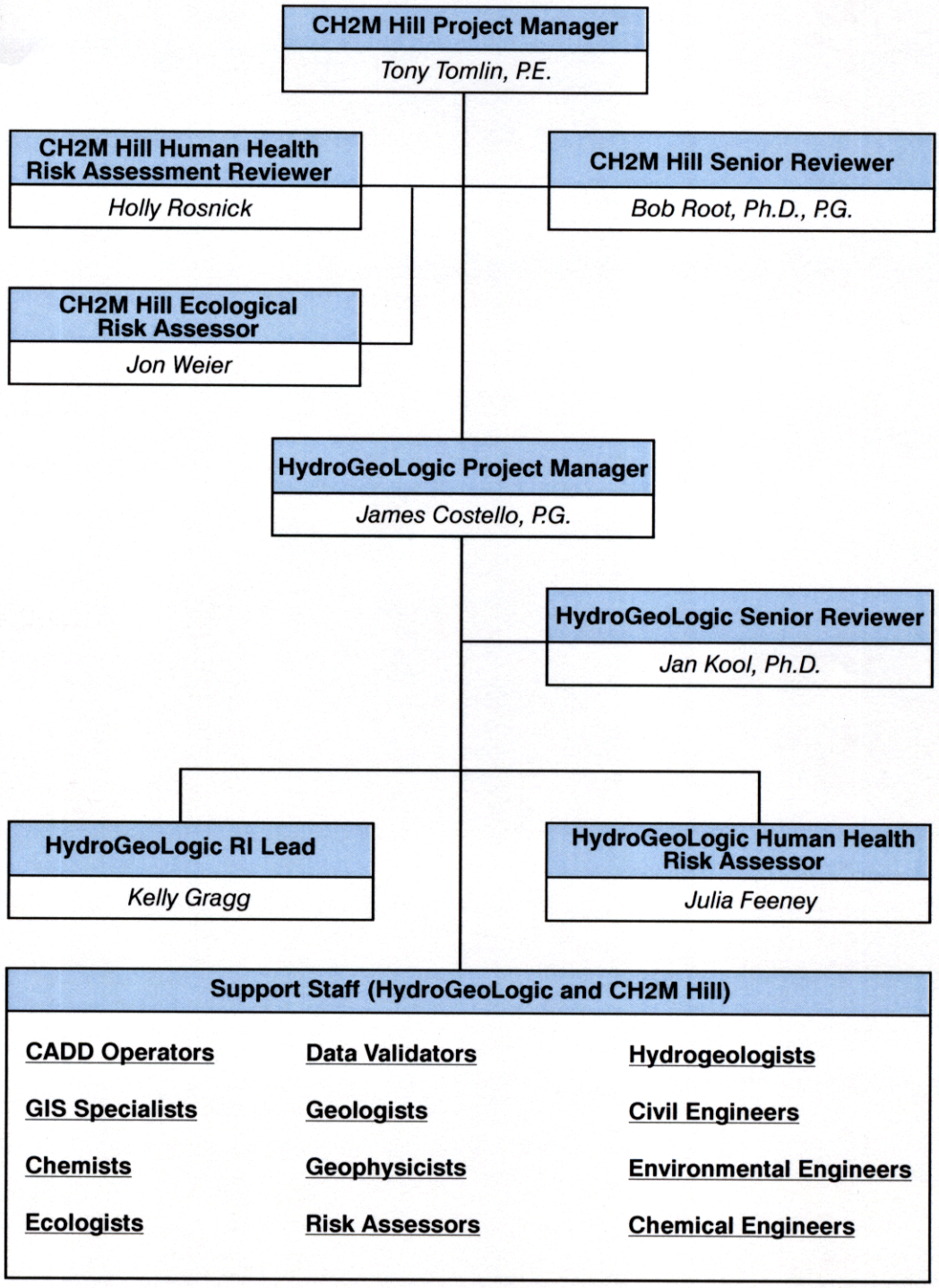

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Figure 1.3
Project Organizational Chart

2. Field Operations

2.1 Work Plan Summary

The proposed environmental sampling to be conducted at the subject sites is summarized in Table 2.1. The specific locations and analyses to be performed at each site are discussed in detail in the site-specific sections (sections 3.0 through 5.0).

2.2 General Field Operations

This section provides information on the general field operations and the basis for selection of the location of the environmental sampling to be conducted.

2.2.1 Mobilization/Demobilization

The field crew will consist of a Field Operations Leader (FOL), qualified technicians, and specialized subcontractors. Depending on the tasks to be conducted, the size and make up of the field team will vary. Prior to mobilization, all field team members will review the project documents including the CH2M HILL Health and Safety Plan provided in the Addendum (CH2MHILL 2000) to address health and safety during field activities at IHDIV-NSWC.

The equipment required for field operations will be brought to the site by the HydroGeoLogic, Inc., field team. All required bottleware will be shipped directly to the site by the laboratory. Demobilization will entail following proper decontamination procedures for all site personnel and equipment and returning the site to the condition prior to field investigation activities. All sampling equipment used for collecting samples will be decontaminated prior to beginning field sampling, between collection of each sample, and at the end of the sampling event. Decontamination procedures are discussed in IHDIV-NSWC SOP SA-13, contained in the Master WP (B&RE, April 1997). The IDW is to be handled in accordance with the Disposal of Waste Fluids and Solids SOP presented in Appendix C. Field records will be kept as directed in IHDIV-NSWC SOP SA-12 contained in the Master WP (B&RE, April 1997).

2.2.2 Field Sampling

The proposed locations of samples to be collected are provided in the site specific sections of this document; however, it should be noted that field judgment should be used to fine tune the location of the sample collection points. The field team shall consider topography, stressed vegetation, erosion and seeps, changes in type of vegetation, discolorations, accessibility, and past sampling experiences.

Table 2.1
Work Plan Summary
Indian Head, Maryland

Site Name	Work Plan Summary	Soil Sampling			Shallow Groundwater Sampling			Surface Water Samples	Sediment Samples	Surface Soil Samples from Seasonally Wet Area
		Surface Soil Samples	Soil Borings	Soil Boring Samples	Grab Ground water Samples	New Wells[1]	Wells to Sample[1]			
Site 6	Conduct a thorough investigation of surface soils, subsurface soils, surface water, and shallow groundwater to determine if contaminated as result of a spent fixer spill.	10	5	5	0	3	3	2	none	3
Site 39	Conduct a thorough investigation of surface soils, subsurface soils, and shallow groundwater to determine if contaminated as result of stack emissions from Buildings 497 and 498.	21	21	21	0	3	3	none	none	none
Site 45	Conduct a thorough investigation of surface soils, subsurface soils, surface water, sediment and shallow groundwater to determine if contaminated as result of possible leakage from abandoned drums.	5	5	5	4	5	5	2	4	none

[1] Part of a Phase 2 investigation if contamination is found in the subsurface soil.

The specific locations of all field sampling points will be based on the evaluation of historical site data and conditions observed during an initial site visit. The field team will consider the following factors in selecting sample locations:

- Historical use/cause of potential contamination
- Site layout, topography, and drainage characteristics
- Type of contamination
- Mobility of contaminants
- Potential off site transport pathways of contaminants

The equipment required to perform a given type of sampling is common among the sites where that type of sampling will be performed. The majority of the sampling to be performed includes:

- Surface Soil Sampling; IHDIV-NSWC SOP SA-03
- Sediment Sampling; IHDIV-NSWC SOP SA-02
- Subsurface Soil Sampling; IHDIV-NSWC SOP SA-03
- Hydraulic Push Sampling; IHDIV-NSWC SOP SA-06
- Groundwater Sampling; IHDIV-NSWC SOP SA-01
- Surface Water Sampling; IHDIV-NSWC SOP SA-02

The SOPs listed above discuss the equipment and procedures required to perform each type of sampling.

2.3 Sample Handling

Sample handling includes the field-related considerations regarding the selection of sample containers and preservatives, allowable holding times, and the analyses required. These topics are discussed in the site specific sections. The sample identification system to be applied to the samples and the shipping requirements are discussed below.

2.3.1 Sample Identification System

Each sample will be designated by a unique alphanumeric code that identifies the site and matrix sampled and contains a sequential sample number. Site-specific procedures are elaborated below.

The following is a general guide for sample identification:

First Segment of Sample Number	Second Segment of Sample Number	Third Segment of Sample Number		
Naval Installation Abbreviation	Site Number	Sample Type	Sample Location	Additional Qualifiers (sample depth, date)
A	ANN	AA	NN	NNNN(A)

Symbol Definition:

"A"	=	Alphabetic
"N"	=	Numeric

Site Abbreviation:

A	=	One letter abbreviation identifying the Naval Installation where the sample was collected. (i.e., Indian Head = I)

Site Number:

ANN	=	One letter and two numbers identifying the site on the facility where the sample was collected (i.e., S06 = Site 6)

Sample Type:

SS	=	Surface Soil Sample
SB	=	Subsurface Soil Sample
SD	=	Sediment Sample
SW	=	Surface Water Sample
GW	=	Grab Groundwater Sample
MW	=	Monitoring Well Sample
WS	=	Waste (solid)
WW	=	Waste (water)
TB	=	Trip Blank
EB	=	Equipment Blank
FB	=	Field Blank

Sample Location:

MM	=	QC Samples - 2-digit month of sampling event (i.e., 01 = January)
NN	=	All other Samples - Unique 2-digit sample number (i.e., 01, 02, 03, etc)

Additional Qualifiers:

MMYY	=	Monitoring Well and Grab Groundwater Samples - 2-digit month and 2-digit year of sampling event (i.e., January 2001 = 0101)
BDED	=	Surface Soil, Subsurface Soil, and Sediment Samples – 2-digit begin depth and 2-digit end depth rounded up to nearest foot (i.e., 2′ – 2′ 6″ = 0203)
P	=	Duplicate sample
DDYY	=	QC Samples – 2-digit day and 2-digit year of sampling event

Examples of this numbering approach are:

IS06SS040001	The 4th surface soil sample collected at Site 6, from 0 to 1 feet below ground surface
IS06GW020800P	The 2nd grab GW sample collected at Site 6 in August 2000 (a duplicate sample)
IS06WS01	The 1st IDW sample collected from drums at Site 6

Examples of this numbering approach for QA/QC samples are:

IS06FB100196	Field blank collected at Site 6 on October 1, 1996
IS39TB07299701	First trip blank collected at Site 39 on July 29, 1997
IS45EB080198	Equipment blank collected at Site 45 on August 1, 1998

2.3.2 Sample Packaging and Shipping

Samples will be packaged in accordance with IHDIV-NSWC SOP SA-11 "Non-Radiological Sample Handling". The samples will be either picked up at the site by the analytical laboratory or sent via Federal Express. The samples shall be tightly packed in a cooler with bubble wrap or Vermiculite packaging material and ice as a preservative. The FOL is responsible for completion of the following forms:

- Sample labels and Chain-of-Custody (COC) seals
- COC forms
- Appropriate labels and forms required for shipment

Custody of the samples must be maintained and documented at all times. COC begins with the collection of the samples in the field and is continued through the analysis of the sample at the analytical laboratory.

3. Site 6 – Hypo Spill, Radiographic Facility Accelerator Control Building, and Open Drain

3.1 Background Information and Site Description

Site 6 consists of the area around Building 1349 (the former control building which is currently being used for storage), Building 1718 (the current control building), and Building 1140 (the radiographic accelerator building), Figure 3.1. Buildings 1349 and 1140 were built in 1965, while Building 1718 was built in 1985. X-ray photographs of explosives are taken in Building 1140 and these x-ray photographs are developed in the control building using fixer and developer solutions. The fixer solution contains silver.

When the Initial Assessment Study was conducted in 1983 by the NEESA, approximately 2000 x-ray sheets were developed per month. In the process, some of the silver from the solution is "fixed" to the x-ray film and the remainder of the silver is washed off. One interviewee stated that prior to 1977, all photographic process liquid wastes including spent fixer and developer were discharged into the nearby open ditch, but this could not be confirmed.

Ten gallons of fixer were reportedly spilled onto the ground behind Building 1349 in 1973 when the contents of an old tank were transferred to a new storage facility. Site reconnaissance in 1982 indicated approximately 200 square feet of bare soil and stressed vegetation in the vicinity of the spill (NEESA, 1983). Subsequent spills may also have occurred behind Building 1349 (NEESA, 1983). Table 3-1 summarizes the estimated quantities of hazardous materials released at Site 6 from the fixer spill. The nature and extent of the suspected contamination from the 1973 spill and possible subsequent spills will be investigated in the proposed field effort.

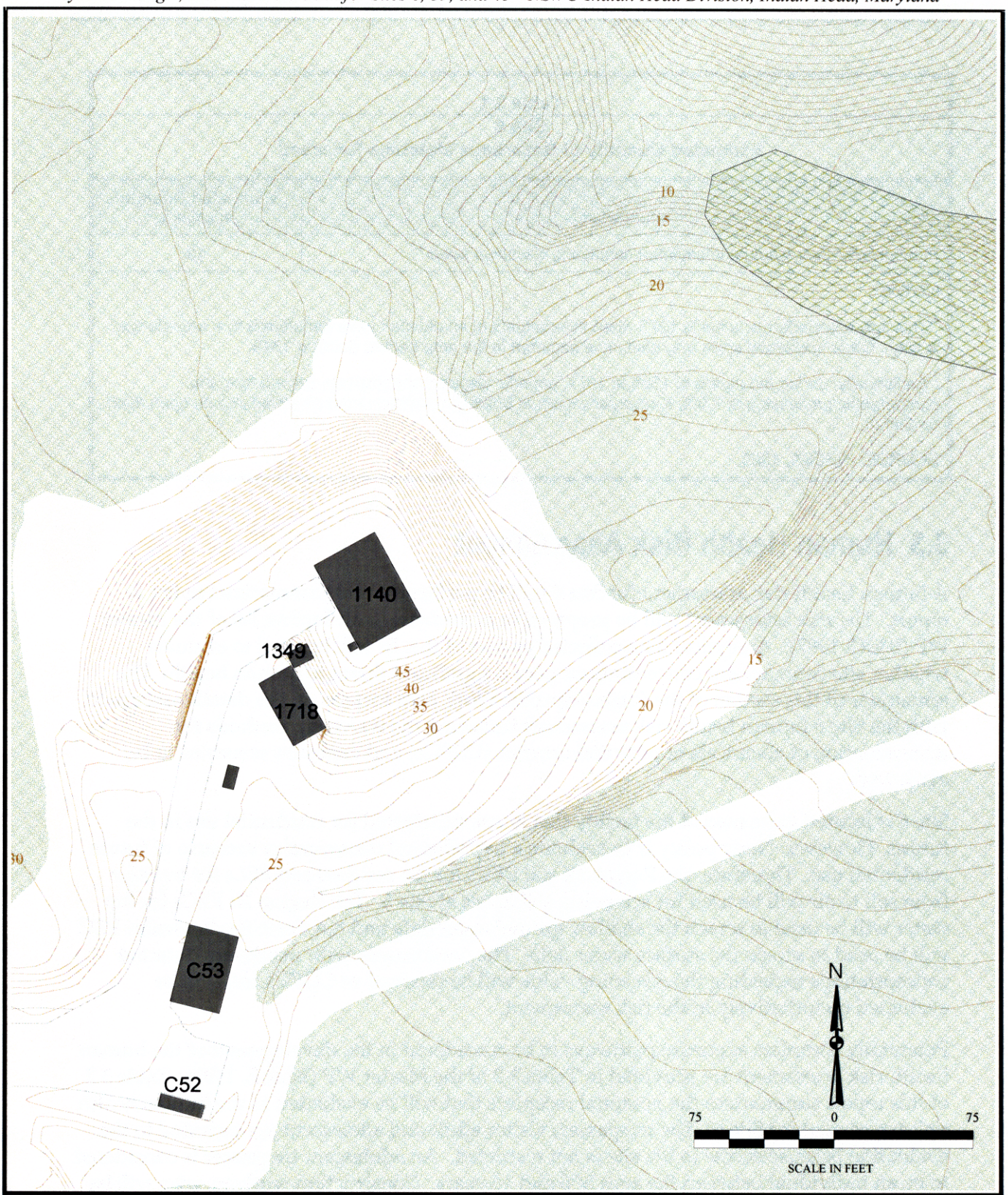
3.2 Previous Environmental Investigations

The Initial Assessment Study (IAS) was conducted by the NEESA in 1983. This report recommended that a Confirmation Study should be conducted at Site 6 to establish contaminant concentrations and potential environmental effects if the Site 5 study revealed a risk to aquatic life due to releases of silver-bearing wastes derived from the development of X-ray film (NEESA, 1983).

Site 5 was excavated in two removal actions occurring between 1992 and 1995. Silver contaminated soil was removed from two drainage swales and the area was backfilled with clean soil. The soil removed from the first swale was encapsulated and placed in the base of an earthen explosive berm. The soil from the second swale was used to recover a "borrow" pit at Rum Point on Stump Neck Annex. Groundwater monitoring is on-going and the Navy plans to resample the site in the near future to determine the effectiveness of the

removal actions and to identify any additional actions required at the site to ensure the protection of human health and the environment.

In consultation with the appropriate regulatory agencies, the Navy has decided to consider Site 6 as a stand-alone site. Thus, the investigation of Site 6 will now continue without waiting for further sampling results from Site 5.



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HYDRO GeoLogic INC.

Legend

- Building/Structure
- Surface Water Drainage
- Wetland
- Forested Area
- Ground Elevation Contour (1ft.)

Figure 3.1
Existing Conditions
Site 6

00665B03X

Table 3.1
Site 6
Estimated Quantity of Hazardous Materials Released

Contaminant	Estimated Quantity (in gallons)
Photographic fixer (sodium thiosulfate) containing dissolved silver[1, 2]	10

NOTES:

[1] This spill reportedly occurred in 1973 when the contents of an old tank were transferred to a new storage facility. Other accidental spills may also have occurred in the area behind Building 1349.

