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FINAL

Site Screening Work Plan for Site 5

Naval Surface Warfare Center
Indian Head Division
Indian Head, Maryland

Contract Task Order 0066

September 2001

Prepared for

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

Under the

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

Prepared by

CH2MHILL

Herndon, Virginia

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Acronyms and Abbreviations

ABB	ABB Environmental Services
bgs	below ground surface
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
CNO	Chief of Naval Operations
COC	Chain of Custody
COPC	Chemical of Potential Concern
CTO	Contract Task Order
DI	Deionized
ERA	Ecological Risk Assessment
EPCs	Exposure Point Concentrations
FOL	Field Operations Leader
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HNUS	Halliburton NUS Corporation
HRS	Hazard Ranking System
IAS	Initial Assessment Study
IDW	Investigation-Derived Wastes
IHDIV-NSWC	Indian Head Division, Naval Surface Warfare Center
IR	Installation Restoration
MCL	Maximum Contaminants Level
MDE	Maryland Department of the Environment
msl	mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants
NEESA	Naval Energy and Environmental Support Activity
NOS	Naval Ordnance Station
NPL	National Priorities List
NWI	National Wetlands Inventory
OHM	OHM Corporation
PCBs	Polychlorinated biphenyls
QAPP	Quality Assurance Project Plan
RAC	Atlantic Division Remedial Action Contractor
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act

Acronyms and Abbreviations (Continued)

RI	Remedial Investigation
RPM	Remedial Project Manager
SERA	Screening Ecological Risk Assessment
SVOC	Semivolatile Organic Compounds
SOP	Standard Operating Procedure
SW	Surface Water
TAL	Target Analyte List
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WP	Work Plan

Executive Summary

This Site Screening Work Plan (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) 0066, under the Comprehensive Long-term Environmental Action Navy (CLEAN), contract number N62470-95-D-6007. The purpose of this Work Plan is to present site-specific information regarding one Installation Restoration (IR) site on the IHDIV-NSWC.

The specific site covered by this Work Plan is Site 5. The site consists of two drainage swales or depressions originating at Building 731 (Swale 1, originating on the southeast side of Building 731, and Swale 2, originating from the southwest corner of Building 731). Soil in these swales was contaminated by silver from photographic processing wastewater between 1953 and 1965. Previous investigations at Site 5 focused on soil contamination in Swale 1 and the northern portion of Swale 2, which subsequently resulted in two soil removal actions for Swale 1 in 1992-1993 and the northern portion of Swale 2 in 1994-1995.

The field investigation addressed in this Work Plan will include the installation of three monitoring wells in the shallow aquifer. Groundwater samples will be collected from the three wells and two existing wells and analyzed for total and dissolved Target Analyte List (TAL) metals, Total Compound List (TCL) volatile organic compounds (VOCs), and TCL semi volatile organic compounds (SVOCs), total organic carbon, pH, and hardness. Water level measurements will be taken to determine groundwater flow direction at the site. Sediment samples will be collected and analyzed for total silver, total organic carbon, pH, and grain size distribution. The total silver data will be used to characterize the lateral extent of silver contamination in the unsampled southern portion of Swale 2. Moreover, surface water samples will be collected from the sediment locations to assess surface water quality along the southern portion of Swale 2. The surface water samples will be analyzed for total silver, dissolved silver, total organic carbon, pH, and hardness. Data obtained for the various media will be used to assess ecological and human health risks.

Table ES-1 summarizes the tasks covered in this Work Plan.

TABLE ES-1
Site 5 Site Screening Work Plan
Indian Head, Maryland

Site Name	Work Plan Summary	New Monitoring Wells	Number of Primary Samples	Ecological Risk Assessment	Human Health Risk Assessment
Site 5: Building 731, Grain Manufacture and X-ray Building	Determine if contamination has entered the shallow groundwater. Develop a monitoring well network by installing three new wells and using two existing wells.	3	5	Yes	Yes
Southern Portion of Swale 2	Characterize the lateral extent of silver in sediments. Collect sediment samples from three locations along the swale.	Not applicable	3	Yes	Yes
Southern Portion of Swale 2	Assess surface water quality. Collect surface water samples from corresponding sediment locations along the swale.	Not applicable	3	Yes	Yes

1.0 Introduction

This Site Screening Work Plan has been prepared to address the shallow groundwater quality at Site 5 and sediment and surface water qualities in the southern portion of Swale 2. Two drainage swales, Swale 1 and Swale 2, originate from the southeast and southwest corners, respectively, of Building 731. The location of Site 5 is shown on Figure 1-1 and the locations of the swales are shown on Figure 3-1. Soils in these swales were contaminated due to the discharge of photographic processing wastewater between 1953 and 1965. Previous investigations at Site 5 focused on soil contamination in Swale 1 and the northern portion of Swale 2, which subsequently resulted in two soil removal actions for Swale 1 in 1992–1993 and the northern portion of Swale 2 in 1994–1995.

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

- Master Work Plan (Master WP), prepared by Brown & 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 above-referenced master planning documents will provide the methods and procedures that will be used to perform the environmental investigative work proposed herein for Site 5. Unless otherwise noted, all SOPs referenced in this Work Plan are contained in the Master Work Plan. The objectives of the work described in this Work Plan are to (1) assess groundwater quality in the shallow aquifer, (2) determine groundwater flow direction in the shallow aquifer, (3) characterize the lateral extent of silver contamination in sediments from the unsampled southern portion of Swale 2, and (4) assess surface water quality along the southern portion of Swale 2. These objectives were established based on a review and evaluation of site historical information.