[2] Additionally, during the period of 1965 to 1977, periodic disposal of chemicals derived from the photographic processing of 2,000 X-rays per month at Building 1349 may have occurred into an open ditch on Site 6.

SOURCE: NEESA, 1983.

3.3 Human Health Risk Assessment

A human health risk assessment for Site 6 will be performed and summarized in the RI report. The risk assessment will be prepared in accordance with Section 3.0 of the Master WP (B&RE 1997). Analytical data collected as part of this RI will be used to evaluate whether site contaminant concentrations pose a significant threat to human health. The remainder of this section of the Project-Specific Work plan focuses on the details associated with the Site 6 human health risk assessment including the screening methods for determination of chemicals of potential concern (COPCs) and exposure scenarios to be evaluated.

Site 6 is located in an area of the facility that is not anticipated for residential use in the future. However, Navy policy is to evaluate a hypothetical conservative scenario of future residential use. Therefore, the Region III soil RBCs for the resident and SSLs for transfer from soil to air will be used for screening soil levels at Site 6. The Region III RBCs for tap water will be used to screen the shallow groundwater data and ten times the tap water RBC will be used to screen the surface water data. The constituents with maximum detected concentrations exceeding the screening value will be retained as COPCs and will be evaluated quantitatively in the risk assessment.

Potentially complete exposure pathways to be considered in the development of the human health risk assessment are provided in Table 3-2 of the Master WP (B&R E, 1997). Table 3.2 of this report summarizes the potential receptors that will be evaluated in the human health risk assessment for Site 6. The trespasser/visitor adult and adolescent are included in the evaluation because access to the site is not restricted. An adolescent trespasser is considered to be an individual between the ages of 6 and 16 years. Construction workers, who will be considered to be potential receptors for future land use, will be evaluated for exposure to surface/subsurface soil. Industrial workers are included in the evaluation because these types of individuals may be exposed to site media while performing maintenance activities or daily duties, both currently and in the future. The site is not anticipated to be used for

residential purposes in the future, however, the future on-site resident is conservatively included in this evaluation for exposure to shallow groundwater and soil.

Table 3.2
Potential Exposure Pathways
Site 6
Indian Head, Maryland

Media	Exposure Route	Current			Future			
		Industrial Worker	Trespasser/Visitor		Onsite Resident		Construction Worker	Industrial Worker
			Adult	Adolescent	Adult	Child		
Surface Soil	Ingestion	X	X	X				
	Dermal	X	X	X				
	Inhalation	X	X	X				
Surface Water	Ingestion							
	Dermal	X						
	Inhalation	X						
Surface Soil from Seasonally Wet Area	Ingestion	X						
	Dermal	X						
	Inhalation	X						
Shallow Groundwater*	Ingestion				X	X		
	Dermal				X	X	X	
	Inhalation				X	X	X	
Subsurface and Surface Soil Combined	Ingestion				X	X	X	X
	Dermal				X	X	X	X
	Inhalation				X	X	X	X

X Quantitative evaluation.
* Shallow groundwater sampling data will only be collected if warranted based on results of soil sampling.

3.4 Ecological Risk Assessment – Screening Level Problem Formulation

The purpose of this section is to present a screening-level problem formulation for Site 6 (i.e., Step 1 of the 8-step Ecological Risk Assessment (ERA) process). The document was prepared in accordance with the Navy-Tier II ERA approach for Region III, which is based on the process described in the USEPA guidance document *Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997) and Navy ERA guidance (CNO 1999).

3.4.1 Screening-Level Problem Formulation

Step 1 (screening-level problem formulation) involves: (1) compiling and reviewing existing data on the nature and extent of contamination and on the habitats and biota potentially present on the site; (2) developing a preliminary conceptual model that includes a qualitative evaluation of potential sources, fate and transport mechanisms, mechanisms of toxicity, potential receptors, and exposure pathways; and (3) developing preliminary assessment endpoints, measurement endpoints, and risk hypotheses.

The two major products of the screening-level problem formulation are the preliminary conceptual model and the preliminary endpoints/hypotheses. The preliminary conceptual model provides the basic framework for the screening ERA and will be revised, as appropriate, during any of the subsequent steps deemed necessary.

3.4.1.1 Environmental Setting

Habitats and Biota. Habitats within the vicinity of Site 6 include mixed hardwood and pine forest. Areas of mowed grass surround the buildings. There is an area behind the buildings were water is conveyed off-site. This area is seasonally wet due to its low grade and may provide seasonal habitat for amphibians. However it does not represent true aquatic habitat.

Surrounding Land Uses. The surrounding land is primarily forested.

3.4.1.2 Summary of Available Analytical Data

There are no known analytical data currently available for the site.

3.4.1.3 Toxicological Properties of Contaminants

Silver is acutely toxic to some aquatic animals at low concentrations; however, information on its toxicity to terrestrial animals is limited. Silver toxicity data is not available for birds; however, a study conducted on mice indicated that a dose of 18.1 mg/kg/day caused hyperactivity (Rungby and Danscher 1984).

3.4.1.4 Preliminary Conceptual Model

Figure 3.2 illustrates the preliminary diagrammatic conceptual model for Site 6. Important components of the preliminary conceptual model are the identification of potential sources of contaminants, transport pathways, exposure media, potential exposure routes, and

potential receptor groups. The potential source areas for Site 6 are surface and subsurface soils in locations where photographic fixer containing dissolved silver was disposed in the past.

Exposure Pathways. An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Based on the preliminary conceptual model for Site 6 (Figure 3-2), complete exposure pathways in terrestrial habitats exist to surface soils located on Site 6. Animals that live in the soil or forage on soil invertebrates or plants, such as robins and mice, may be exposed through this pathway.

A potential exposure pathway from surface water may also exist seasonally where ponding occurs. Complete exposure pathways also exist to upper trophic level receptors that may feed on prey items at the site.

Dermal and inhalation exposures for upper trophic level receptor species are not considered in this ERA because of the general fate properties (e.g., relatively high adsorption to solids) of the chemicals commonly present on these sites and the protection offered by hair or feathers. Relative to ingestion, the contribution from the dermal and inhalation routes to total exposure is generally low. Incidental ingestion of soil/sediment during feeding, preening, or grooming activities is, however, considered in the risk estimates.

Endpoints and Risk Hypotheses. The conclusion of the screening-level problem formulation includes the selection of assessment and measurement endpoints (Table 3.3). These are chosen based on the preliminary conceptual model. Table 3.3 also identifies reasons for the assessment endpoint selections and the specific receptors species or groups associated with each assessment endpoint.

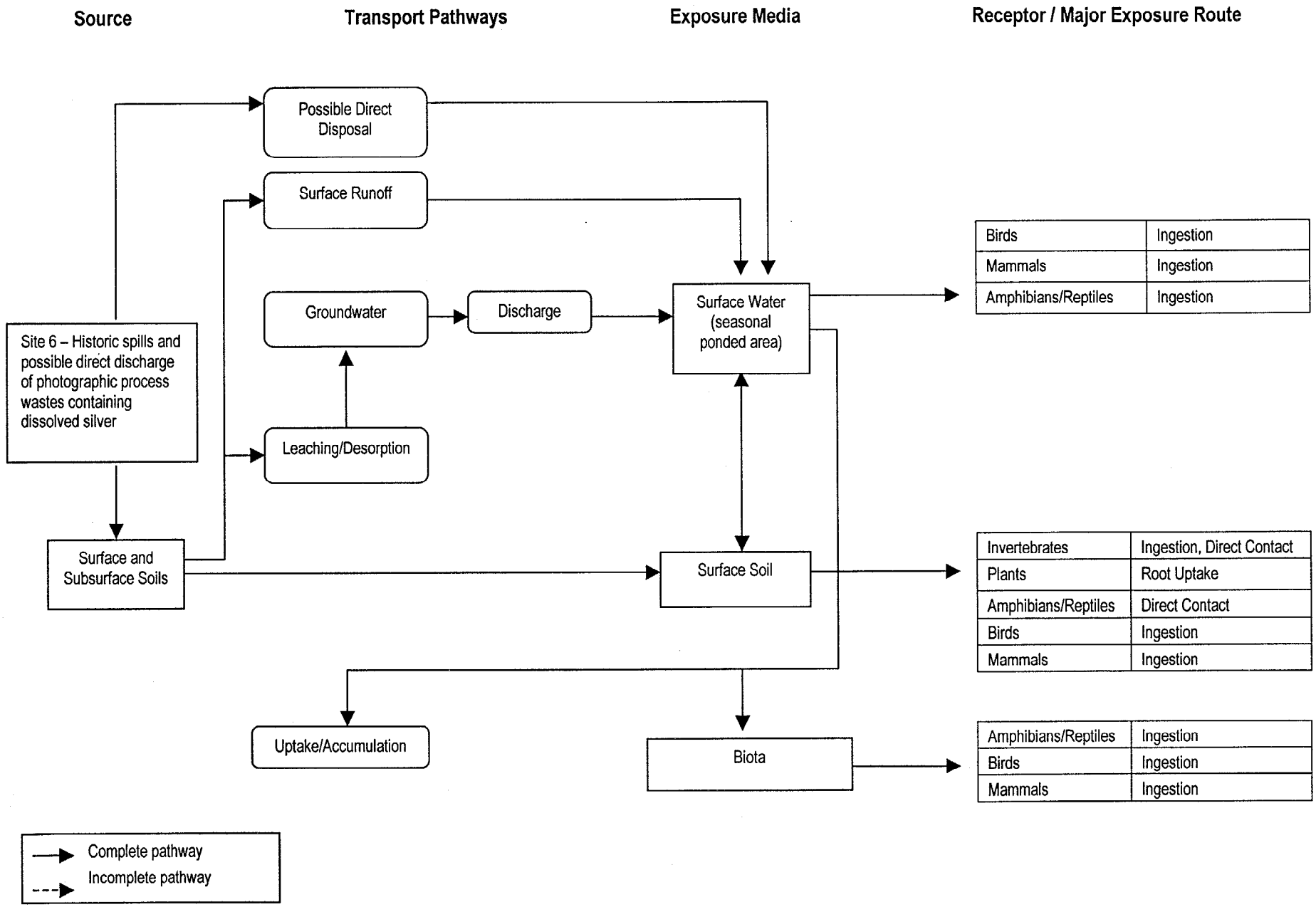


FIGURE 3.2 PRELIMINARY CONCEPTUAL MODEL
NSWC INDIAN HEAD – SITE 6

Table 3.3

Preliminary Assessment Endpoints, Risk Hypotheses, And Measurement Endpoints - Site 6

NSWC Indian Head, Maryland

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities.	Healthy, viable soil invertebrate communities are necessary for a well developed, balanced terrestrial ecosystem. The invertebrates provide important functions in nutrient recycling and availability and soil conditioning. By serving as prey species for many upper trophic predators (American robin), they are critical to the sustenance of the communities of upper trophic level species.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Soil Invertebrates (earthworms)
Survival, growth, and reproduction of terrestrial plant communities.	Plants are critical to the ecosystem in their role as primary producers. Plants take abiotic elements and energy and convert them into available organic compounds. They are the foundation of terrestrial ecosystems and are the first step in nutrient and energy transfer within an ecosystem. In addition to forage for herbivores, plants also often provide the physical structure in habitat necessary for animals.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of avian terrestrial insectivores.	Avian terrestrial omnivores (e.g. American robin) are important consumers of both vegetation (seeds) and invertebrates (as well as other animals in some cases). They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such birds are prey for many species of mammals and raptors (hawks and owls). Many birds are also valued by society for their visual and vocal traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	American robin
Survival, growth, and reproduction of avian terrestrial carnivores.	Avian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal and bird populations versus forage abundance and available habitat. Many such birds are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red-tailed hawk

Table 3.3
Preliminary Assessment Endpoints, Risk Hypotheses, And Measurement Endpoints - Site 6
NSWC Indian Head, Maryland

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial omnivores.	Mammalian terrestrial omnivores are consumers of vegetation and invertebrates. As such, they provide a critical second link in the transfer of energy and nutrients in an ecosystem, changing plant compounds and invertebrate biomass into more biologically available compounds for other animals. They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such mammals are prey for many species of predatory mammals and raptors.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	White-footed mouse
Survival, growth, and reproduction of mammalian terrestrial carnivores.	Mammalian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal populations versus forage abundance and available habitat. Many such mammals are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red fox
Survival, growth, and reproduction of amphibians/reptile communities.	Amphibian and reptiles are consumers of vegetation and invertebrates. As such, they provide a critical second link in the transfer of energy and nutrients in an ecosystem, changing plant compounds and invertebrate biomass into more biologically available compounds for other animals. They are also sensitive to many contaminants, and thus good indicators of ecosystem health. Amphibians and reptiles are prey for many predatory birds and mammals.	Comparison of maximum chemical concentrations in surface water and/or soil with medium-specific screening values.	Amphibians/Reptiles

3.5 Work Plan

The objectives of the remedial investigation at Site 6 are to determine whether the suspected releases of photographic process liquid wastes are a source of contamination in the underlying soils and/or the shallow groundwater at the site and whether these suspected chemical spills migrated via surface runoff to the adjacent seasonally wet area. The shallow groundwater under Site 6 will be examined in Phase 2 only if evidence of contamination is found in the soils.

The primary components of photographic fixer (sodium thiosulfate) and developer (hydroquinone) degrade rapidly under environmental conditions. Hydroquinone is toxic, but reportedly begins to decompose to quinone shortly after discharge, and after further oxidation, the decomposition products include basic acids, which are generally considered non-toxic. Both hydroquinone and sodium thiosulfate are extremely soluble in water, and sodium thiosulfate decomposes rapidly under natural conditions. The most significant potential environmental hazard associated with Site 6 is silver, which even at low levels, is toxic to marine life. The silver thiosulfate complex, in the presence of sunlight, is reduced to a silver sulfide precipitate. Furthermore, stagnant pools would form anaerobic reducing environments favorable to the formation of silver precipitates. Thus, all samples collected will be analyzed for silver. In addition to provide data for the ecological risk assessment, surface water and shallow groundwater samples will be analyzed for dissolved silver (filtered), pH and hardness. Surface soil and the surface soil sampled from the seasonally wet area will be analyzed for grain size analysis, TOC, and pH. Field measurements of water temperature, pH, conductivity, dissolved oxygen (DO) and salinity will also be collected at each surface water and shallow groundwater location. Unless otherwise specified, samples will be submitted for analysis with a standard 28-day turnaround time (TAT).

Only half of the surface soil sampling locations will have samples collected for grain size, TOC and pH analyses. The collection of these samples will be distributed across the proposed sampling locations. If the field observations note a wide degree of variation in the soils being sampled then the sample, frequency for grain size, TOC and pH will be increased.

Background samples for surface and subsurface soils will be collected in areas that are upgradient of the site and not expected to be affected by any potential contamination originating at Site 6. Additionally, if shallow groundwater sampling is warranted based on observed soil contamination, background shallow groundwater concentrations will be sampled from a well installed upgradient of the site. These background samples will be used as reference for comparison of analytical results from site samples.

The proposed scope for the field investigation is summarized on Table 3.4. Proposed sample locations are indicated on Figure 3.3. Table 3.5 reviews the sampling program for Site 6, and Table 3.6 provides sample bottleware, preservation, and holding time requirements. A breakdown of the sampling by media is given below:

Phase 1

- *Surface Soils*: One surface soil sample will be collected adjacent to the former location of the fixer tank and a total of eight other samples will be taken along the perimeters of the Buildings 1349 and 1718, around the base of the hill, and along the nearby drainage ditches. Surface soil samples will be positioned in drainage areas as determined in the field. Surface soils will be collected from 0 to 6 inches below ground surface (bgs) using hand tools. All surface soil samples will be analyzed for silver. Half of the surface soil samples will be analyzed for grain size, TOC and pH.

- *Subsurface Soils*: One subsurface soil sample will be collected adjacent to the former location of the fixer tank; and a total of three other samples will be collected at the same locations as the surface soil samples. Subsurface soils will be collected from 30 to 36 inches bgs using a hand auger. All subsurface soil samples will be analyzed for silver.

- *Surface Soil Sampled from Seasonally Wet Areas*: In order to determine the nature and extent of possible contamination in the surface soil in the marshy area south of Building 1718, three samples will be taken from the seasonally wet areas around the site. Sediment will be sampled if standing water is present in these areas, otherwise surface soil will be sampled. The surface soil samples from seasonally wet areas will be collected from 0 to 6 inches bgs using hand tools and will be analyzed for silver, grain size TOC and pH.

- *Surface Water*: In order to determine whether surface runoff from Site 6 is a source of contamination to the adjacent seasonally wet area, a total of two surface water samples will be taken from the seasonally wet areas around the site. All surface water samples will be analyzed for total silver (unfiltered), dissolved silver (filtered), hardness, and pH. Field measurements of water temperature, pH, conductivity, DO and salinity will also be collected at each location.

- *Background:* One surface soil and one subsurface soil background sample will be collected from a location upgradient of the site. The surface soil sample will be collected at the same location as the subsurface soil sample. Surface soils will be collected from 0 to 6 inches bgs using hand tools. Subsurface soils will be collected from 30 to 36 inches bgs using a hand auger. These samples will be analyzed for silver. The surface soil sample will also be analyzed for grain size analysis, TOC and pH.