The objectives will be accomplished through the following field and laboratory activities: (1) installation of three monitoring wells in the shallow aquifer to set up a five monitoring well network consisting of the three proposed monitoring wells and two existing wells for sampling; (2) collection and analysis of groundwater samples from the five monitoring well network to assess groundwater quality with respect to metals, VOCs, and SVOCs; (3) measurement of water levels in the five monitoring well network to determine groundwater flow direction; (4) collection and analysis of sediment samples from the southern portion of Swale 2 to determine the lateral extent of silver contamination; and (5) collection and analysis of surface water from the southern portion of Swale 2 to assess surface water quality with respect to silver.

1.1 IHDIV-NSWC Description and Environmental Setting

IHDIV-NSWC is a military facility consisting of 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 located across Mattawoman Creek, covers 1,084 acres. IHDIV-NSWC is located in northwestern Charles County, Maryland, and is approximately 25 miles southwest of Washington, D.C. 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. The main installation includes Marsh Island and Thoroughfare Island, which are located in Mattawoman Creek. Elevations range from sea level to 111 feet above mean sea level (msl) on Cornwallis Neck.

Both the main installation (Cornwallis Neck Peninsula) and the Stump Neck Annex are on the National Priorities List (NPL). 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.

1.1.1 Current and Historical Uses of IHDIV-NSWC

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, and 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 attached 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, also was acquired in this year. Bullitt Neck was obtained in five small acquisitions during 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 Naval Ordnance Station 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

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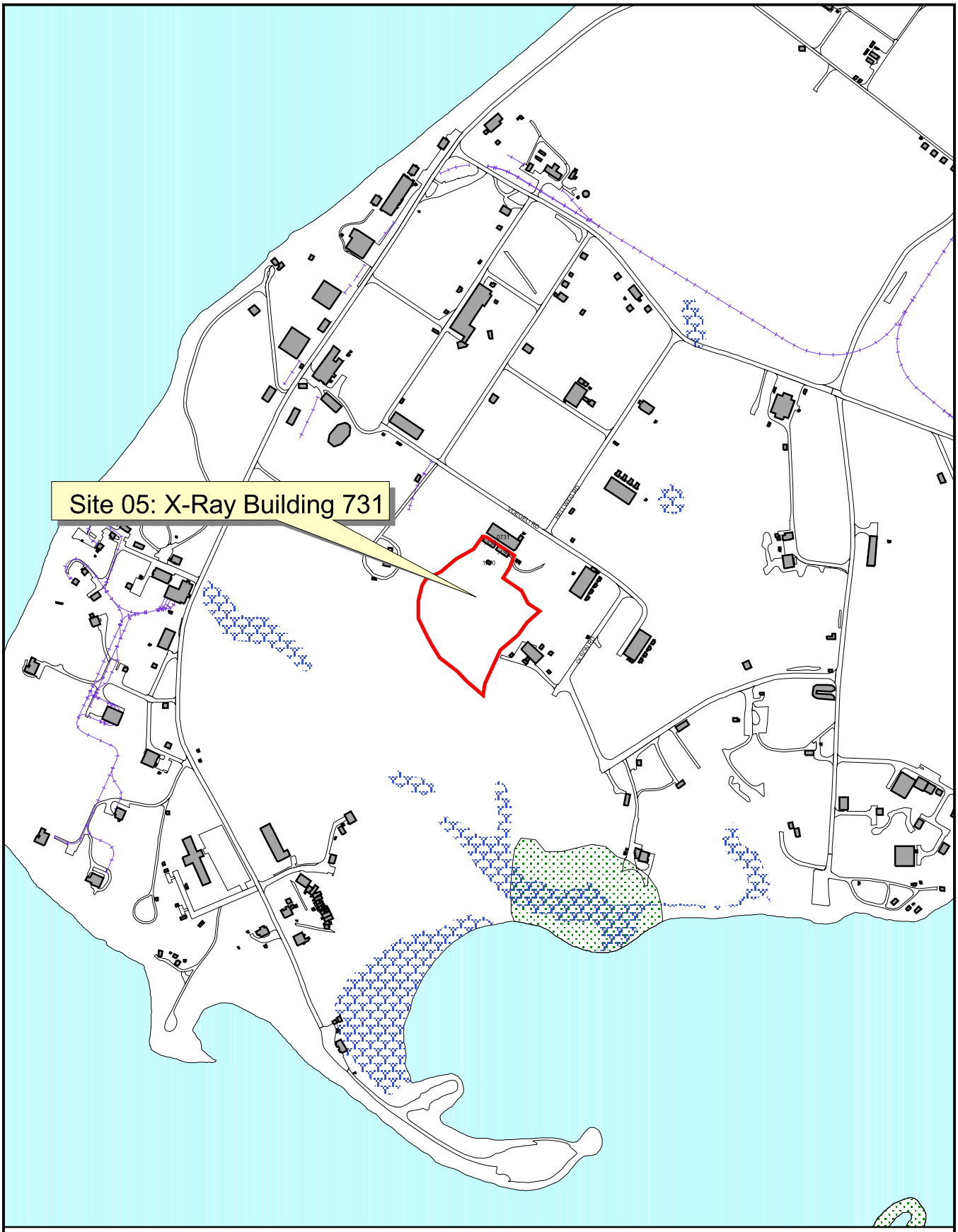

LEGEND

- IR Sites
- Buildings
- Railroads
- Wetlands

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Figure 1-1
Location of Site 5 - X-Ray Building 731
Site Screening Work Plan for Site 5
Naval Surface Warfare Center
Indian Head Division

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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.

1.1.2 Surrounding Land Uses

IHDIV-NSWC is generally surrounded by commercial, residential, and state park lands 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 where most residential developments are located. The Indian Head Highway (Route 210) extends eastward from 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.

1.1.3 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).

1.1.4 Soils

IHDIV-NSWC lies within the Atlantic Coastal Plain physiographic province and is underlain by unconsolidated sand, gravel, and clay from the Pleistocene and Cretaceous Periods. 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.
- Evensboro-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 soils and generally located on floodplains and in miscellaneous unclassified wetlands.

The USDA 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 levels of sand and clay. They are found predominantly on upland areas and, due to their slope, have high erosion potential (Parsons, 2000).

1.1.5 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 because 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 and 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.

1.1.6 Ecological Communities

1.1.6.1 Terrestrial Systems

IHDIV-NSWC comprises approximately 2,500 acres of terrestrial ecological communities on Cornwallis Neck and about 1,084 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 oak, hickory, 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.

1.1.6.2 Wetland Systems

National Wetland Inventory (NWI) 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 swamps 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).

1.1.7 Fauna

The diverse ecological communities at Indian Head support many wildlife species. The Integrated Natural Resources Management Plan for IHDIV-NSWC provides a list of fauna inhabiting the base (Parsons, 2000). Fifteen 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 have been observed at the base.

1.1.8 Rare, Threatened, and Endangered Species

The Maryland Natural Heritage Program conducted a survey of rare, threatened, and endangered species 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, respectively, 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 includes five state-listed endangered plants, two state-listed threatened plants, one state-listed endangered invertebrate, and eighteen species of regional concern.

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.

1.2 Document Organization

Section 2 presents a summary of field operations to be conducted under this Work Plan. Section 3 contains site-specific information for Site 5; a summary of previous environmental investigations performed at the site; data assessment and investigative scoping, and a site-specific Work Plan summary.

1.3 Previous Investigation and Evaluation of Activity

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 the 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 NACIP 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. A remedial investigation was completed at Site 12 in March 1999. A Draft Final Feasibility Study for Site 12 was submitted in July 2000.

A Hazardous Ranking System (HRS) Final Scoring Report was conducted and submitted by Ensafe/Allen & Hoshall on April 1, 1994. The HRS Report identified the Activity as scoring 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.

Previous investigations at Site 5 have evaluated the possible ecological impact from silver contamination to downstream ecosystems and concluded that the contamination might pose a risk. Subsequently, removal actions of contaminated soil have been performed. CH2M HILL summarized existing data in a memorandum, dated May 3, 2000, to the Indian Head Installation Restoration Team. The current investigation will focus on determining if metals contamination has entered the underlying shallow aquifer and if silver contamination in sediments and surface water in the previously uninvestigated segment of Swale 2 (southern portion) present a risk to human and ecological receptors. Table 1-3 shows human health and marine aquatic screening values for analytes in groundwater that will be analyzed during the investigation.

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 laeve*	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 in peril in the state, but status uncertain.

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.

TABLE 1-3
Human Health and Marine Aquatic Screening Values for Groundwater

TAL Metals	Drinking Water MCLs µg/L	AWQC/AO Marine Continuous µg/L	Human Health RBC µg/L
Aluminum	50 to 200(S)	--	37,000
Antimony	6	500	15
Arsenic	50	36	0.045
Barium	2,000	--	2,600
Beryllium	4	--	73
Cadmium	5	9.3	18
Calcium	--	--	--
Chromium	100	50	110
Cobalt	--	--	2,200
Copper	1300(T)	--	1,500
Iron	300(S)	--	11,000
Lead	15(T)	8.5	--
Magnesium	--	--	--
Manganese	50(S)	--	730
Mercury	2	0.025	--
Nickel	1,000	8.3	730
Potassium	2	--	--
Selenium	50	71	180
Silver	100(S)	2.3	180
Sodium	--	--	--
Thallium	2	--	--
Vanadium	--	--	260
Zinc	5000(S)	86	11,000

Notes:

MCL - Maximum Contaminant Level

AWQC/AO - Ambient Water Quality Criteria for Aquatic Organisms

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

(S) - National Secondary Drinking Water Standards (NSDWRs). Non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.

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

1.4 Data Quality Level

Data will be analyzed in accordance with the specifications identified in the Quality Assurance Project Plan (QAPP).

1.5 Project Organization

CH2M HILL will perform this screening phase of the project with support from the Navy. The Navy RPM will be Mr. Jeff Morris.