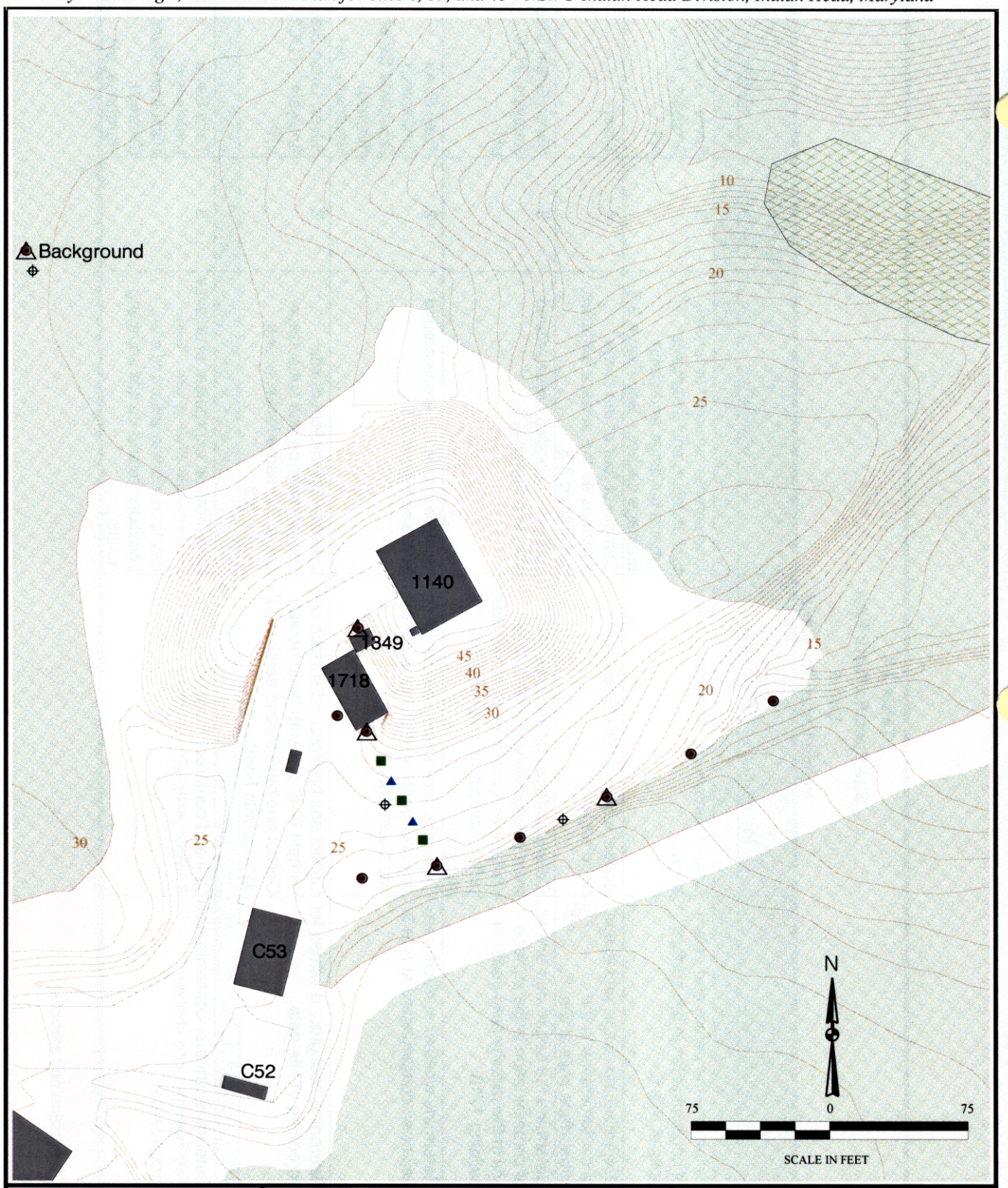
Phase 2

- *Shallow Groundwater*: If the surface and subsurface soils are found to be contaminated, three monitoring wells will be installed in Phase 2 of the field work: one well will be placed upgradient of the site and two wells will be placed downgradient of the site, or as appropriate based on soil sampling results. If shallow groundwater sampling is deemed necessary, shallow groundwater samples will be collected using a pump or bailer and will be analyzed for total silver (unfiltered), dissolved silver (filtered), hardness, and pH. Field measurements of water temperature, pH, conductivity, DO and salinity will also be collected at each location.

Table 3.4
Site Specific Work Plan
Site 6
Indian Head, Maryland

Media	Objective	Investigative Technique	Locations	Number of Samples	Analysis
Phase I					
Surface Soil	Determine the nature and extent of contamination in the surface soils at Site 6.	Collect samples 0"-6" bgs with hand trowel.	One sample adjacent to former tank location and 8 samples around buildings and along drainage ditches. See Figure 3.3.	9	Silver, Grain Size Analysis, TOC, pH
Subsurface Soil	Determine the nature and extent of contamination in the subsurface soils at Site 6.	Collect samples 30"-36" bgs with hand auger.	Sample at four of the same locations as the surface samples, see Figure 3.3.	4	Silver
Surface Soil from Seasonally Wet Areas	Determine the nature and extent of contamination in the surface soil in the marshy area south of building 1718.	Collect surface soil samples 0"-6" from seasonally wet areas. If no surface water is present at site then collect sample as a surface soil sample.	Sample in ponded areas around site, see Figure 3.3.	3	Silver, Grain Size Analysis, TOC, pH
Surface Water	Determine whether surface water has been contaminated at Site 6.	Collect surface water samples from any seasonally wet areas within the site boundaries.	Sample in ponded areas around site, see Figure 3.3.	2	Total Silver (unfiltered), Dissolved Silver (filtered), Hardness, pH
Background	Determine background values for screening of site data.	Collect one background surface soil sample 0"-6" bgs with hand trowel. Collect one background sample 30"-36" bgs with hand auger.	Location upgradient of site, sample surface and subsurface soil at the same location, see Figure 3.3.	2	Silver, Grain Size Analysis*, TOC*, pH*
Phase II					
Shallow Groundwater	Determine whether contamination has migrated into shallow groundwater.	Drill and construct monitoring wells. Sample wells with pump or bailer.	One location upgradient of shallow groundwater flow at site. Two locations downgradient of site. Locations based on soil sampling results.	3	Total Silver (unfiltered), Dissolved Silver (filtered), Hardness, pH

* = Analysis only applies to surface soil samples.



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HYDRO GeoLogic INC.

Legend

- Building/Structure
- Surface Water Drainage
- Wetland
- Forested Area
- Ground Elevation Contour (1ft.)
- Surface Soil Sample
- Sub-Surface Soil Sample
- Surface Water Sample
- Surface Soil Sample from Seasonally Wet Area
- Phase 2 Monitoring Well, Shallow Groundwater Sample Potential Location

Figure 3.3
Proposed Sampling Locations, Site 6

00665 B04Y

Table 3.5
Summary Of Sampling Program For Site 6
NSWC Indian Head, Maryland

Sample Media	Sample ID Number		Purpose	Sample Depth/Location	Analysis					
	From	To			Silver	Grain Size (Sieve)	TOC	Dissolved Silver (Filtered)	Hardness	pH
Phase I										
Surface Soil	IS06SS01		Site sample	0"-6" / Collect surface soil sample adjacent to Building 1718 at the former location of the fixer storage tank. See Figure 3.3.	•	•	•			•
	IS06SS02	IS06SS03	Site sample	0"-6" / Collect surface soil samples adjacent to Buildings 1718 and 1349. See Figure 3.3.	•	•	•			•
	IS06SS04	IS06SS09	Site sample	0"-6" / Collect surface soil samples along drainage ditches. See Figure 3.3.	•	•	•			•
	IS06SS10		Background	0"-6" / Collect background surface soil sample upgradient of Site 6. See Figure 3.3.	•	•	•			•
Subsurface Soils	IS06SB01		Site sample	30"-36" / Collect subsurface soil sample adjacent to Building 1718 at the former location of the fixer storage tank, at the same location as the surface soil sample. See Figure 3.3.	•					
	IS06SB02		Site sample	30"-36" / Collect subsurface soil sample adjacent to Building 1349, at the same location as the surface soil sample. See Figure 3.3.	•					
	IS06SB03	IS06SB04	Site sample	30"-36" / Collect subsurface soil samples along the drainage ditches, at the same locations as the surface soil samples. See Figure 3.3.	•					
	IS06SB05		Background	30"-36" / Collect background subsurface soil sample upgradient of Site 6, at the same location as the surface soil sample. See Figure 3.3.	•					•
Surface Soil from Seasonally Wet Area	IS06SD01	IS06SD03	Site sample	0"-6" / Collect surface soil samples in the seasonally wet areas around the site. See Figure 3.3.	•	•	•			•

Table 3.5
Summary Of Sampling Program For Site 6
NSWC Indian Head, Maryland

Sample Media	Sample ID Number		Purpose	Sample Depth/Location	Analysis					
	From	To			Silver	Grain Size (Sieve)	TOC	Dissolved Silver (Filtered)	Hardness	pH
Surface Water	IS06SW01	IS06SW02	Site sample	Collect surface water samples in the seasonally wet areas around the site. See Figure 3.3.	•			•	•	•
Phase II										
Shallow Groundwater[1]	IS06MW01*MMYY*	IS06MW02*MMYY*	Site sample	Determined from soil analysis.	•			•	•	•
	IS06MW03*MMYY*		Background	Located hydraulically upgradient of Site 6.	•			•	•	•

[1] Part of a Phase 2 investigation if contamination is found in the subsurface soil.

Table 3.6
Bottleware, Preservation and Holding Time Requirements for Site 6
NSWC Indian Head, Maryland

Media	Analysis	Total Number of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
Shallow Groundwater	Total Silver (unfiltered)	3	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Hardness - EPA Method 130.1	3	1	250ml glass bottle	HNO_3 pH <2	6 months
	Dissolved Silver (filtered) - CLP	3	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	pH - Field analysis	3	1	40 ml vial	None	Analyzed immediately
Surface Soil	Silver	10	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Total Organic Carbon and pH - EPA Method 415.1, SW-846-9045	5	1	8 oz. plastic or glass	Cool to 4^0C	28 days to analysis
	Grain Size Analysis ASTM D-422 # 200 Sieve	5	1	8 oz. glass	None	6 months
Subsurface Soil	Silver	5	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
Surface Soil from Seasonally Wet Area	Silver	3	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Total Organic Carbon and pH - EPA Method 415.1, SW-846-9045	3	1	8 oz. plastic or glass	Cool to 4^0C	28 days to analysis
	Grain Size Analysis ASTM D-422 # 200 Sieve	3	1	8 oz. glass	None	6 months
Surface Water	Total Silver (unfiltered)	2	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Hardness - EPA Method 130.1	2	1	250ml glass bottle	HNO_3 pH <2	6 months
	Dissolved Silver (filtered) - CLP	2	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	pH - Field analysis	2	1	40 ml vial	None	Analyzed immediately

4. Site 39 – Silver Release to Sediments/Stack Emissions

4.1 Background Information and Site Description

Site 39 is located in the vicinity southeast of Building 497, and entails an elemental silver/silver nitrate release from Building 497 to the Mattawoman Creek. The investigation of Site 39 has been expanded to include the soils in the area around Buildings 497, 497A, and 498 to address possible contamination from stack emissions (Figure 4.1). Buildings 497, 497A, and 498 were all built in 1942. The contamination in Mattawoman Creek is being addressed under the ongoing Mattawoman Creek Ecological Study. This Project Specific Work Plan will therefore only address the potentially contaminated soils in the area around Buildings 497, 497A, and 498.

Buildings 497, the organic chemical plant, 497A, and 498, were built in 1942 and have been utilized for the large-scale manufacture of chemicals and explosives for use in weapons. Established originally to produce Exposive D (ammonium picrate), these facilities were also used to manufacture a number of other materials. These included: nitroguanidine, Composition D-2, dinitropropanol (DNPOH), bis-dinitropropyl acetal/formal, plastisol nitrocellulose, dimethyl ammonium nitrate, dimethyl nitramine, unsymmetrical dimethylhydrazine (UDMH), and high-bulk-density nitroguanidine (HBNQ) (NEESA, 1983).

According to Navy records, bis-2,2-dinitropropyl acetal/formal was produced at Building 497 from 1961 to 1965, possibly resulting in the release of elemental silver, silver nitrate, DNPOH, ethylene dichloride, methylene chloride, and formaldehyde. Silver nitrate was used as a catalyst in the production of acetal/formal, a plasticizer or propellant binder that is used in Polaris rocket motors. In the reaction, the silver nitrate catalyst was converted to elemental silver, and this silver was then recovered from the reaction vessel to be returned to the supplier for nitration back to silver nitrate. However, interviews with Navy personnel revealed that a significant amount of silver, as well as the other chemicals listed above, might have entered the surrounding soils or the adjacent creek through spills and human error. For example, on one occasion, a valve was mistakenly left open and the contents of the 500 gallon batch reactor in Building 497, including the silver nitrate catalyst, were released to the Mattawoman Creek. Additionally, there is one stack at Building 497 which was used in the production of UDMH and two stacks on the roof of 498 which were was used in the drying process of nitroguanidine. Emissions from these stacks may have caused surface soil contamination in the vicinity of these buildings, although the quantities of contaminants are unknown.

The sampling described in this Project Specific Work Plan will be undertaken to determine whether these curing and drying process emissions from Buildings 497 and 498 resulted in the contamination of surface soils, subsurface soils, and/or shallow groundwater and to determine the extent of any contamination found.

4.2 Previous Environmental Investigations

Site 39 was included in the supplemental PA that was conducted by NEESA in 1992. The PA report recommended further investigation to assess the nature and extent of possible sediment contamination at the site.

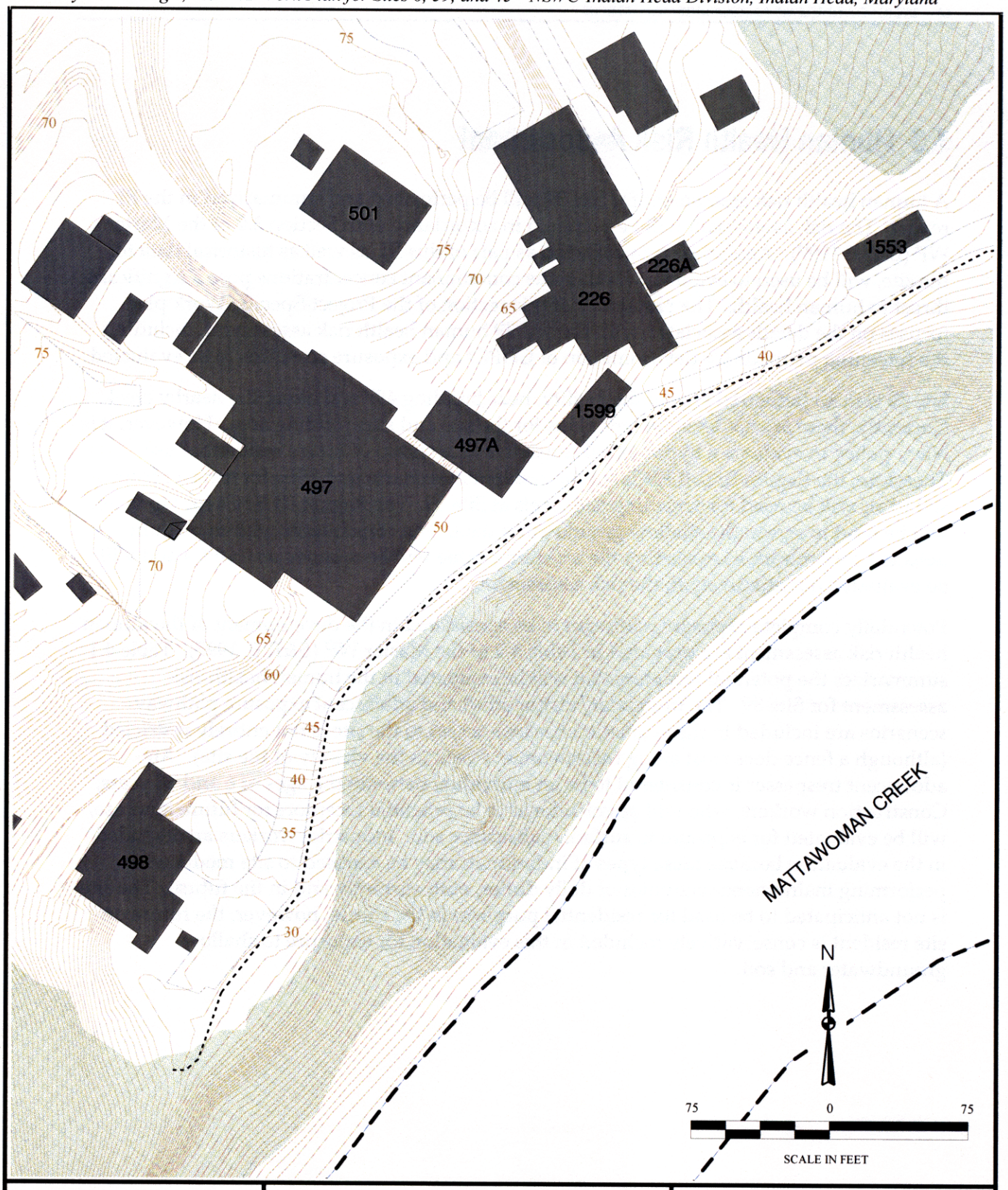
The following summarizes the sediment sampling in and on the banks of Mattowoman Creek and deals with the ongoing Mattowoman Creek Ecological Study. There have been no previous investigations of the soils around Buildings 497, 497A, and 498.

As a follow-up to the supplemental PA, a SI was conducted for Site 39 in 1992 that included taking two sediment samples from the outfall of a discharge pipe from Building 497 to Mattawoman Creek and four sediment samples from Mattawoman Creek. Sediment samples were collected by surface soil and petite ponar sampling techniques. One surface sediment sample was collected at the outfall of the discharge point and the second at the effluent point of entry to the creek. Three shallow sediment samples were collected downstream of the outfall point and a fourth was collected upstream. Sediment samples were collected from apparent low energy zones of the creek and all creek sample points were spaced approximately 200 feet apart along the main channel.

Analytical results from this sampling are as follows:

- Volatile Organic Compounds (VOCs): Acetone was detected in one sample at an estimated concentration of 780 μg/kg; chloromethane and carbon disulfide were each detected in two samples at concentrations below the method detection limit.
- Base Neutral Analytes (BNAs): Thirteen BNA compounds were detected in samples from Site 39. All concentrations were reported as estimated values. Individual analytes may be representative of compounds commonly found in petroleum products and/or waste oils.
- Target Analyte List (TALs): Twelve TAL analytes were detected in all sediment samples. Four of these 12 analytes (lead, cobalt, mercury, and silver) were reported at concentrations above the corresponding average background level in soil. Arsenic was detected in all but one sediment sample.
- Explosive derivatives: Pelletized nitrocellulose (PNC) was detected in all six sediment samples at estimated concentrations from 9.9 to 365 mg/kg. UDMH was detected in three sediment samples at concentrations from 57.5 to 85.5 mg/kg. HBNQ was detected in three sediment samples at concentrations from 1.88 to 429 mg/kg.

Based on these results, the 1994 Final SI report recommended additional study of soil and sediments at Site 39 to better determine the nature and extent of contamination.



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Created: 11/13/00 TH
Revised: 12/12/00 jb
Source: CH2MHILL, HydroGeoLogic, Inc.

HYDRO GeoLogic INC.

Legend

- Base Boundary
- Building/Structure
- Surface Water Drainage
- Wetland
- Forested Area
- Ground Elevation Contour (1ft.)

Figure 4.1
Existing Conditions, Site 39

00665B05Y

4.3 Human Health Risk Assessment

A human health risk assessment for Site 39 will be performed and summarized in the RI report. The risk assessment will be prepared in accordance with Section 3.0 of the Master WP (B&RE 1997). Analytical data collected as part of this RI, as well as historical data for the site, will be used to evaluate whether site contaminant concentrations pose a significant threat to human health. The remainder of this section of the Project-Specific Work plan focuses on the details associated with the Site 39 human health risk assessment, including the screening methods for determination of COPCs and exposure scenarios to be evaluated.

Site 39 is in an industrial area of the facility, near Building 497 and along the nearby creek. Currently, there are no development plans for the site and surrounding area. However, it is Navy policy to evaluate a hypothetical conservative scenario of future residential use. Therefore, the Region III soil RBCs for the residential scenario and SSLs for transfer from soil to air will be used for screening soil levels at Site 39. The Region III RBCs for tap water will be used to screen the shallow groundwater data. The constituents with maximum detected concentrations exceeding the screening value will be retained as COPCs and will be evaluated quantitatively in the risk assessment.

Potentially complete exposure pathways to be considered in the development of the human health risk assessment are provided in Table 3-2 of the Master WP (B&R E, 1997). Table 4.1 summarizes the potential receptors that will be evaluated in the human health risk assessment for Site 39. The trespasser/visitor adult and adolescent exposure pathway scenarios are included in the evaluation because access to the site is not entirely restricted (although a fence does exist along Mattawoman Creek in the vicinity of the site). An adolescent trespasser is considered to be an individual between the ages of 6 and 16 years. Construction workers, who will be considered to be potential receptors for future land use, will be evaluated for exposure to surface/subsurface soil. Industrial workers are included in the evaluation because these types of individuals may be exposed to site media while performing maintenance activities or daily duties, both currently and in the future. The site is not anticipated to be used for residential purposes in the future, however, the future on-site resident is conservatively included in this evaluation for exposure to shallow groundwater and soil.

Table 4.1
Potential Exposure Pathways
Site 39
Indian Head, Maryland

Media	Exposure Route	Current			Future					
		Industrial Worker	Trespasser/Visitor		Onsite Resident		Construction Worker	Industrial Worker	Trespasser/Visitor	
			Adult	Adolescent	Adult	Child			Adult	Adolescent
Surface Soil										
	Ingestion	X	X	X						
	Dermal	X	X	X						
	Inhalation	X	X	X						
Shallow Groundwater *										
	Ingestion				X	X				
	Dermal				X	X	X			
	Inhalation				X	X	X			
Subsurface and Surface Soil Combined	Ingestion				X	X	X	X	X	X
	Dermal				X	X	X	X	X	X
	Inhalation				X	X	X	X	X	X

X Quantitative evaluation.

* Shallow groundwater sampling data will only be collected if warranted based on results of soil sampling.

4.4 Ecological Risk Assessment – Screening Level Problem Formulation

The purpose of this section is to present a screening-level problem formulation for Site 39 (i.e., Step 1 of the 8-step ERA process). The document was prepared in accordance with the Navy-Tier II ERA approach for Region III, which is based on the process described in the USEPA guidance document *Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997) and Navy ERA guidance (CNO 1999).

4.4.1 Screening-Level Problem Formulation

Step 1 (screening-level problem formulation) involves: (1) compiling and reviewing existing data on the nature and extent of contamination and on the habitats and biota potentially present on the site; (2) developing a preliminary conceptual model that includes a qualitative evaluation of potential sources, fate and transport mechanisms, mechanisms of toxicity, potential receptors, and exposure pathways; and (3) developing preliminary assessment endpoints, measurement endpoints, and risk hypotheses.

The two major products of the screening-level problem formulation are the preliminary conceptual model and the preliminary endpoints/hypotheses. The preliminary conceptual model provides the basic framework for the screening ERA and will be revised, as appropriate, during any of the subsequent steps deemed necessary.

4.4.1.1 Environmental Setting

Habitats and Biota. Pavement and mowed grassy areas surround the buildings at Site 39. The area to the southeast of the fence line, between the site and Mattawoman Creek, is forested with mixed oak and pine.

Surrounding Land Uses. The surrounding land north of Site 39 is heavily developed with military buildings and structures. The remaining land is primarily forest with pockets of development.

4.4.1.2 Summary of Available Analytical Data

There are no surface soil analytical data currently available for the site. Sediment samples have been collected from the outfall of the discharge pipe from Building 497, however this area is being addressed under the Mattawoman Creek Ecological Study.

4.4.1.3 Toxicological Properties of Contaminants

The suspected COPCs at Site 39 included silver nitrate, and several organic chemicals used in the production of acetal/formal, including DNOPH, ethylene dichloride, methylene chloride, and formaldehyde. Silver is acutely toxic to some aquatic animals at low concentrations; however, information on its toxicity to terrestrial animals is limited. Silver toxicity data is not available for birds; however, a study conducted on mice indicated that a dose of 18.1 mg/kg/day caused hyperactivity (Rungby and Danscher 1984).

Methylene chloride can cause cancer in animals that receive large dosages (ATSDR 1989). A two year study on the effects of methylene chloride on the livers of rats indicated a chronic Lowest Observed Adverse Effects Level (LOAEL) of 50 mg/kg/day (NCA, 1982). Rats fed this dose developed histological changes in the liver. No adverse effects were observed at the dose of 5.85 mg/kg/day.

4.4.1.4 Preliminary Conceptual Model

Figure 4.2 illustrates the preliminary diagrammatic conceptual model for Site 39. The potential source area is the surface soils near Building 497 where silver, silver nitrate, and other hazardous substances may have been released during production of acetal/formal. An additional potential source is surface soils surrounding Buildings 497 and 498 that may have been affected by atmospheric deposition of contaminated particulate matter derived from the stacks at these buildings.

Exposure Pathways. An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Based on the preliminary conceptual model for Site 39 (Figure 4-2), potentially complete exposure pathways in terrestrial habitats exist to surface soils at the site. Animals that forage on plants and animals near the site may be exposed via direct contact with the soil, incidental ingestion, and through diet.

Dermal and inhalation exposures for upper trophic level receptor species are not considered in this ERA because of the general fate properties (e.g., relatively high adsorption to solids) of the chemicals commonly present on these sites and the protection offered by hair or feathers. Relative to ingestion, the contribution from the dermal and inhalation routes to total exposure is generally low. Incidental ingestion of soil/sediment during feeding, preening, or grooming activities is, however, considered in the risk estimates.

Although no surface water bodies occur on Site 39, Mattawoman Creek is located nearby. Potentially complete transport pathways via surface runoff and groundwater link Site 39 to this waterbody. Thus, complete exposure pathways exist to the surface water and sediments in the creek. However, the potential risk posed by this exposure is being evaluated separately in the Mattawoman Creek Investigation.

Endpoints and Risk Hypotheses. The conclusion of the screening-level problem formulation includes the selection of assessment endpoints and measurement endpoints. They are chosen based on the conceptual model. Table 4.2 also identifies reasons for assessment endpoint selections and specific receptor species or groups used to represent each assessment endpoint.

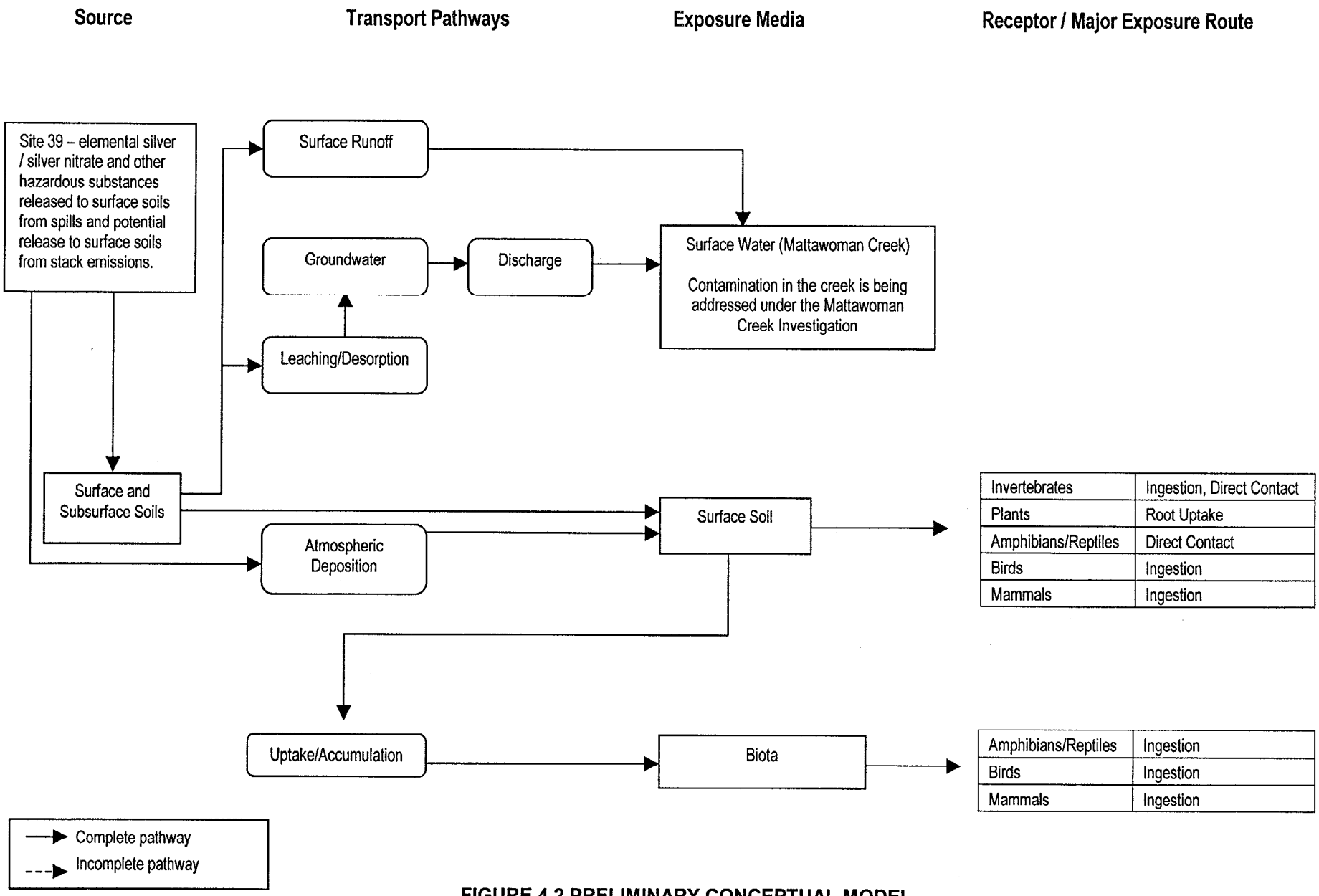


FIGURE 4.2 PRELIMINARY CONCEPTUAL MODEL
NSWC INDIAN HEAD – SITE 39

Table 4.2
Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints - Site 39
NSWC Indian Head, Maryland

Assessment Endpoint	Basis for Assessment Endpoint	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities.	Healthy, viable soil invertebrate communities are necessary for a well developed, balanced terrestrial ecosystem. The invertebrates provide important functions in nutrient recycling and availability and soil conditioning. By serving as prey species for many upper trophic predators (American robin), they are critical to the sustenance of the communities of upper trophic level species.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Soil Invertebrates (earthworms)
Survival, growth, and reproduction of terrestrial plant communities.	Plants are critical to the ecosystem in their role as primary producers. Plants take abiotic elements and energy and convert them into available organic compounds. They are the foundation of terrestrial ecosystems and are the first step in nutrient and energy transfer within an ecosystem. In addition to forage for herbivores, plants also often provide the physical structure in habitat necessary for animals.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of avian terrestrial insectivores.	Avian terrestrial omnivores (e.g. American robin) are important consumers of both vegetation (seeds) and invertebrates (as well as other animals in some cases). They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such birds are prey for many species of mammals and raptors (hawks and owls). Many birds are also valued by society for their visual and vocal traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	American robin

Table 4.2
Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints - Site 39
NSWC Indian Head, Maryland

Assessment Endpoint	Basis for Assessment Endpoint	Measurement Endpoint	Receptor
Survival, growth, and reproduction of avian terrestrial carnivores.	Avian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal and bird populations versus forage abundance and available habitat. Many such birds are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red-tailed hawk
Survival, growth, and reproduction of mammalian terrestrial omnivores.	Mammalian terrestrial omnivores are consumers of vegetation and invertebrates. As such, they provide a critical second link in the transfer of energy and nutrients in an ecosystem, changing plant compounds and invertebrate biomass into more biologically available compounds for other animals. They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such mammals are prey for many species of predatory mammals and raptors.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	White-footed mouse
Survival, growth, and reproduction of mammalian terrestrial carnivores.	Mammalian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal populations versus forage abundance and available habitat. Many such mammals are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red fox

4.5 Work Plan

The objective of the remedial investigation at Site 39 is to determine whether surface and subsurface soils have been contaminated by stack emissions, silver or silver nitrate. The surface soil and subsurface soil will be analyzed. The shallow groundwater under Site 39 will be examined in Phase 2 only if evidence of contamination is found in the soils.

Collected samples will be analyzed for a full suite of analytes: Target Compound List (TCL) Semi Volatilie Organic Compounds (SVOCs), TAL metals, explosives (including HBNQ, UDMH, pentaerythritol tetranitrate (PETN), nitroglycerin (NG), PNC, and acetal/formal), and ammonium perchlorate. In addition, to provide data for the ecological risk assessment, surface soil will be sampled for grain size analysis, TOC, and pH, and shallow groundwater samples will be analyzed for dissolved metals (filtered), pH and hardness. Field measurements of water temperature, pH, conductivity, DO and salinity will also be collected at each shallow groundwater sampling location. All samples will be submitted for analysis with a standard 28-day TAT.

Only half of the surface soil sampling locations will have samples collected for grain size, TOC and pH analyses. The collection of these samples will be distributed across the proposed sampling locations. If the field observations note a wide degree of variation in the soils being sampled, then the sample frequency for grain size, TOC and pH will be increased.

Background samples will be collected in areas that are upgradient of the site and not expected to be affected by any potential contamination originating at Site 39. These background samples will be used as reference for comparison of analytical results from site samples.

In addition to sampling, a description of each sample location will be included in the field book to assist with the ecological risk assessment. The description will note the presence of water, water depth, emergent and submergent vegetation, animal life, etc.

The proposed sampling techniques and analysis for the field investigation are summarized on Table 4.3. Proposed sample locations are indicated on Figure 4.3. Table 4.4 reviews the sampling program for Site 39, and Table 4.5 provides sample bottleware, preservation, and holding time requirements. A breakdown of the sampling by media is given below:

Phase 1

- *Surface Soils*: Ten surface soil samples will be collected along the perimeter of Buildings 497, 497A and 498 and ten samples will be collected approximately 50 feet from these buildings. Surface soils will be collected from 0 to 6 inches bgs using hand tools. All surface soil samples will be analyzed for TCL SVOCs, TAL metals, explosives (including HBNQ, UDMH, PETN, NG, PNC and acetal/formal), ammonium perchlorate, grain size analysis, TOC and pH.

- *Subsurface Soils*: Ten subsurface soil samples will be collected along the perimeter of Buildings 497, 497A and 498 and ten samples will be collected approximately 50 feet

from Buildings 497, 497A and 498. The same sample locations will be used for both surface and subsurface soil sampling. Subsurface soils will be collected from 30 to 36 inches bgs using a hand auger. All subsurface soil samples will be analyzed for TCL SVOCs, TAL metals, explosives (including HBNQ, UDMH, PETN, NG, PNC and acetal/formal), and ammonium perchlorate.

- *Background:* One surface soil and one subsurface soil background sample will be collected from a location upgradient of the site. The surface soil sample will be collected at the same location as the subsurface soil sample. Surface soils will be collected from 0 to 6 inches bgs using hand tools. Subsurface soils will be collected from 30 to 36 inches bgs using a hand auger. These samples will be analyzed for TCL SVOCs, TAL metals, explosives (including HBNQ, UDMH, PETN, NG, PNC and acetal/formal), and ammonium perchlorate. The surface soil sample will also be analyzed for grain size analysis, TOC and pH.

Phase 2

- *Shallow Groundwater*: If the surface and subsurface soils are found to be contaminated, three monitoring wells will be installed in Phase 2: one well will be placed upgradient of the site and two wells will be placed downgradient of the site. Shallow groundwater samples will be analyzed for TCL SVOCs, total TAL metals (unfiltered), explosives (including HBNQ, UDMH, PETN, NG, PNC and acetal/formal), ammonium perchlorate, dissolved metals (filtered), hardness and pH. One or more of the analyses may be eliminated if none of the corresponding analytes are detected in Phase 1 soil samples.