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

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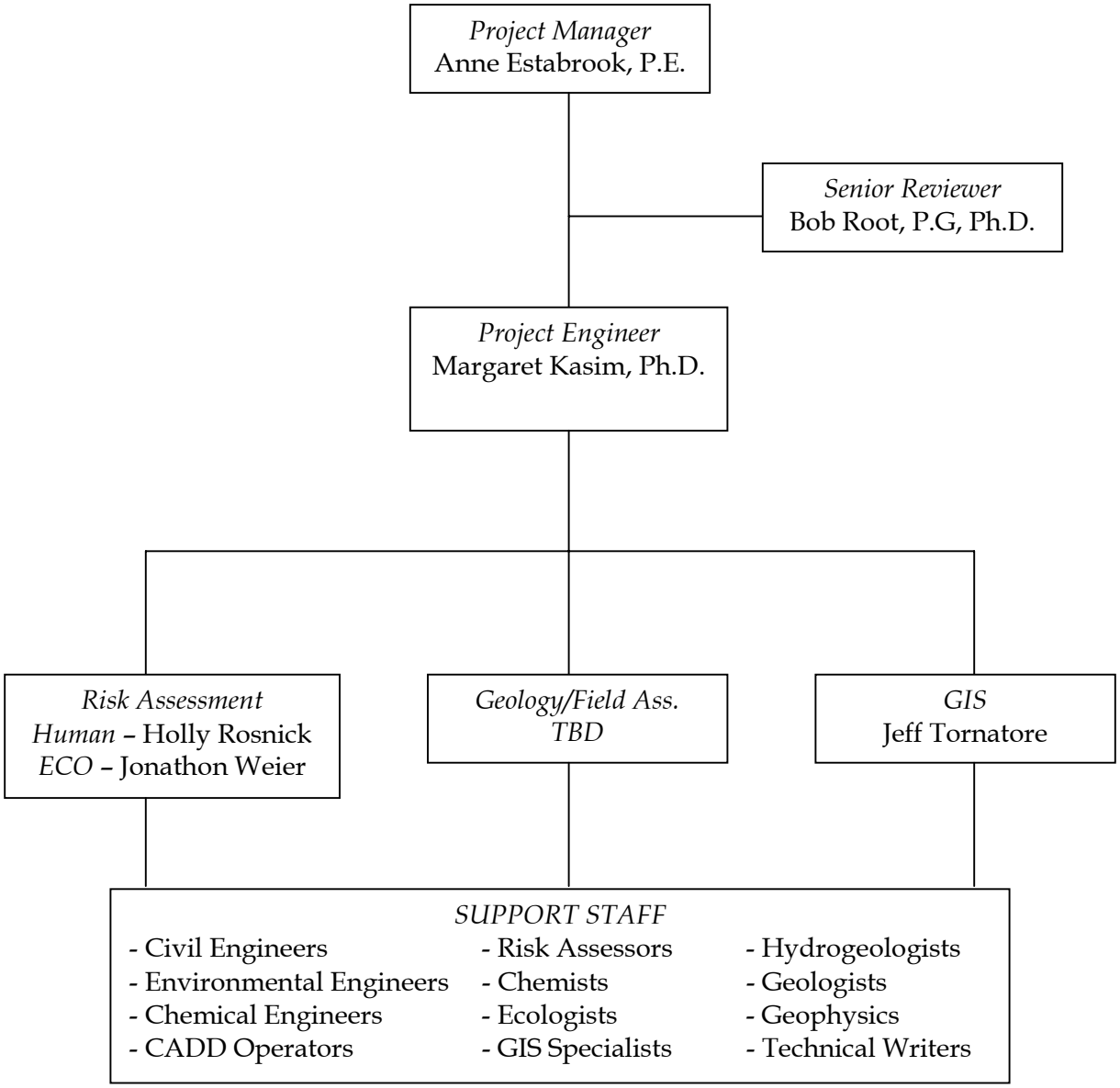
The CH2M HILL Project Organization is shown on Figure 1-2.

FIGURE 1-2
Project Organization Chart



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2.0 Field Operations

2.1 Work Plan Summary

The general Work Plan consists of developing a network of five monitoring wells screened in the shallow water-bearing unit at Site 5 and then sampling them to determine if contamination has entered the shallow groundwater. The network will consist of two existing monitoring wells and the three proposed monitoring wells. Sediment and surface water samples will be collected from the southern portion of Swale 2 and analyzed for silver to address any data gap for future site closure plans. The rationale for the proposed monitoring well, sediment, and surface water locations and for groundwater, sediment, and surface water sampling and analyses are described in Section 3. General field operations and protocol are summarized below.

2.2 General Field Operations

This section provides information on the general field operations, methods, and protocol to be used in the field with regard to construction of three monitoring wells, and collection of groundwater, sediment, and surface water samples.

2.2.1 Mobilization/Demobilization and Decontamination

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 site specific Health and Safety Plan provided in the Master WP addendum (CH2M HILL, March 2000), and the IHDIV-NSWC Hazard Control Briefing.

All equipment required for field operations will be brought to the site by the CH2M HILL field team. The contracted laboratory will ship all sample containers directly to the site. Demobilization will entail following proper decontamination procedures for all site personnel and equipment. 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. All downhole equipment required for drilling will be decontaminated prior to beginning drilling, between boreholes, and at the end of the drilling operations. Decontamination procedures are discussed in IHDIV-NSWC SOP SA-13. The investigation derived waste (IDW) will be handled in accordance with IHDIV-NSWC SOP SA-13, and field records will be kept as directed in IHDIV-NSWC SOP SA-12.

2.2.2 Monitoring Well Installation and Groundwater Sampling

2.2.2.1 Monitoring Well Installation

Three monitoring wells will be installed at Site 5 to assess metal, VOC, and SVOC contamination in shallow groundwater. Each monitoring well will be installed to an estimated

depth of 20 feet below ground surface (bgs) and will be screened in the shallow ground-water unit as determined by the onsite geologist from examination of lithological sampling during drilling. Boreholes will be advanced with hollow stem augers. Soil samples for lithological characterization will be collected with a split spoon sampler in 2-foot increments every 5 feet (i.e., 0-2 ft, 5-7 ft, 10-12 ft, etc.) until the first saturated zone, indicating the shallow groundwater, is encountered. After well installation, the wells will be developed until the water runs clear or until the field geologist determines the well cannot be developed further. The methods and procedures to be used can be found in IHDIV-NSWC SOP GH-03. The field geologist will generate a detailed boring log for each borehole as outlined in IHDIV-NSWC SOP SA-12. Similarly, a monitoring well construction log will be created for each well.