Table 4.3
SITE SPECIFIC WORK PLAN
SITE 39
INDIAN HEAD, MARYLAND

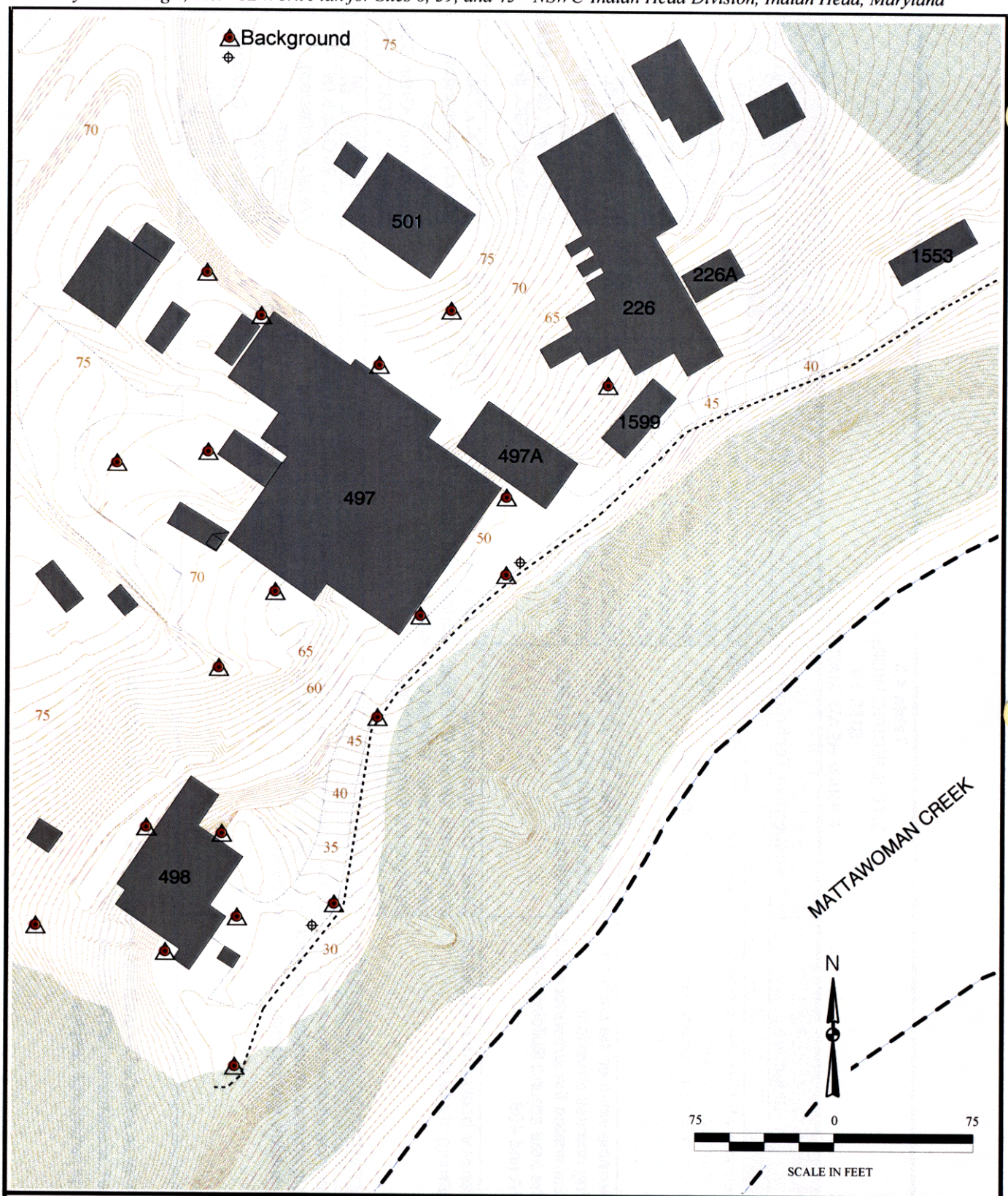
Media	Objective	Investigative Technique	Locations	Number of Samples	Analysis
Phase 1					
Surface Soil	Determine whether the curing or drying process emissions contaminated the surface soils in the area around Buildings 497, 497A and 498.	Collect samples 0"-6" bgs with hand trowel around Buildings 497, 497A and 498.	Collect 10 samples along the perimeter of Buildings 497, 497A and 498. Collect an additional 10 samples approximately 50-feet from the buildings. See Figure 4.3.	20	TCL SVOCs,TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis, TOC, pH
Subsurface Soil	Determine whether the curing or drying process emissions contaminated the subsurface soils in the area around Buildings 497, 497A and 498.	Collect samples 30"-36" bgs with hand auger around Buildings 497, 497A and 498.	Sample subsurface samples at the same locations as the surface soil samples above. See Figure 4.3.	20	TCL SVOCs,TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis, TOC, pH
Background	Determine background values for screening of site data.	Collect one background surface soil sample 0"-6" bgs with hand trowel. Collect one background sample 30"-36" bgs with hand auger	Location upgradient of site, sample surface and subsurface soil at the same location, see Figure 4.3.	2	TCL SVOCs,TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis**, TOC**, pH**
Phase 2					
Shallow Groundwater	Determine whether the curing or drying process emissions leached into shallow groundwater.	Drill and construct monitoring wells. Sample wells with pump or bailer.	One location upgradient of shallow groundwater flow at site. Two locations downgradient of site. Locations based on soil sampling results.	3	TCL SVOCs,total TAL Metals (unfiltered), Ammonium Perchlorate, Explosives*, Dissolved Metals (filtered), Hardness, pH

'Notes

Surface soil samples will only be collected for grain size analysis, TOC and pH at half of the sample locations.

* = Including HBNQ, UDMH, acetal/formal, PETN, NG, and PNC

** = Analysis only applies to surface soil samples.



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Source: CH2MHILL, HydroGeoLogic, Inc.

Legend

- Base Boundary
- Building/Structure
- Surface Water Drainage
- Wetland
- Forested Area
- Ground Elevation Contour (1ft.)
- Surface Soil Sample
- Subsurface Soil Sample
- Phase 2 Monitoring Well, Shallow Groundwater Sample Potential Location

Figure 4.3
Proposed Sampling Locations, Site 39

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Table 4.4
Summary of Sampling Program for Site 39
NSWC Indian Head, Maryland

Sample Media	Sample ID Number From	Sample ID Number To	Purpose	Sample Depth/Location	Analysis: SVOCs	Metals	Explosives	Grain Size (sieve)	TOC	Dissolved Metals (filtered)	Hardness	pH
Phase I												
Surface Soil	IS39SS010001	IS39SS100001	Site Sample	0"-6" / Collect surface soil samples adjacent to Buildings 497, 497A and 498. See Figure 4.3.	•	•	•	•	•			•
	IS39SS110001	IS39SS200001	Site Sample	0"-6" / Collect surface soil samples approximately 50' away from Buildings 497, 497A and 498. See Figure 4.3.	•	•	•	•	•			•
	IS39SS210001		Background	0"-6" / Collect background surface soil sample upgradient of Site 39. See Figure 4.3.	•	•	•	•	•			•
Subsurface Soil	IS39SB010304	IS39SB100304	Site Sample	30"-36" / Collect subsurface soil samples adjacent to Buildings 497, 497A and 498 at the same locations as the surface soil samples. See Figure 4.3.	•	•	•					
	IS39SB110304	IS39SB200304	Site Sample	30"-36" / Collect surface soil samples approximately 50' away from Buildings 497, 497A and 498 at the same locations as the surface soil samples. See Figure 4.3.	•	•	•					
	IS39SB210304		Background	30"-36" / Collect background subsurface soil sample at the same location as the background surface soil sample. See Figure 4.3.	•	•	•					
Phase II												
Shallow Groundwater[1]	IS39MW01*MMYY*	IS39MW02*MMYY*	Site Sample	Determined from soil analysis.	•	•	•			•	•	•
	IS39MW03*MMYY*		Site Sample	Located upgradient of Site 39.	•	•	•			•	•	•

[1] Part of a Phase 2 investigation if contamination is found in the subsurface soil.

Table 4.5
Bottleware, Preservation and Holding Time Requirements for Site 39
NSWC Indian Head, Maryland

Media	Analysis	Total Number of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
Shallow Groundwater	TCL SemiVOCs – CLP OLM03.0	3	1	1L amber glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Total TAL Metals (unfiltered) – CLP ILM04.0	3	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	3	1	1L amber glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Explosives - including PETN - SW - 8330	3	2	1L amber glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Nitrocellulose - Modified E353.2	3	2	500 ml amber glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Ammonium Perchlorate	3	1	250 ml Plastic bottle	Cool to 4°C	14 days to analysis
	Hardness - EPA Method 130.1	3	1	250ml glass bottle	HNO_3 pH <2	6 months
	Dissolved Metals (filtered) - CLP	3	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	pH - Field analysis	3	1	40 ml vial	None	Analyzed immediately
Surface Soil	TCL SemiVOCs – CLP OLM03.0	21	1	250 ml CWM glass	Cool to 4°C	14 days to analysis
	TAL Metals – CLP ILM04.0	21	1	250 ml CWM glass	HNO_3 pH <2	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	21	1	250 ml CWM glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Explosives - including PETN - SW - 8330	21	1	8 oz. glass	Cool to 4°C	14 days to extract; 40 days to analysis
	Nitrocellulose - Modified E353.2	21	1	8 oz. glass	Cool to 4°C	14 days to extract; 40 days to analysis
	Ammonium Perchlorate	21	1	4 oz. glass	Cool to 4°C	14 days to analysis
	Total Organic Carbon and pH - EPA Method 415.1, SW-846-9045	11	1	8 oz. plastic or glass	Cool to 4°C	28 days to analysis
	Grain Size Analysis ASTM D-422 # 200 Sieve	11	1	8 oz. glass	None	6 months

Table 4.5
Bottleware, Preservation and Holding Time Requirements for Site 39
NSWC Indian Head, Maryland

Media	Analysis	Total Number of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
Subsurface Soil	TCL SemiVOCs – CLP OLM03.0	21	1	250 ml CWM glass	Cool to 4°C	14 days to analysis
	TAL Metals – CLP ILM04.0	21	1	250 ml CWM glass	HNO_3 pH <2	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	21	1	250 ml CWM glass	Cool to 4°C	7 days to extract; 40 days to analysis
	Explosives - including PETN - SW - 8330	21	1	8 oz. glass	Cool to 4°C	14 days to extract; 40 days to analysis
	Nitrocellulose - Modified E353.2	21	1	8 oz. glass	Cool to 4°C	14 days to extract; 40 days to analysis
	Ammonium Perchlorate	21	1	4 oz. glass	Cool to 4°C	14 days to analysis

CWM – Clear Wide Mouth
* - Includes analysis for nitrate esters (PETN, nitroglycerin, nitrocellulose, nitroguanidine) in Modified SW-846-8330.

5. Site 45 – Abandoned Drums

5.1 Background Information and Site Description

Site 45 is located approximately 300 feet west of Site 44 (Soak Out Area) in the northwest-central portion of the facility. The site is located in a wooded area, approximately 125 feet northeast of Building 674 and 450 feet northwest of Building 1363 as shown in Figure 5.1. The terrain is generally flat and slopes to the southeast. There are two drainage ditches near the site, one is located east of the site and slopes toward the south, while the other is south of the site and slopes toward the southeast. The site previously consisted of 21 empty, partially rusted 55-gallon drums and two overpack drums. The drums were rusted through in some places and some appeared to have been cut and welded end-to-end in a manner similar to the drums that were used at Site 44 (Soak Out Area). The actual origin and previous contents of the drums are not known with certainty. However, according to the January 1992 PA (NEESA, 1992), the drums were reported to have been in this area for 15 to 20 years and may have originated from the soak out process at Site 44. Thus, it is suspected that these drums originally contained a hazardous waste, probably solvent(s). Had these drums been full when placed at the site, up to approximately 1300 gallons of solvent could have been leaked to the underlying soil (Engineering Field Activity, Chesapeake Naval Facilities Engineering Command, Oct 1997). Table 5.1 summarizes the estimated quantities of hazardous materials disposed at Site 45.

Site 44 was reportedly active during the late 1960s to early 1970s; during this period, a soak tank was used to remove propellant from rocket motor catapult tubes (NEESA, 1992). The soak tank consisted of two 55-gallon drums welded together one on top of the other and was located about 75 feet east of Building 1363. The tank was filled with a nonflammable solvent believed to be Pennchem 9018, a polysulfide solvent containing mercaptan (NEESA, 1992). The propellant-contaminated tubes were then dipped into the solvent and soaked for 2 to 3 days. A smaller catch tank was placed at the bottom of the larger tank to collect pieces of propellant that would fall out of the tubes during cleaning. The soak tank was reportedly located directly on the ground, and so it is expected that some solvent was spilled during these cleaning activities. Additionally, it was reported that during the 3 to 4 years that the soak tank was in use, no vegetation was able to grow within an area of about 20-feet in diameter around the tank. However, no signs of stressed vegetation currently exist at Site 44.

The drums at Site 45 have been removed, and the site was staked to identify an area approximately 20′ by 10′ where the drums were located. This area currently shows no signs of stressed vegetation.

Table 5.1 Site 45 Estimated Quantity of Hazardous Materials Released	
Contaminant	**Estimated Quantity (in gallons)**
Unknown solvent[1]	Up to 1300[2]

NOTES:

[1] The actual origin and previous contents of the drums are not known with certainty however, according to the January 1992 PA, the drums were reported to have been in this area for 15 to 20 years and may have originated from the soak out process at Site 44. Thus, it is suspected that these drums originally contained a hazardous waste, probably solvent(s). The solvent believed to have been used at Site 44 is Pennchem 9018, a polysulfide solvent containing mercaptan (NEESA, 1992).

[2] The estimated released quantity of solvent assumes that the drums were full when placed on site and the entire contents leaked to the underlying soil (B&RE, 1997).

SOURCES:

Indian Head NSWC Site Management Plan, Engineering Field Activity, Chesapeake Naval Facilities Engineering Command, Oct 1997.

NEESA, 1992.

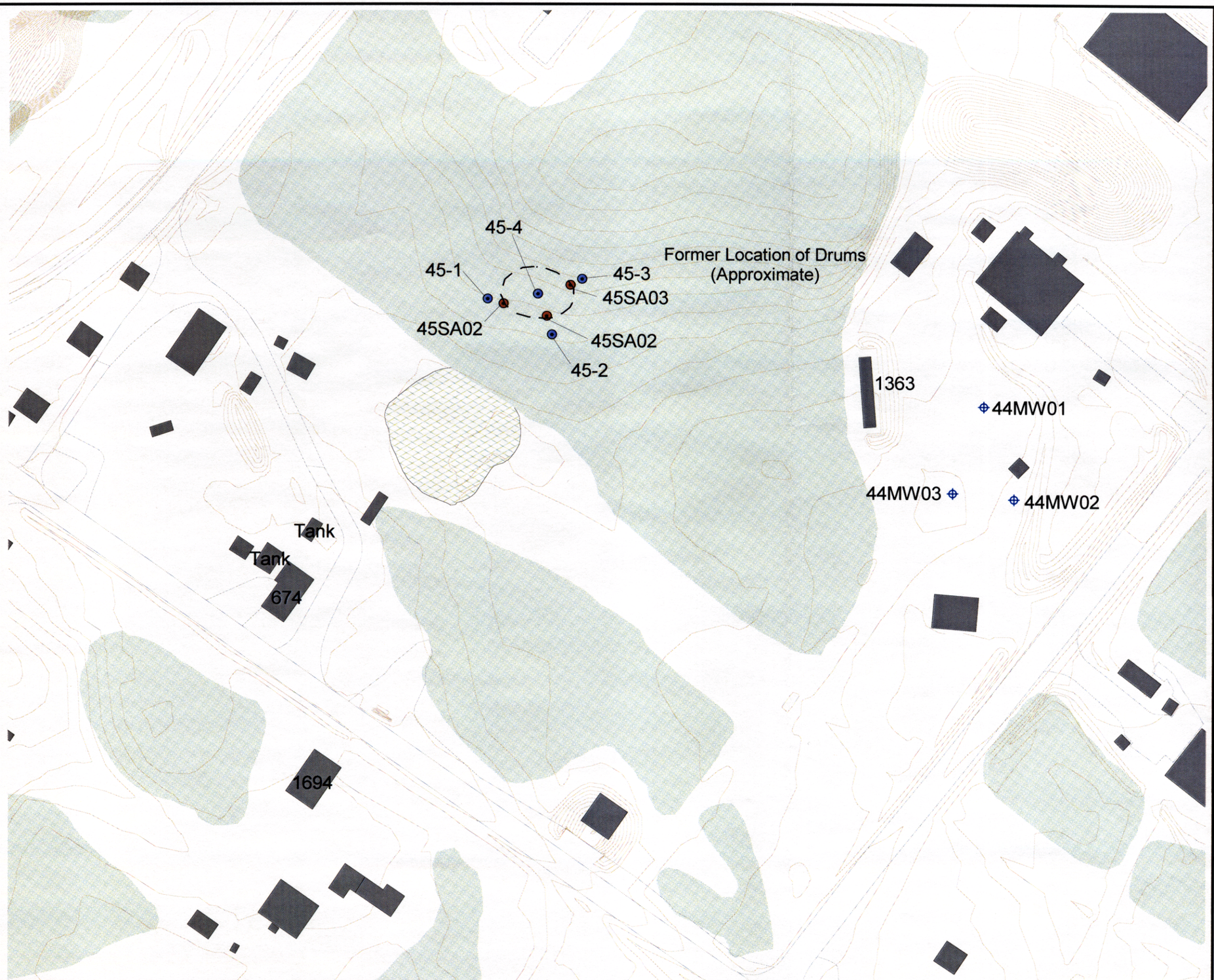

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Figure 5.1
Existing Conditions and Previous Sampling Locations, Site 45

U.S. Department of the Navy

legend

- Building/Structure
- Ground Elevation Contour (1ft.)
- Surface Water Drainage
- Forested Area
- Wetland
- Previous Surface Soil Sample
- Previous Soil-Gas Sample
- Existing Monitoring Well

N

75 0 75 150

SCALE IN FEET

Filename: X:\CHM003\Indianhead\Report\work_plan.apr
Project: CHM003-0403
Created: 11/13/00 TH
Revised: 02/13/01 jb
Source: CH2MHILL, HydroGeoLogic, Inc—GIS Database

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5.2 Previous Environmental Investigations

Following a 1992 supplemental PA, a Phase II SI was completed to determine if the surface soils had been contaminated as a result of placing the drums at the site. This limited study, performed in 1992, was documented in the 1994 Final SI Report for Phase II, included conducting a shallow soil-gas survey and collecting surface soil samples. The drums were present at the time of the investigation.