The following criteria were considered in selecting monitoring well locations:

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

The proposed locations of the monitoring wells to be installed are shown on Figure 3-1, though actual site conditions will dictate the final locations. The field team shall consider topography, stressed vegetation, erosion and seeps, changes in type of vegetation, discolorations, accessibility, and past investigative experiences to select the locations.

After installation, the wells will be surveyed for horizontal and vertical coordinates.

2.2.2.2 Groundwater Sampling

Prior to sampling the three newly installed wells and two existing wells, groundwater elevations will be recorded to the nearest 0.01 foot. The water-level depth and well depth will be used to calculate the volume of groundwater in the well. Purging will be performed using a Grundfos Redi-flo2 submersible pump and low flow techniques. The pH, specific conductance, turbidity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and temperature of the purge water will be recorded after each well volume. Sampling will commence once these parameters have stabilized (i.e., pH within 0.05 units, temperature within 1°C, and ORP, dissolved oxygen, and specific conductance to within 10 percent over three consecutive measurements at least 3 minutes apart). Turbidity will be reduced to the extent practical. The purging process will continue until the parameters are stable or at least five well volumes have been removed, whichever comes first. After purging of the wells is complete and water quality parameters have stabilized, samples will be collected directly from the pump tubing. The equipment and procedures required to perform the groundwater sampling can be found in IHDIV-NSWC SOP SA-01.

2.2.2.3 Investigation Derived Waste

Investigation derived waste will consist of soil cuttings and groundwater from well installation and development, and groundwater from well purging during sampling activities. All IDW will be handled in accordance with IHDIV-NSWC SOP SA-13. A staging area for the IDW will be coordinated with base personnel prior to initiating field activities.

2.2.2 Sediment Sampling

Three sediment samples will be collected from a depth of 0 to 6 inches bgs from three evenly spaced locations (Figure 3-1) along the southern unsampled stretch of Swale 2. Samples will be collected using hand tools, such as trowels or hand augers. Associated QA/QC samples, consisting of a matrix spike/matrix spike duplicate, field duplicate, and equipment rinsate blank will be collected. Sampling activities (collection, handling, and decontamination of sampling equipment) will be performed in accordance with existing SOPs.

2.2.3 Surface Water Sampling

Three surface water samples will be collected from corresponding sediment locations as shown on Figure 3-1 to examine surface water quality along the southern unsampled stretch of Swale 2. At each location, a surface water sample will be collected first, if water is present, before collection of the sediment sample. Samples will be collected from a downstream to upstream direction to ensure collection of undisturbed samples. In addition, two QA/QC samples, consisting of a field duplicate and a field blank, will be collected for data validation and review purposes. Sampling activities (collection, handling, and decontamination of sampling equipment) will be performed in accordance with existing SOPs.

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 Section 3. 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 an 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

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., S05 = Site 05)

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)
TB = Trip Blank
EB = Equipment Blank
FB = Field Blank

Sample Location:

MM = QC Samples – 2-digit month of sampling event

NN = Primary Samples - 2-digit number indicating sample location

Additional Qualifiers:

MMYY = Monitoring Well and Grab Groundwater Samples - 2-digit month and 2-digit year of sampling event (i.e., Jan 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)

DDYY = QC Samples – 2-digit day and 2-digit year of sampling event

Examples of this numbering approach are:

IS05SS040001	The 4th surface soil sample collected from 0 ft to 1 ft at Site 5
IS05GW020801	The 2nd grab GW sample collected at Site 5 in August 2001
IS05WS01	The 1st waste sample collected from drums at Site 5

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

IS05FB100101	Field blank collected at Site 5 on October 1, 2001
IS05TB07290101	First trip blank collected at Site 5 on July 29, 2001
IS05EB080101	Equipment blank collected at Site 5 on August 1, 2001

2.3.2 Sample Packaging and Shipping

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

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

Custody of the samples will be maintained and documented at all times. Chain-of-Custody will begin with the collection of the samples in the field and will continue through the analysis of the sample at the analytical laboratory.

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3.0 Site 05: Building 731, X-Ray Building

3.1 Background Information and Site/Building Description

Site 5 is the site of the Grain Manufacture and X-ray Building (Building 731) constructed in 1953. The X-ray section of this building houses an X-ray machine that uses water to cool the X-ray tube and to rinse the X-ray photos in the developing process. Approximately 4,000 X-ray sheets per month are processed in this facility (NEESA, 1983).

Prior to 1965, process waste waters, including fixer and developer, were discharged into open ditches located south of Building 731 (Figure 3-1). A combined quantity of approximately 180,000 pounds of sodium thiosufate (fixer) and hydroquinone (developer) containing 720 pounds of silver was estimated to have been discharged over the 12-year period in which untreated wastewater was discharged from the X-ray facility (NEESA, 1983).

The site consists of two depressions emanating from the southeast (Swale 1) and southwest (Swale 2) corners of Building 731. Soils in these swales were contaminated with silver-laden photographic processing wastewater released from Building 731 between 1953 and 1965. Photographic operations are still performed in Building 731; however, the spent fixer is now collected and the silver is recovered.

A 1991 Site Characterization Report conducted by ABB Environmental Services, Inc. (ABB) evaluated the impact of silver concentrations in Site 5 soils on downstream ecosystems (ABB, 1991). The report concluded that areas of high silver contamination might be a risk to aquatic invertebrates. However, risks cannot be quantified based on available information (i.e., the lack of surface water data). Effects also were expected for ecological receptors that live in the water column in the ditch and the wetland in areas containing high levels of sediment contamination (ABB, 1991). Similarly, effects to terrestrial organisms may have occurred as they drank contaminated surface water or came into contact with contaminated sediments (ABB, 1991).

A removal action was performed on Swale 1 between November 1992 and January 1993. The removal action included the excavation and treatment of soil and sediment containing silver at concentrations exceeding the identified action level of 10 mg/kg. The results of the removal action were documented in the Removal Action Findings Report (ABB, 1993). According to the 1993 report, post excavation field sampling confirmed that removal of contaminated soil/sediment was achieved (ABB, 1993). The treated soil was placed in the base of the soil berm extension between Buildings 728 and 731.

Previous sampling at Site 5 (ABB, 1991) indicated that some soils and sediments in Swale 2 also exceeded the 10 mg/kg action level. In February 1993, Haliburton NUS conducted additional field sampling to define the horizontal and vertical extents of silver contamination within Swale 2. The findings and conclusions of this sampling activity are contained in the Field Sampling Report for Site 5 – Swale 2 (Halliburton NUS, 1994a). An Engineering

Evaluation/Cost Analysis (EE/CA) examining the possible remediation alternatives for mitigating contamination at Swale 2 was prepared (Haliburton NUS, 1994b), and the design specifications and construction documents for the selected remediation alternative were developed (HNUS, 1994c,d). Construction was begun at Site 5-Swale 2 by the Atlantic Division Remedial Action Contractor (RAC), OHM Corporation (OHM), in December 1994.

Approximately 1,745 cubic yards of silver–contaminated soil were excavated from Swale 2 during the removal action. The soil was deposited and capped at the Rum Point 'borrow' pit. The results of the post excavation sampling results showed the majority of silver-contaminated soil had been removed; however, five specific locations revealed residual silver concentrations above the 10 mg/kg action level. The areas that showed levels above 10 mg/kg were subsequently re-excavated and removed.

3.2 Previous Environmental Investigation

Site 5 was included as part of the IAS of the IHDIV-NSWC performed by NEESA in 1982 (NEESA, 1983). The report identified Site 5 as being a potential threat to human health and the environment. Site 5 was then included in a Navy Assessment and Control of Installation Pollutants (NACIP) Confirmation Study (CH2M HILL, 1985). Following the Confirmation Study a Site Characterization Report was submitted (ABB, 1991), which evaluated contamination in soils and sediments at the site. Soil and sediment samples collected during the Site Characterization investigation contained silver concentrations above the 10-mg/kg action level in Swale 1 and above the action level in some soils and sediments in Swale 2. Following the Site Characterization Study, a removal action was conducted on Swale 1 between November 1992 and January 1993 (see Section 3.1). In 1993, Haliburton NUS (HNUS) conducted additional sampling to determine the extent of contamination in Swale 2. OHM subsequently performed a removal action on the northern portion of Swale 2 in September 1994 (Figure 3-1). Final post-removal action sampling showed all remaining soil and sediments to be below the 10-mg/kg action level for silver. Following the removal actions, the excavations were backfilled with clean soil and the drainage swales were reconstructed with erosion controls.

Previous Site 5 investigations have focused on soil, sediment, and surface water contamination and the risks associated with each. Groundwater has not been studied or sampled as part of a site-specific Site 5 investigation. However, at an adjacent IR site, Site 42, located on the eastern and southeastern boundary of Site 5, groundwater samples have been collected. Two monitoring wells installed during the Site 42 investigation are located in and directly downgradient of Site 5 (Figure 3-1). These two Site 42 wells were sampled in 1993 and 1997 for volatile organic analyses (VOAs), semivolatile organic analyses (SVOAs), Pesticides/ polychlorinated biphenyls (PCBs), and inorganics analyses that included the full TAL metals list. The TAL metals results are shown in Table 3-1. The contaminant of concern, silver, was not detected in either well.