Three soil borings were made using a hand auger and were located along the downgradient side of the drum area, as presented in Figure 5.1. One soil sample was then collected from each boring from 0 to 1 foot bgs. Carbon disulfide and dimethylphenol were detected at estimated concentrations of 2.0 μg/kg and 66.0 μg/kg, respectively, and all detected metals were within natural background levels, with the exception of cadmium (1.2 and 1.6 mg/kg) and cobalt (26.8 mg/kg) (E/A&H, 1994). However, none of these concentrations exceeded the corresponding USEPA Region III RBC screening levels.

Four soil-gas samples were collected by a manually-driven probe and were located both in and surrounding the drum area: one boring upgradient of the drum area, two borings downgradient of the drum area, and one boring in the approximate center of the drum area, as presented in Figure 5.1. Low levels of total volatiles, xylene, and PCE vapors were detected by gas chromatograph/flame-ionization detector in all four soil-gas samples, suggesting that volatile constituents may be present in subsurface soils (E/A&H, 1994). However, none of these concentrations exceeded the corresponding USEPA Region III RBC screening levels.

Based on these results, the Final SI report recommended removing and disposing of all drums prior to any subsequent field activities and then performing additional subsurface soil sampling to better define the nature and extent of contamination at the site, as explained below:

- Subsurface Soil – Soil gas sampling did not indicate levels that warrant further investigation. No additional sampling was proposed.
- Surface Soil – Previous sampling conducted to evaluate surface soils did not exceed USEPA Region III RBC screening levels. However, two additional surface soil samples were proposed to be collected from within the wetland area to determine if Site 45 contaminants may have migrated offsite.
- Surface Water – Seasonal ponding periodically occurs within the nearby wetland area. As a further check on possible offsite contaminant migration from Site 45, one surface water sample was proposed to be collected from any ponded water found in the wetland.
- Shallow Groundwater – Because no shallow groundwater samples were collected in past investigations at the site, shallow groundwater sampling was proposed to determine if a human health or ecological risk exists at Site 45. Additionally, migration of shallow groundwater could impact offsite waters. Three shallow groundwater samples were proposed to be collected using direct push technology (DPT) borings and a peristaltic pump.

These recommendations have been reevaluated and revised and are presented in Section 5.5.

5.3 Human Health Risk Assessment

A human health risk assessment for Site 45 will be performed and summarized in the RI report. The risk assessment will be prepared in accordance with Section 3.0 of the Master WP (B&RE 1997). Analytical data collected as part of this RI, as well as historical data for the site, will be used to evaluate whether site contaminant concentrations pose a significant threat to human health. The remainder of this section of the Project-Specific Work plan focuses on the details associated with the Site 45 human health risk assessment, including the screening methods for determination of COPCs and the exposure scenarios to be evaluated.

Site 45 is in the wooded area west of Building 1363. Currently, there are no development plans for the site and surrounding area. However, Navy policy is to evaluate a hypothetical conservative scenario of future residential use. Therefore, the Region III soil RBCs for the resident and SSLs for transfer from soil to air will be used for screening soil levels at Site 45. The sediment data from the site will be screened against an RBC that is ten times the residential soil value. The Region III RBCs for tap water will be used to screen the shallow groundwater data and ten times the tap water RBC will be used to screen the surface water data. The constituents with maximum detected concentrations exceeding the screening value will be retained as COPCs and will be evaluated quantitatively in the risk assessment.

Potentially complete exposure pathways to be considered in the development of the human health risk assessment are provided in Table 3.2 of the Master WP (B&R E, 1997). Table 5.2 summarizes the potential receptors that will be evaluated in the human health risk assessment for Site 45. The trespasser adult/visitor and adolescent exposure pathway scenarios are included in the evaluation because the site is not enclosed by a fence. An adolescent trespasser is considered to be an individual between the ages of 6 and 16 years. Construction workers, who will be considered to be potential receptors for future land use, will be evaluated for exposure to surface/subsurface soil. Industrial workers are included in the evaluation because these types of individuals may be exposed to site media while performing maintenance activities or daily duties, both currently and in the future. The site is not anticipated to be used for residential purposes in the future, however, the future on-site resident is conservatively included in this evaluation for exposure to shallow groundwater and soil.

Table 5.2
Potential Exposure Pathways
Site 45
Indian Head, Maryland

Media	Exposure Route	Current			Future					
		Industrial Worker	Trespasser/Visitor		Onsite Resident		Construction Worker	Industrial Worker	Trespasser/Visitor	
			Adult	Adolescent	Adult	Child			Adult	Adolescent
Surface Soil										
	Ingestion	X	X	X						
	Dermal	X	X	X						
	Inhalation	X	X	X						
Surface Water										
	Ingestion									
	Dermal	X								
	Inhalation	X								
Sediment										
	Ingestion									
	Dermal	X								
	Inhalation	X								
Shallow Groundwater										
	Ingestion				X	X				
	Dermal				X	X	X			
	Inhalation				X	X	X			
Subsurface and Surface Soil Combined										
	Ingestion				X	X	X	X	X	X
	Dermal				X	X	X	X	X	X
	Inhalation				X	X	X	X	X	X

X Quantitative evaluation.

5.4 Ecological Risk Assessment – Screening Level Problem Formulation

The purpose of this section is to present a screening-level problem formulation for Site 45 (i.e., Step 1 of the 8-step ERA process). The document was prepared in accordance with the Navy-Tier II ERA approach for Region III, which is based on the process described in the USEPA guidance document *Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997) and Navy ERA guidance (CNO 1999).

5.4.1 Screening-Level Problem Formulation

Step 1 (screening-level problem formulation) involves: (1) compiling and reviewing existing data on the nature and extent of contamination and on the habitats and biota potentially present on the site; (2) developing a preliminary conceptual model that includes a qualitative evaluation of potential sources, fate and transport mechanisms, mechanisms of toxicity, potential receptors, and exposure pathways; and (3) developing preliminary assessment endpoints, measurement endpoints, and risk hypotheses.

The two major products of the screening-level problem formulation are the preliminary conceptual model and the preliminary endpoints/hypotheses. The preliminary conceptual model provides the basic framework for the screening ERA and will be revised, as appropriate, during any of the subsequent steps deemed necessary.

5.4.1.1 Environmental Setting

Habitats and Biota. Habitats within the vicinity of Site 45 include mixed hardwood and pine forest and a small freshwater wetland (approximately 80 ft in diameter) surrounded by grassy areas. The forested area likely supports many songbird species, and various mammals, such as gray squirrel, red fox, and white-tailed deer. The wetland area likely supports amphibians, reptiles, wetland-associated bird species, and semi-aquatic mammals, such as raccoons.

Surrounding Land Uses. The land surrounding Site 45 is heavily developed with military buildings and structures. The remaining land is primarily forest with pockets of development.

5.4.1.2 Summary of Available Analytical Data

Three surface soil samples were collected from the drum disposal area during a Phase II Site Inspection in 1992. The data from these samples will be used to evaluate potential risk to terrestrial ecological receptors from contaminants at the site. A few metals and VOCs at low concentrations were detected in these samples. Metals were near background levels. In general, ecological receptor exposure to these contaminants is expected to be minimal due to the low concentrations and limited spatial extent.

Surface runoff and/or shallow groundwater migration to the nearby wetland may have occurred. No analytical data for the surface water and sediment in the nearby wetland have been collected.

5.4.1.3 Toxicological Properties of Contaminants

Solvents are the suspected potential contaminants at Site 45. Solvents can be toxic through direct exposure when present at high concentrations, however they generally do not bioaccumulate. Therefore, risks to upper trophic level receptors are probably not a concern at this site. Additionally, solvents tend to evaporate quickly and thus may not be persistent at the site.

5.4.1.4 Preliminary Conceptual Model

Figure 5.2 illustrates the preliminary diagrammatic conceptual model for Site 45. Important components of the preliminary conceptual model are the identification of potential sources of contaminants, transport pathways, exposure media, potential exposure routes, and potential receptor groups. The potential source area is the former location of the drum disposal at Site 45.

Exposure Pathways. An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Based on the preliminary conceptual model for Site 45 (Figure 5-2), complete exposure pathways in terrestrial habitats exist to surface soils at the site. Animals that forage in the soil or near the surface of the soil, such as the short-tailed shrew, could potentially be exposed via this pathway.

Potentially complete transport pathways via surface runoff and groundwater link the drum disposal area (source) to the small wetland, based on topography and proximity. Thus, complete exposure pathways exist to the surface water and sediments in the wetland adjacent to Site 45. Animals that live or forage in the wetland, such as sediment invertebrates, could be potentially exposed via this pathway.

Complete exposure pathways also exist to upper trophic level receptors that may feed in the terrestrial and wetland habitats. However, solvents generally do no bioaccumulate, therefore exposure via this pathway is unlikely. However, if bioaccumulative chemicals are found in the wetland, than this pathway could be a source of exposure for upper trophic level animals that forage there, such as raccoon.

Dermal and inhalation exposures for upper trophic level receptor species are not considered in this ERA because of the general fate properties (e.g., relatively high adsorption to solids) of the chemicals commonly present on these sites and the protection offered by hair or feathers. Relative to ingestion, the contribution from the dermal and inhalation routes to total exposure is generally low. Incidental ingestion of soil/sediment during feeding, preening, or grooming activities is, however, considered in the risk estimates.

Endpoints and Risk Hypotheses. The conclusion of the screening-level problem formulation includes the selection of assessment and measurement endpoints (Table 5.3). These are chosen based on the preliminary conceptual model. Table 5.3 also identifies reasons for the assessment endpoint selection and the specific receptor species or groups that will be used to represent each assessment endpoint.

The focus of the investigation will be on the wetland adjacent to Site 45. The removal action undertaken in the upland and the available chemical data for soil suggest that there is no

ecological risk from chemicals in soils. However, this will be confirmed through the ERA process.

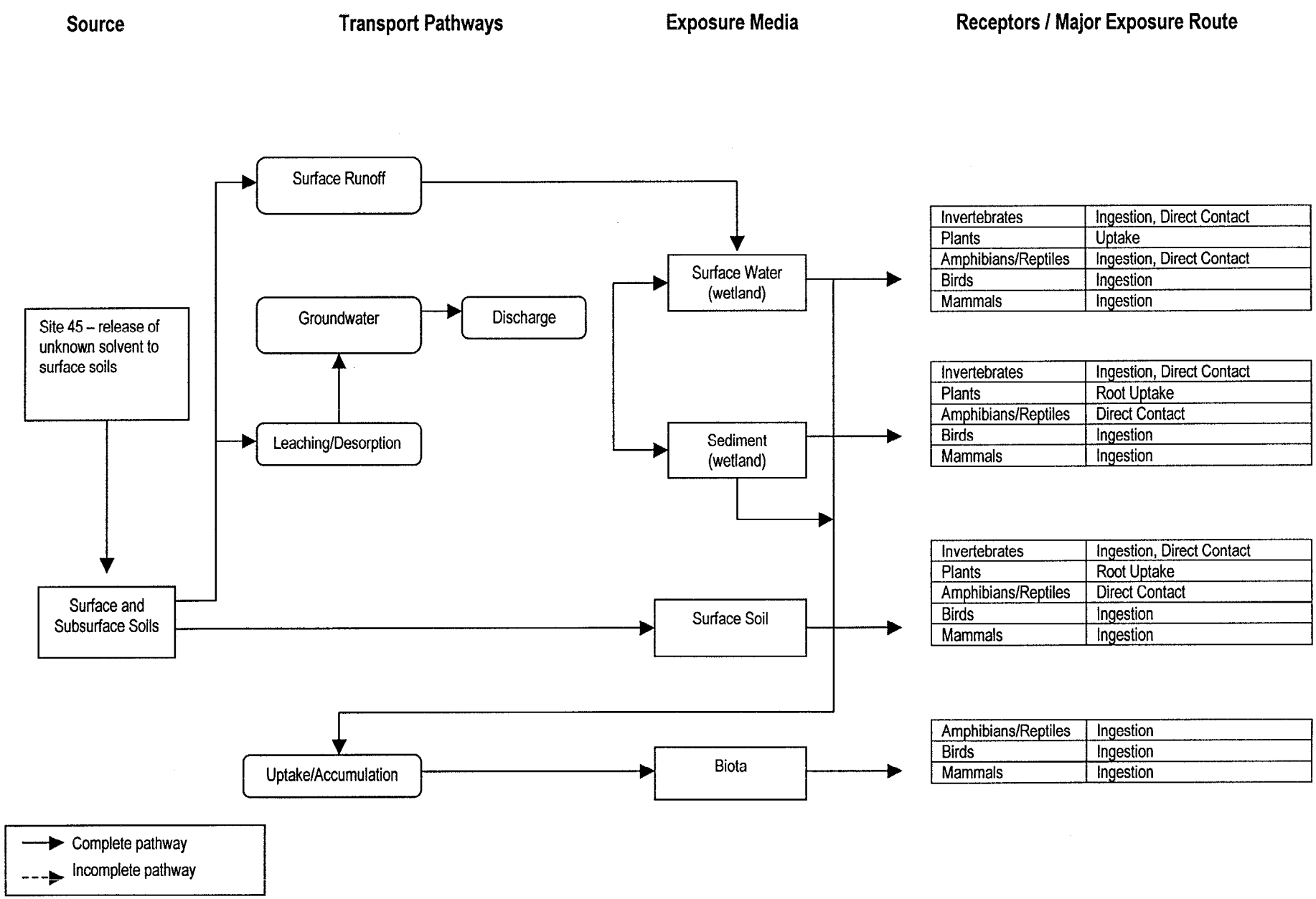


FIGURE 5.2 PRELIMINARY CONCEPTUAL MODEL
NSWC INDIAN HEAD – SITE 45

Table 5.3
Preliminary Assessment Endpoints, Risk Hypotheses, And Measurement Endpoints - Site 45
NSWC Indian Head, Maryland

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities.	Healthy, viable soil invertebrate communities are necessary for a well developed, balanced terrestrial ecosystem. The invertebrates provide important functions in nutrient recycling and availability and soil conditioning. By serving as prey species for many upper trophic predators (American robin), they are critical to the sustenance of the communities of upper trophic level species.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Soil Invertebrates (earthworms)
Survival, growth, and reproduction of terrestrial plant communities.	Plants are critical to the ecosystem in their role as primary producers. Plants take abiotic elements and energy and convert them into available organic compounds. They are the foundation of terrestrial ecosystems and are the first step in nutrient and energy transfer within an ecosystem. In addition to forage for herbivores, plants also often provide the physical structure in habitat necessary for animals.	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of avian terrestrial insectivores.	Avian terrestrial omnivores (e.g. American woodcock) are important consumers of both vegetation (seeds) and invertebrates (as well as other animals in some cases). They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such birds are prey for many species of mammals and raptors (hawks and owls). Many birds are also valued by society for their visual and vocal traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	American woodcock
Survival, growth, and reproduction of avian terrestrial carnivores.	Avian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal and bird populations versus forage abundance and available habitat. Many such birds are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red-tailed hawk

Table 5.3

Preliminary Assessment Endpoints, Risk Hypotheses, And Measurement Endpoints - Site 45

NSWC Indian Head, Maryland

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial insectivores.	Mammalian terrestrial insectivores are consumers of invertebrates. As such, they provide a critical second link in the transfer of energy and nutrients in an ecosystem, changing invertebrate biomass into more biologically available biomass for other animals. Such mammals are prey for many species of predatory mammals and raptors.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Short-tailed shrew
Survival, growth, and reproduction of mammalian terrestrial carnivores.	Mammalian carnivores are important upper trophic level consumers in terrestrial ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small mammal populations versus forage abundance and available habitat. Many such mammals are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum soil concentrations.	Red fox
Wetland and Aquatic Habitats			
Survival, growth, and reproduction of benthic invertebrate communities.	Healthy, viable sediment invertebrate communities are necessary for a well developed, balanced aquatic ecosystem. The invertebrates provide important functions in nutrient recycling and availability and sediment conditioning. By serving as prey species for many upper trophic predators, they are critical to the sustenance of the communities of upper trophic level species.	Comparison of maximum chemical concentrations in surface water and/or sediment with medium-specific screening values.	Benthic invertebrates
Survival, growth, and reproduction of aquatic and wetland plant communities.	Plants are critical to the ecosystem in their role as primary producers. Plants take abiotic elements and energy and convert them into available organic compounds. They are part of the foundation of aquatic ecosystems. In addition to forage for herbivores, plants also often provide the physical structure in habitat necessary for aquatic animals.	Comparison of maximum chemical concentrations in surface water and/or sediment with medium-specific screening values.	Aquatic/wetland plants
Survival, growth, and reproduction of amphibians/reptile communities.	Amphibian and reptiles are consumers of vegetation and invertebrates. As such, they provide a critical second link in the transfer of energy and nutrients in an ecosystem, changing plant compounds and invertebrate biomass into more biologically available compounds for other animals. They are also sensitive to many contaminants, and thus good indicators of ecosystem health. Amphibians and reptiles are prey for many predatory birds and mammals.	Comparison of maximum chemical concentrations in surface water and/or soil with medium-specific screening values.	Amphibians/Reptiles

Table 5.3
Preliminary Assessment Endpoints, Risk Hypotheses, And Measurement Endpoints - Site 45
NSWC Indian Head, Maryland

Assessment Endpoint	Basis For Assessment Endpoint	Measurement Endpoint	Receptor
Survival, growth, and reproduction of avian aquatic/wetland insectivores.	Avian wetland omnivores are important consumers of both vegetation (seeds) and invertebrates (as well as other animals in some cases). They often play an important role in the colonization of areas by plants through spreading seed in their feces. Such birds are prey for many species of mammals and raptors (hawks and owls). Many birds are also valued by society for their visual and vocal traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface water and/or sediment concentrations.	Marsh wren
Survival, growth, and reproduction of mammalian aquatic/wetland omnivores.	Mammalian omnivores are important upper trophic level consumers in wetland/aquatic ecosystems. In this function, they are often reflective of ecosystem health, and are particularly susceptible to toxin that bioaccumulate in the food chain. In their function as a predator, they serve to maintain a balance in small aquatic animal populations versus forage abundance and available habitat. Many such mammals are also valued by society for their visual traits.	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface water and/or sediment concentrations.	Raccoon

5.5 Work Plan

The objectives of the remedial investigation at Site 45 are to determine whether the drums and/or their contents contaminated the surface soil, subsurface soil, surface water, sediment and/or shallow groundwater in the surrounding area. The proposed sampling is targeted to address this goal by assessing the potential contamination under the former location of the rusted drums. Surface soil, subsurface soil, surface water, sediment and shallow groundwater grab samples will be collected. The installation and sampling of monitoring wells at Site 45 will be examined in Phase 2 only if evidence of contamination is found in the soils and shallow groundwater.