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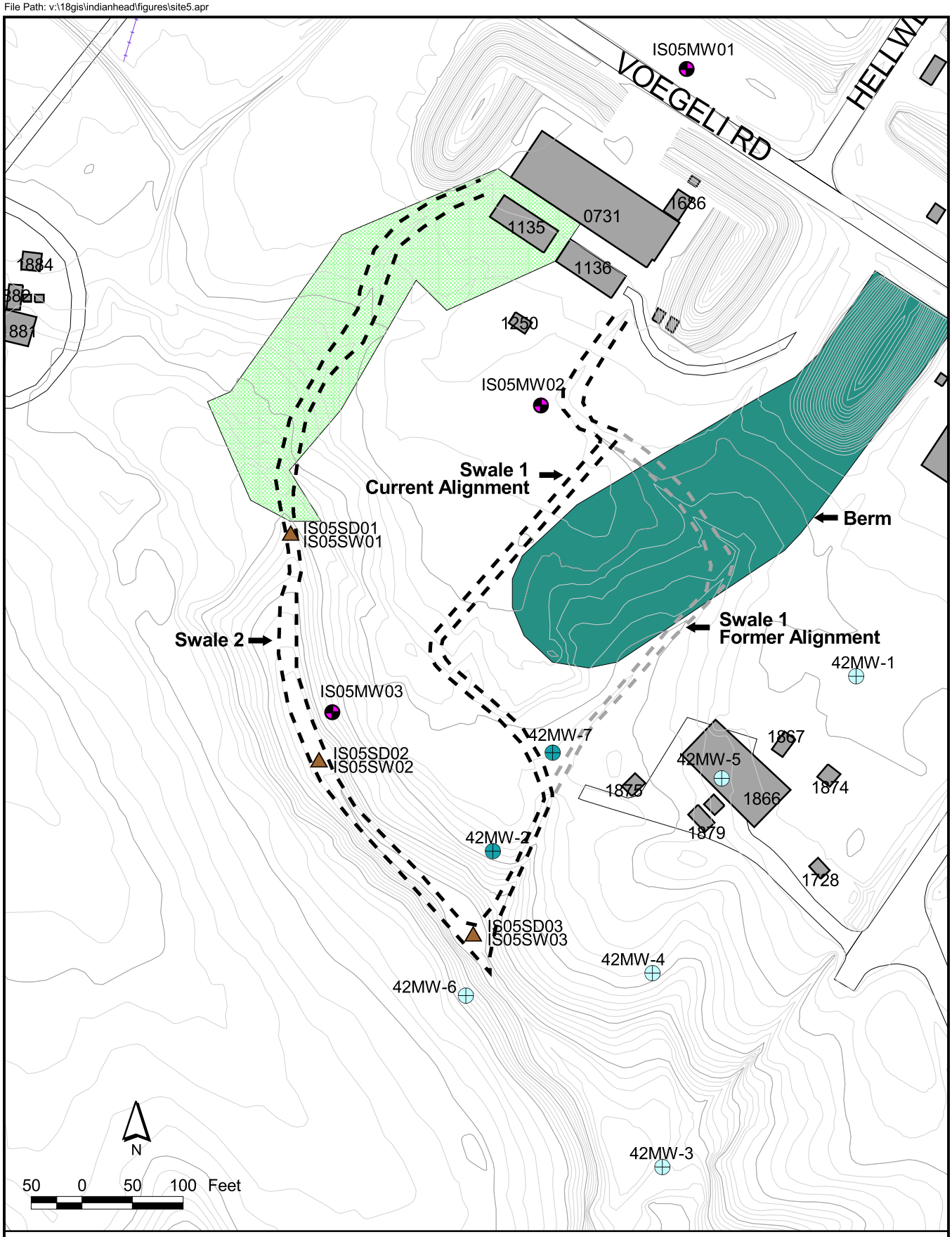

LEGEND

- Proposed Monitoring Well Locations
- Existing Monitoring Wells
- Existing Monitoring Wells to be used in Monitoring Network
- Proposed Sediment and Surface Water Sample Locations
- Approximate Limit of Excavated Area (1994)
- Buildings

Figure 3-1
Proposed Monitoring Well, Sediment, and Surface Water Sample Locations
Site Screening Work Plan for Site 5
Naval Surface Warfare Center
Indian Head Division

CH2MHILL

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TABLE 3-1
Site 42 Wells Previously Sampled

TAL Metal (μg/l)	42MW-2	42MW-6	42MW-2*	42MW-6*
	04/10/1993	04/10/1993	10/11/1997	10/12/1997
Aluminum	6280	11300	20.0 U	20.0 U
Antimony	36.0 U	36.0 U	2.6 UR	2.6 U
Arsenic	2.2 U	2.2 U	8.3 J	3.3
Barium	123 J	119 J	374 L	270
Beryllium	1.0 U	1.2 J	0.1 U	0.1 U
Cadmium	5.0 U	5.0 U	0.55 U	0.3 U
Calcium	3700 J	5860	6370 K	4290 K
Chromium	10.9	28.8	0.5 UL	0.5 U
Cobalt	20.0 U	20.0 U	7.1	0.79 U
Copper	9.4 J	14.7 J	3.6 U	4.7 U
Iron	13200 J	17000 J	30900 L	1220 J
Lead	2.9 J	7.5	1.0 UR	1.0 U
Magnesium	3560 J	2780 J	2600 K	1070 K
Manganese	548	172	689	79.2 J
Mercury	0.2 U	0.21 U	0.1 U	0.1 U
Nickel	23.6 J	20.0 U	9.4 K	4.3 K
Potassium	1070 J	7170	1020	703
Selenium	7.0 R	7.0 R	2.8 UL	2.8 UL
Silver	5.0 U	5.0 U	0.8 UL	0.8 U
Sodium	53800	16000	36300	13300 J
Thallium	11.0 U	2.2 U	2.9 U	2.9 U
Vanadium	15.9 J	23.4 J	1.1 UL	1.1 U
Zinc	91.7	76.4	116 J	115

Notes:

* Duplicate samples were collected from these wells during the sampling event. The higher result is recorded.

J – Analyte detected at an estimated concentration below the detection limit.

K – Result is biased high.

L – Result is biased low.

R – Data judged unusable by data reviewer.

U – Analyte not detected at detection limit.

3.3 Human Health Risk Assessment

A human health risk assessment for Site 5 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) and current USEPA guidance. Analytical data collected from the monitoring wells at Site 5 and from the sediment and surface water will be used to evaluate whether site contaminant concentrations pose a significant threat to human health. This section focuses on the details associated with the Site 5 human health risk assessment (HHRA) including the screening methods for selection of chemicals of potential concern (COPCs) and exposure scenarios to be evaluated.