Collected samples will be analyzed for a full suite of analytes: TCL VOCs, TCL SVOCs, TAL metals, explosives (including nitroguanidine, PETN, NG, and nitrocellulose), and ammonium perchlorate. In addition, to provide data for the ecological risk assessment, surface soil will be analyzed for grain size analysis, TOC, and pH, and surface water and shallow groundwater samples will be analyzed for dissolved metals (filtered), pH and hardness. Field measurements of water temperature, pH, conductivity, DO and salinity will also be collected at each surface water and shallow groundwater sampling location. All samples will be submitted for analysis with a standard 28-day TAT.

Background samples will be collected in areas that are upgradient of the site and not expected to be affected by any potential contamination originating at Site 45. These background samples will be used as reference for comparison of analytical results from site samples.

The proposed sampling techniques and analysis for the field investigation are summarized on Table 5.4. Table 5.5 reviews the sampling program for Site 45, and Table 5.6 provides sample bottleware, preservation, and holding time requirements. Proposed sampling locations are presented in Figure 5.3. A breakdown of the sampling by media is given below:

- *Surface Soil*: Four surface soil samples will be collected at the DPT boring locations. The samples will be collected prior to advancing the DPT for subsurface samples. Surface soils will be collected from 0 to 6 inches bgs using hand tools. These samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, ammonium perchlorate, explosives (including nitroguanidine, PETN, NG, and nitrocellulose), grain size analysis, TOC and pH.
- *Subsurface Soil*: Four subsurface soil samples will be collected from the DPT borings. Continuous split spoons will be collected from each boring and the soil screened with a photoionization detector (PID) meter. Soil samples will be collected from the interval with the highest PID reading. If no organic vapors are detected with the PID meter at any interval, then soil samples will be collected just above the water table. These samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, ammonium perchlorate, and explosives (including nitroguanidine, PETN, NG, and nitrocellulose).
- *Shallow Groundwater*: Four shallow groundwater grab samples will be collected from the DPT borings with a peristaltic pump. One of the DPT borings will be located in the area of the former drums, one will be located downgradient of the source area, one will be

located upgradient of the potential source area and one will be located southwest of the source area, between the source area and the wetland area. Shallow groundwater grab samples will be analyzed for TCL VOCs, TCL SVOCs, total TAL metals (unfiltered), ammonium perchlorate, explosives (including nitroguanidine, PETN, NG, and nitrocellulose), dissolved metals (filtered), pH and hardness. Field measurements of water temperature, pH, conductivity, DO, and salinity will also be collected at each sample location. If the shallow groundwater is turbid then two 0.45 micron filters in-line, to prevent filter break-thru, will be used to collect the dissolved metals samples.

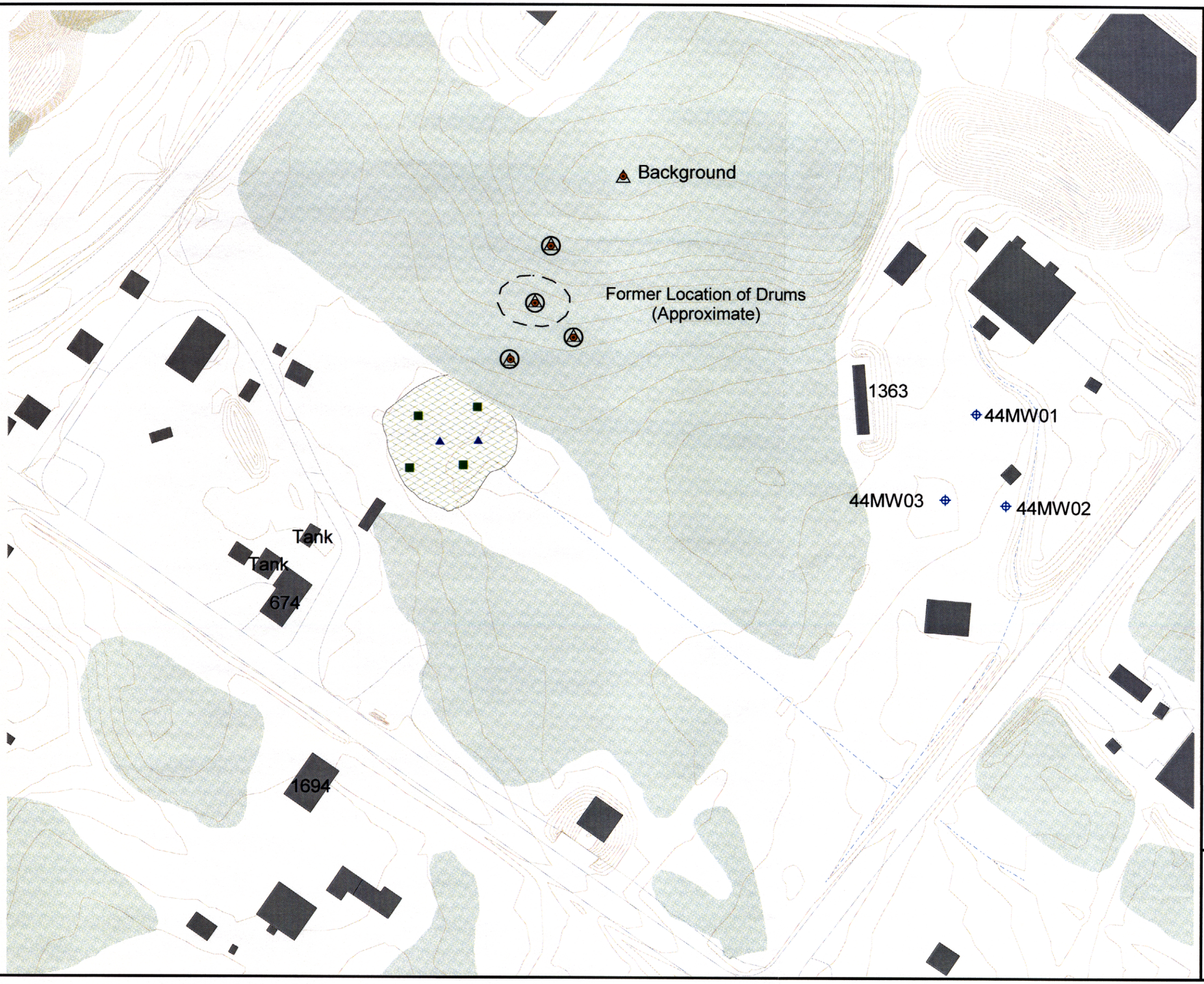
- If the results of the above analyses indicate shallow groundwater contaminant concentrations above the appropriate screening levels, then one monitoring well will be installed adjacent to each of the four DPT borings in Phase 2 of the field work to further investigate the nature and spatial extent of the contamination. If the results of the above analyses indicate shallow groundwater concentrations below the appropriate screening levels, then no further action will be recommended.

- *Surface Water*: Two surface water sample will be collected from wetland area adjacent to the drum disposal area. All surface water samples will be analyzed for TCL VOCs, TCL SVOCs, total TAL metals (unfiltered), ammonium perchlorate, explosives (including nitroguanidine, PETN, NG, and nitrocellulose), dissolved metals (filtered), pH and hardness. Field measurements of water temperature, pH, conductivity, DO, and salinity will also be collected at each sample location.

- *Sediment*: Four sediment samples will be collected in the wetland area adjacent to the drum disposal area to investigate potential surface migration of contaminants offsite. Sediment will be collected from 0 to 6 inches bgs. All sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, ammonium perchlorate, explosives (including nitroguanidine, PETN, NG, and nitrocellulose) grain size analysis, TOC and pH.

- *Background:* One surface soil and one subsurface soil background sample will be collected from a location upgradient of the site. Surface soils will be collected from 0 to 6 inches bgs using hand tools. Subsurface soil will be collected from 30 to 36 inches bgs using a hand auger. These samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, ammonium perchlorate, and explosives (including nitroguanidine, PETN, NG, and nitrocellulose). The surface soil sample will also be analyzed for grain size analysis, TOC and pH.

- If the results of the DPT sample analyses indicate shallow groundwater contaminant concentrations above the appropriate screening levels, then one monitoring well will be installed adjacent the one background DPT boring in Phase 2 of the field work.



HydroGeoLogic, Inc.—RI Work Plan for Sites 6, 39, and 45
NSWC - Indian Head Division, Indian Head, Maryland

Figure 5.3
Proposed Sampling Locations,
Site 45

U.S. Department of the Navy

Legend

- Building/Structure
- Ground Elevation Contour (1ft.)
- Surface Water Drainage
- Forested Area
- Wetland
- Surface Soil Sample [1]
- Subsurface Soil Sample
- Sediment Sample
- Surface Water Sample
- Shallow Groundwater Grab Sample
- Existing Monitoring Well

1 - Phase 2 Monitoring Well, Groundwater Sample Potential Location

N

75 0 75 150

SCALE IN FEET

Filename: X:\CHM003\Indianhead\Report\work_plan.apr
Project: CHM003-0403
Created: 11/13/00 TH
Revised: 02/14/01 jb
Source: CH2MHILL, HydroGeoLogic, Inc—GIS Database

HYDRO GeoLogic INC.

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Table 5.4
Site Specific Work Plan
Site 45
Indian Head, Maryland

Media	Objective	Investigative Technique	Locations	Number of Samples	Analysis
Phase I					
Surface Soil	Determine the nature and extent of contamination in the surface soils at Site 45.	Collect four surface soil samples 0"-6" bgs with hand trowel.	See Figure 5.3	4	TCL VOCs, TCL SVOCs, TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis, TOC, pH
Subsurface Soil	Determine the nature and extent of contamination in the subsurface soils at Site 45.	Collect four subsurface soil samples using DPT borings.	Collect samples at the same locations as the surface soil samples. See Figure 5.3	4	TCL VOCs, TCL SVOCs, TAL Metals, Ammonium Perchlorate, Explosives*
Shallow Groundwater	Determine the nature and extent of contamination in the shallow groundwater at Site 45.	Collect four grab shallow groundwater samples from DPT borings. If unable to reach shallow groundwater using this technique, then conventional drilling techniques will be employed.	See Figure 5.3	4	TCL VOCs, TCL SVOCs, TAL Metals, Ammonium Perchlorate, Explosives*, Dissolved Metals (filtered), Hardness, pH
Sediment	Investigate potential surface migration of contaminants offsite.	Collect four sediment samples within the wetland boundaries.	See Figure 5.3, and refine according to field evaluation.	4	TCL VOCs, TCL SVOCs, TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis, TOC, pH
Surface Water	Investigate potential surface migration of contaminants offsite.	Collect a maximum of two surface water sample within the wetland boundaries.	Determined in the field.	2	TCL VOCs, TCL SVOCs, total TAL Metals (unfiltered), Ammonium Perchlorate, Explosives*, Dissolved Metals (filtered), Hardness, pH
Background	Determine background values for screening of site data.	Collect one background surface soil sample 0"-6" bgs with hand trowel. Collect one background subsurface soil sample 30"- 36" bgs with hand auger.	Location upgradient of site, see Figure 5.3.	2	TCL VOCs, TCL SVOCs, TAL Metals, Ammonium Perchlorate, Explosives*, Grain Size Analysis**, TOC**, pH**
Phase II					
Shallow Groundwater	Further investigate potential contamination in shallow groundwater.	Drill and construct monitoring wells. Sample wells with pump or bailer.	Install one monitoring well adjacent to each DPT boring	5	TCL VOCs, TCL SVOCs, total TAL Metals (unfiltered), Ammonium Perchlorate, Explosives*, Dissolved Metals (filtered), Hardness, pH

'Notes

* = Including PETN, nitroguanidine, NG and nitrocellulose.

**=Analysis only applies to surface soil samples.

Table 5.5
SUMMARY OF SAMPLING PROGRAM FOR SITE 45
NSWC INDIAN HEAD, MARYLAND

Sample Media	Sample ID Number		Purpose	Sample Depth/Location	Analysis								
	From	To			VOCs	SVOCs	Metals	Explosives	Grain Size (sieve)	TOC	Dissolved Metals (filtered)	Hardness	pH
Phase I													
Surface Soil	IS45SS01	IS45SS04	Site Sample	0"-6" / Collect surface soil samples in and around the former drum location. See Figure 5.3	•	•	•	•	•	•			•
	IS45SS05		Background	0"-6" / Collect background surface soil sample upgradient of Site45. See Figure 5.3	•	•	•	•	•	•			•
Subsurface Soil	IS45SB01	IS45SB04	Site Sample	Collect subsurface soil samples in and around the former drum location, at the same locations as the surface soil samples. See Figure 5.3	•	•	•	•					•
	IS45SB05		Background	30"-36" / Collect background subsurface soil sample upgradient of Site 45, at the same location as the background surface soil sample. See Figure 5.3	•	•	•	•					•
Shallow Groundwater	IS45GW01*MMYY*	IS45GW04*MMYY*	Site Sample	Same locations as the surface and subsurface samples, (See Figure 5.3).	•	•	•	•			•	•	•
Sediment	IS45SD01	IS45SD04	Site Sample	0"-6" / Collect surface soil samples in the wetland area, see Figure 5.3.	•	•	•	•	•	•			•
Surface Water	IS45SW01	IS45SW02	Site Sample	Collect surface water samples in the wetland area, see Figure 5.3.	•	•	•	•			•	•	•
Phase II													
Shallow Groundwater[1]	IS45MW05*MMYY*	IS45MW08*MMYY*	Site Sample	Located adjacent to the DPT boring locations.	•	•	•	•			•	•	•
	IS45MW09*MMYY*		Background	Located upgradient of Site 45.	•	•	•	•			•	•	•

Notes: [1] = Part of a Phase 2 investigation if contamination is found in the subsurface soil.

Table 5.6

Bottleware, Preservation and Holding Time Requirements for Site 45

NSWC Indian Head, Maryland

Media	Analysis	Total Number Of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
Shallow Groundwater	TCL VOCs – CLP OLM03.0	9	1	40 ml glass	HCL pH <2, Cool to 4^0C	14 days to analysis
	TCL SemiVOCs – CLP OLM03.0	9	1	1L amber glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Total TAL Metals (unfiltered) – CLP ILM04.0	9	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	9	1	1L amber glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Ammonium Perchlorate	9	1	250 ml Plastic bottle	Cool to 4^0C	14 days to analysis
	Hardness - EPA Method 130.1	9	1	250ml glass bottle	HNO_3 pH <2	6 months
	Dissolved Metals (filtered) - CLP	9	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	pH - Field analysis	9	1	40 ml vial	None	Analyzed immediately
Surface Soil	TCL VOCs – CLP OLM03.0	5	1	250 ml CWM glass	Cool to 4^0C	14 days to analysis
	TCL SemiVOCs – CLP OLM03.0	5	1	250 ml CWM glass	Cool to 4^0C	14 days to extract; 40 days to analysis
	TAL Metals – CLP ILM04.0	5	1	250 ml CWM glass	Cool to 4^0C	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	5	1	250 ml CWM glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Ammonium Perchlorate	5	1	4 oz. Glass	Cool to 4^0C	14 days to analysis
	Total Organic Carbon and pH - EPA Method 415.1, SW-846-9045	5	1	8 oz. plastic or glass	Cool to 4^0C	28 days to analysis
	Grain Size Analysis ASTM D-422 # 200 Sieve	5	1	8 oz. glass	None	6 months
Subsurface Soil	TCL VOCs – CLP OLM03.0	5	1	250 ml CWM glass	Cool to 4^0C	14 days to analysis

Table 5.6
Bottleware, Preservation and Holding Time Requirements for Site 45
NSWC Indian Head, Maryland

Media	Analysis	Total Number Of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
Subsurface Soil	TCL SemiVOCs – CLP OLM03.0	5	1	250 ml CWM glass	Cool to 4^0C	14 days to extract; 40 days to analysis
	TAL Metals – CLP ILM04.0	5	1	250 ml CWM glass	Cool to 4^0C	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	5	1	250 ml CWM glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Ammonium Perchlorate	5	1	4 oz. Glass	Cool to 4^0C	14 days to analysis
Sediment	TCL VOCs – CLP OLM03.0	4	1	250 ml CWM glass	Cool to 4^0C	14 days to analysis
	TCL SemiVOCs – CLP OLM03.0	4	1	250 ml CWM glass	Cool to 4^0C	14 days to extract; 40 days to analysis
	TAL Metals – CLP ILM04.0	4	1	250 ml CWM glass	Cool to 4^0C	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	4	1	250 ml CWM glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Total Organic Carbon and pH - EPA Method 415.1, SW-846-9045	4	1	8 oz. plastic or glass	Cool to 4^0C	28 days to analysis
	Grain Size Analysis ASTM D-422 # 200 Sieve	4	1	8 oz. glass	None	6 months
	Ammonium Perchlorate	4	1	4 oz. Glass	Cool to 4^0C	14 days to analysis
Surface Water	TCL VOCs – CLP OLM03.0	2	2	40 ml glass	HCL pH <2, Cool to 4^0C	14 days to analysis
	TCL SemiVOCs – CLP OLM03.0	2	1	1L amber glass	Cool to 4^0C	7 days to extract; 40 days to analysis
	Total TAL Metals (unfiltered) – CLP ILM04.0	2	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	Explosives – Modified SW-846-8330*	2	1	1L amber glass	Cool to 4^0C	7 days to extract; 40 days to analysis

Table 5.6

Bottleware, Preservation and Holding Time Requirements for Site 45

NSWC Indian Head, Maryland

Media	Analysis	Total Number Of Samples	Number of Containers Per Sample	Container Type	Preservation	Holding Times
	Ammonium Perchlorate	2	1	250 ml Plastic bottle	Cool to 4^0C	14 days to analysis
	Hardness - EPA Method 130.1	2	1	250ml glass bottle	HNO_3 pH <2	6 months
	Dissolved Metals (filtered) - CLP	2	1	1L plastic	HNO_3 pH <2	6 months; Hg 28 days
	PH - Field analysis	2	1	40 ml vial	None	Analyzed immediately
CWM – Clear Wide Mouth						

* - Includes analysis for nitrate esters (PETN, nitroglycerin, nitrocellulose, nitroguanidine) in Modified SW-846-8330.

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Appendix A
Lists of Fauna Observed at NSWC Indian Head Division

Reptilian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Northern copperhead	*Agkistrodon contortrix*
Eastern worm snake	*Carphophis amoenus*
Snapping turtle	*Chelydra serpentina*
Eastern painted turtle	*Chrysemys picta*
Spotted turtle	*Clemmys guttata*
Black racer	*Coluber constrictor*
Ringneck snake	*Diadophis punctatus*
Black rat snake	*Elaphe obsoleta*
Five-lined skink	*Eumeces fasciatus*
Eastern hognose snake	*Heterodon platirhinos*
Eastern mud turtle	*Kinosternon subrubrum*
Eastern king snake	*Lampropeltis getula*
Northern water snake	*Nerodia sipedon*
Rough green snake	*Opheodrys aestivus*
Redbelly turtle	*Pseudemys rubiventris*
Queen snake	*Regina septemvittata*
Eastern fence lizard	*Sceloporus undulatus*
Ground skink	*Scincella lateralis*
Northern brown snake	*Storeria dekayi*
Eastern box turtle	*Terrapene caronlina*
Eastern ribbon snake	*Thamnophis sauritus*
Eastern garter snake	*Thamnophis sirtalis*
Six-lined racerunner	*Cnemidophorus sexlineatus sexlineatus*

Source: MDNR 1992; Parsons 2000.

Amphibian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Northern cricket frog	*Acris crepitans crepitans*
Southern cricket frog	*Acris gryllus*
Spotted salamander	*Ambystoma maculatum*
Marbled salamander	*Ambystoma opacum*
American toad	*Bufo americanus*
Fowler's toad	*Bufo woodhousii fowleri*
Northern dusky salamander	*Desmognathus fuscus fuscus*
Northern two-lined salamander	*Eurycea bislineata*
Four-toed salamander	*Hemidactylium scutatum*
Gray treefrog	*Hyla chrysoscelis*
Green treefrog	*Hyla cinerea*
Gray treefrog	*Hyla versicolor*
Red-backed salamander	*Plethodon cinereus*
Northern spring peeper	*Pseaudacris crucifer crucifer*
Spring peeper	*Pseudacris crucifer*
Upland chorus frog	*Pseudacris triserata feriarum*
Northern red salamander	*Pseudotriton ruber ruber*
Bullfrog	*Rana catesbeiana*
Green frog	*Rana clamitans*
Pickerel frog	*Rana palustris*
Wood frog	*Rana sylvatica*
Southern leopard frog	*Rana utricularia*

Source: MDNR 1992; Parsons 2000.

Avian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Red-winged blackbird	*Agelaius phoeniceus*
Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
American black duck	*Anas rubripes*
Gadwall	*Anas Strepera*
Ruby-throated hummingbird	*Archilochus colubris*
Great blue heron	*Ardea herodias*
Scaup	*Aythya sp.*
Ringed-necked duck	*Aythya collaris*
Canvasback	*Aythya valisineria*
Cedar waxwing	*Bombycilla cedrorum*
Canada goose	*Branta canadensis*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Red-tailed hawk	*Buteo jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Green-backed heron	*Butorides striatus*
Common snipe	*Capella gallinago*
Whip-poor will	*Caprimulgus vociferus*
Great egret	*Casmerodius albus*
Northern cardinal	*Cardinalis cardinalis*
American goldfinch	*Carduelis tristis*
House finch	*Carpodacus mexicanus*
Turkey vulture	*Cathartes aura*
Brown creeper	*Certhia familiaris*
Belted kingfisher	*Ceryle alcyon*
Chimney swift	*Chaetura pelagica*
Killdeer	*Charadrius vociferus*

Avian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Yellow-billed cuckoo	*Coccyzus americanus*
Common flicker	*Colaptes auratus*
Northern flicker	*Colaptes auratus*
Bobwhite quail	*Colinus virginianus*
Eastern wood peewee	*Contopus virens*
Carolina parakeet	*Conuropsis carolinensis*
American crow	*Corvus brachyrhynchos*
Fish crow	*Corvus ossifragus*
Bluejay	*Cyanocitta cristata*
Tundra swan	*Cygnus columbianus*
Yellow-rumped warbler	*Dendroica caronata*
Prairie warbler	*Dendroica discolor*
Yellow-throated warbler	*Dendroica dominica*
Yellow warbler	*Dendroica pinus*
Pileated woodpecker	*Dryocopus pileatus*
Gray catbird	*Dumetella carolinensis*
Acadian flycatcher	*Empidonax virenscens*
American kestrel	*Falco sparverius*
American Coot	*Fulica americana*
Common loon	*Gavia immer*
Common yellowthroat	*Geothlypis trichas*
Blue grosbeak	*Guiraca caerulea*
Bald eagle	*Haliaeetus leucocephalus*
Worm-eating warbler	*Helmitheros vermivorus*
Barn swallow	*Hirundo rustica*
Wood thrush	*Hylocichla mustelina*
Yellow-breasted chat	*Icteria virens*
Northern oriole	*Icterus galbula*
Orchard oriole	*Icterus spurius*
Tree swallow	*Iridoprocne bicolor*
Laughing gull	*Larus atricilla*
Herring gull	*Larus californicus*
Ring-billed gull	*Larus delawarenis*

Avian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Red-bellied woodpecker	*Melanerpes carolinus*
Wild turkey	*Meleagris gallopavo*
Song sparrow	*Melospiza melodia*
Common merganser	*Mergus merganser*
Hooded merganser	*Lophodytes cucullatus*
Mockingbird	*Mimus polyglotis*
Brown-headed cowbird	*Molothrus ater*
Great crested flycatcher	*Myiarchus crinitus*
Whistling swan	*Olor columbianus*
Kentucky warbler	*Oporonis formosus*
Ruddy duck	*Oxyura jamaicensis*
Osprey	*Pandion haliaetus*
Northern parula	*Parula americana*
Tufted titmouse	*Parus bicolor*
Carolina chickadee	*Parus carolinensis*
House sparrow	*Passer domesticus*
Indigo bunting	*Passerina cyanea*
Great cormorant	*Phalacrocorax carbo*
Double-crested cormorant	*Phalacrocorax auritus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Rufous-sided towhee	*Pililo erythrophthalmus*
Scarlet tanager	*Piranga olivacea*
Summer tanager	*Piranga rubra*
Horned grebe	*Podiceps auritus*
Pied-billed grebe	*Podilymbus podiceps*
Blue-gray gnatcatcher	*Polioptila caerulea*
Purple martin	*Progne subis*
Prothonotary warbler	*Protonotaria citrea*
Common grackle	*Quiscalus quiscula*
Ruby-crowned kinglet	*Regulus calendula*
Bank swallow	*Riparia riparia*
Eastern phoebe	*Sayornis phoebe*

Avian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Ovenbird	*Seiurus aurocapillus*
Louisiana waterthrush	*Seiurus motacilla*
Eastern bluebird	*Sialia sialis*
White breasted nuthatch	*Sitta caronlinensis*
Chipping sparrow	*Spizella passerina*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Least tern	*Sterna antillarum*
Barred owl	*Strix varia*
Eastern meadowlark	*Sturenlla magna*
European starling	*Sturnus vulgaris*
Carolina wren	*Thryothorus ludovicianus*
Brown thrasher	*Toxostoma rufum*
American robin	*Turdus migratorius*
Eastern kingbird	*Tyrannus tyrannus*
Yellow-throated vireo	*Vireo flavifrons*
White-eyed vireo	*Vireo griseus*
Red-eyed vireo	*Vireo olivaceus*
Hooded warbler	*Wilsonia citrina*
Mourning dove	*Zenaida macroura*
White-throated sparrow	*Zonotrichia albicollis*

Source: MDNR 1992; Parsons 2000.

Mammalian Species Observed at NSWC Indian Head Division

Common Name	Scientific Name
Short-tailed shrew	*Blarina brevicauda*
Beaver	*Castor canadensis*
Star-nosed mole	*Condylura cristata*
Least shrew	*Cryptotis parva*
Opossum	*Didelphis virginiana*
Southern flying squirrel	*Glaucomys volans*
Silver-haired bat	*Lasionycteris noctivagans*
Bobcat	*Lynx rufus*
Woodchuck	*Marmota monax*
Striped skunk	*Mephitis mephitis*
Meadow vole	*Microtus pennsylvanicus*
Pine vole	*Microtus pinetorum*
House mouse	*Mus musculus*
Little brown bat	*Myotis lucifugus*
White-tailed deer	*Odocoileus virginianus*
Muskrat	*Ondatra zibethicus*
White-footed mouse	*Peromyscus leucopus*
Eastern pipistrelle	*Pipistrelle subflavus*
Raccoon	*Procyon lotor*
Norway rat	*Rattus norvegicus*
Eastern mole	*Scalopus aquaticus*
Gray squirrel	*Scirus carolinensis*
Southeastern shrew	*Sorex longirostris*
Eastern cottontail	*Sylvilagus floridanus*
Eastern chipmunk	*Tamias striatus*
Gray fox	*Urocyon cinereoargenteus*
Red fox	*Vulpes vulpes*
Meadow jumping mouse	*Zapus hudsonius*

Source: MDNR 1992; Parsons 2000.

Appendix B

Animals Sighted at the Naval Surface Warfare Center, Indian Head Division, During the 1991-1992 Rare Species Survey

Odonates Recorded from 23 May – 19 September 1992 at the Stump Neck Annex

Family	Scientific Name	Common Name*
Damselflies		
Calopterygidae – Broad-winged Damselflies		
	Calopteryx maculata	Ebony Jewelwing
Lestidae – Spreadwings		
	Lestes inequalis	Elegant Spreadwing
	Lestes rectangularis	Slender Spreadwing
	Lestes vigilax	Swamp Spreadwing
Coenagrionidae – Pond Damsels		
	Ischnura posita	Fragile Forktail
	Ischnura verticalis	Eastern Forktail
	Amphiagrion saucium	Eastern Red Damsel
	Argia fumipennis	Variable Dancer
	Argia bipunctulata	Seepage Dancer
	Chromagrion conditum	Variegated Damselfly
	Enallagma civile	Familiar Bluet
	Enallagma durum	Big Bluet
	Enallagma basidens	Double-striped Bluet
	Enallagma divagans	Turquoise Bluet
	Enallagma signatum	Orange Bluet
Dragonflies		
Aeshnidae – Darners		
	Aeshna umbrosa	Shadow Darner
	Anax junius	Common Green Darner
	Epiaeschna heros	Swamp Darner
	Nasiaeschna pentacantha	Cyrano Darner
Gomphidae – Clubtails		
	Gomphus exilis	Lancet Clubtail
Cordulegastridae – Spiketails		
	Cordulegaster bilineata	Brown Spiketail
Macromiidae – Cruisers		
	Didymops transyersa	Stream Cruiser
Cordulidae – Emeralds		
	Epitheca princeps	Prince Baskettail

Odonates Recorded from 23 May – 19 September 1992 at the Stump Neck Annex

Family	Scientific Name	Common Name*
	Epitheca cynosura	Common Baskettail
	Somatochlora linearis	Mocha Emerald
	Somatochlora filosa	Five-lined Emerald
	Somatochlora provocans	Treetop Emerald
	Somatochlora tenebrosa	Clamp-tipped Emerald
Libellulidae – Skimmers		
	Libellula lydia	Common Whitetail
	Libellula semifasciata	Painted Skimmer
	Libellula deplanata	Blue Corporal
	Libellula needhami	Needham's Skimmer
	Lebellula vibrans	Great Blue Skimmer
	Libellula incesta	Slaty Skimmer
	Libellula cyanea	Black-faced Skimmer
	Libellula flavida	Yellow-sided Skimmer
	Libellula luctuosa	Pied Skimmer
	Perithemis tenera	Amberwings
	Pachydiplax longipennis	Blue Dasher
	Erythemis simplicicollis	Eastern Pondhawk
	Pantala hymenea	Spot-winged Glider

*Sources used for taxonomic and common name standards: Dunkle 1989, Dunkle 1990, and Carpenter 1991.

Butterflies Recorded from 25 April – 15 October 1992 at the Stump Neck Annex

Family	Scientific Name	Common Name*
Papilionidae – Swallowtails		
	Eurytides marcellus	Zebra Swallowtail
	Papilio glaucus	Tiger Swallowtail
	Papilio troilus	Spicebush Swallowtail
Pieridae – Whites and Sulphurs		
	Anthocharis midea	Falcate Orange Tip
	Colias philodice	Clouded Sulphur
	Colias eurytheme	Alfalfa Butterfly
	Eurema nicippe	Sleepy Orange
	Phoebis sennae	Cloudless Sulphur
	Pieris rapae	Cabbage Butterfly
Lycaenidae – Harvesters, Coppers, Hairstreaks, and Blues		
	Feniseca tarquinius	Harvester
	Incisalia irus	Frosted Elfin
	Calycopis cecrops	Red-banded Hairstreak
	Strymon melinus	Gray Hairstreak
	Everes comyntas	Eastern Tailed Blue
	Celastrina argiolus	Spring Azure
Nymphalidae – Brushfoots		
	Libytheana carinenta	American Snout
	Euptoieta claudia	Variegated Fritillary
	Speyeria cybele	Great Spangled Fritillary
	Phyciodes tharos	Pearl Cresent
	Polygonia interrogationis	Question Mark
	Polygonia comma	Hop Merchant
	Vanessa atalanta	Red Admiral
	Vanessa virginiensis	American Painted Lady
	Vanessa cardui	Painted Lady
	Limenitis arthemis	Red-spotted Purple
	Satyrodes appalachia	Appalachian Eyed Brown
	Hermeuptychia sosybius	Carolina Satyr
	Megisto cymela	Little Wood Satyr
	Cercyonis pegala	Common Wood Nymph
	Danaus plexippus	Monarch

Butterflies Recorded from 25 April – 15 October 1992 at the Stump Neck Annex

Family	Scientific Name	Common Name*
Hesperiidae – Skippers		
	Epargyreus clarus	Silver-spotted Skipper
	Staphylus hayhurstii	Scalloped Sooty Wing
	Erynnis icelus	Dreamy Dusky Wing
	Erynnis juvenalis	Juvenal's Dusky Wing
	Erynnis horatius	Horace's Dusky Wing
	Nastra lherminier	Swarthy Skipper
	Ancyloxypha numitor	Least Skipper
	Polites peckius	Peck's Skipper
	Polites themistocles	Tawny-edged Skipper
	Polites origenes	Crossline Skipper
	Wallengrenia otho	Broken Dash
	Wallengrenia egeremet	Northern Broken Dash
	Pompeius verna	Little Glassy Wing
	Atalopedes campestris	Sachem
	Poanes zabulon	Zabulon Skipper
	Euphyes dion	Sedge Skipper
	Euphyes vestris	Dun Skipper
	Panoquina ocola	Ocola Skipper

* Source used for taxonomic and common name standards: Opler 1992

Appendix C

Standard Operating Procedure for Disposal of Fluids and Solids

1.0 Disposal of Waste Fluids and Solids

1.1 I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

1.2 II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and

submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample, one sample per rolloff. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. **Storage and Disposal**

The wastes generated at the site at individual locations will be transported to the client specified drum storage area by the drilling services subcontractor. Drums will be stored on large sheets of plastic that will allow the drums to be covered when not being used. Petroleum-recovery "pigs," railroad ties, or other means will be used to construct a temporary containment around drums containing liquid to retain the total volume of liquid in the drums should there be a massive drum failure.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

1.3 IV. Attachments

None.

1.4 V. Key Checks and Preventative Maintenance

Check that representative samples of the containerized materials are obtained.