COPCs will be selected based on a comparison of maximum detected concentrations of constituents in the various media to the Region III risk-based concentrations (RBCs). RBCs that are based on noncarcinogenic effects will be divided by 10 to account for cumulative exposure (i.e., hazard quotient of 0.1). RBCs based on carcinogenic effects will be used as presented in the most current RBC table (EPA, 2000). Constituents having a maximum detected concentration less than the RBC will not be retained as COPCs for the HHRA. Lead concentrations in groundwater will be compared to the Safe Drinking Water Act (SDWA) action level of 15 ppb. If the lead concentration exceeded the screening value, it will be discussed qualitatively in the toxicity assessment section in the risk assessment report. Constituents that are essential human nutrients (e.g., magnesium, calcium, potassium, and sodium) will not be considered for quantitative evaluation in the risk assessment if they are detected at concentrations (i.e., at or near naturally occurring levels) that are not considered toxic.

Site 5 is located in an area of the facility that is not reasonably anticipated for residential use in the future. However, Navy policy is to evaluate a hypothetical conservative scenario of future residential use. Therefore, the exposure scenarios that will be evaluated in the Site 5 HHRA are:

- Exposure to groundwater by the residential adult through ingestion of the water and inhalation of volatiles while showering;
- Exposure to groundwater by the residential child through ingestion of the water and dermal contact while bathing;
- Exposure to groundwater by the construction worker through inhalation of volatiles from an open excavation and incidental ingestion or dermal contact with groundwater during excavation activities;
- Exposure to surface water by the recreational adult and child through incidental ingestion and dermal contact while wading in the drainage swale; and
- Exposure to sediment by the recreational adult and child through incidental ingestion and dermal contact while wading in the drainage swale.

The Exposure Point Concentrations (EPCs) for groundwater for the future scenario will be determined using data from only the most contaminated wells. This will include the evaluation of the groundwater data to determine if there is an identifiable groundwater

plume or multiple plumes. The groundwater data from the plume(s) will be conservatively used for determining the EPC for the residential scenario.

3.4 Ecological Risk Assessment – Screening Level Problem Formulation

The purpose of this section is to present a screening-level problem formulation for Site 5 (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).

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.

3.4.1.1 Environmental Setting

The habitat in the vicinity of Site 5 is mostly mowed grass, with some emergent wetlands supported by water from facility operations. The surrounding area contains mixed pine/ hardwood forest, forested wetlands, and drainages that convey water to Mattawoman Creek.

3.4.1.2 Summary of Available Analytical Data

Soil and sediment samples collected during the site characterization investigation found silver concentrations above the 10-mg/kg action level in Swale 1 and Swale 2. Removal actions were conducted for both Swale 1 and Swale 2, following the Site Characterization Study, with Swale 1 excavated in 1993 and Swale 2 excavated in 1994. Following the removal actions the excavations were backfilled with clean soil. However, it has since become apparent that a small area along the southern portion of Swale 2 has not been adequately characterized. Data collected to support the ERA will include two surface sediment samples (0-12 inches) and one surface soil sample (0-12 inches) from the southern portion of Swale 2. Each sample will be analyzed for silver. In addition, if water is present during sampling, two surface water samples will be collected (co-located with the sediment samples) and analyzed for total and dissolved silver. In addition, groundwater samples will be collected from five monitoring wells and analyzed for total and dissolved metals.

3.4.1.3 Toxicological Properties of Contaminants

Silver adheres strongly to clay particles found in suspended particulates and sediments. The impact of silver is most likely to occur in the soil/water interface. It is acutely toxic to scuds (small freshwater crustaceans) at <6 μg/L and midges (fly larvae that inhabit freshwater sediments) at <5 μg/L. Aquatic plants are less sensitive to silver exposure. Not much

information is available regarding the toxicity of silver to terrestrial animals. 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

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 for Site 5 is primarily limited to groundwater, since soil and sediment in the two drainage swales were remediated. However, there is a potential source area in the sediments and soil of the southern portion of Swale 2.

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. Since both swales were excavated and backfilled with clean-fill site soil, sediment and surface water do not pose a risk to ecological receptors over the majority of the site. The only potential exposure that has not been investigated and/or addressed is infiltration of silver into the groundwater and subsequent discharge to a surface water body. Based on topography and existing groundwater information, it is possible that groundwater from Site 5 could discharge at or near the southern end of the site into a stream channel or forested wetland. After discharge, water column receptors could be exposed to silver in surface water. Additionally, ecological receptors could be exposed to silver in the soil and sediments in the southern portion of Swale 2. Animals may directly contact abiotic media (soil, surface water, or sediment), ingest abiotic media, or consume prey items that have accumulated chemicals.

Assessment Endpoints. The conclusion of the problem formulation stage includes the selection of assessment and measurement endpoints, based on the conceptual model. Endpoints in the screening environmental risk assessment (SERA) define ecological attributes that are to be protected (assessment endpoints) and measurable characteristics of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or could occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site (USEPA, 1997). Assessment endpoints contain an entity (e.g., fish-eating birds) and an attribute of that entity (e.g., survival rate).

The four assessment endpoints selected for Site 5 are as follows:

1) Growth, survival, and reproduction of water column communities — Many water column organisms (e.g., crustaceans, larval amphibians, and aquatic insects) form the foundation of aquatic food chains. These organisms are primary producers and consumers that are important in nutrient and energy recycling in aquatic ecosystems. By serving as the base of the food chain, they are critical to the sustenance of the communities of upper trophic level species.

The corresponding measurement endpoint is as follows:

Comparison of hazard quotients (HQs) for water column organisms to a target HQ of 1. Medium-specific HQs are calculated for individual contaminants by dividing surface water and the ground-water concentrations by a surface water benchmark that is intended to be protective of aquatic life.

A dilution factor may be applied to concentrations of chemicals in groundwater to reflect the attenuation expected between the point of sampling and the discharge point. If a dilution factor is used, a description of the methods used to derive the dilution factor will be included in the risk assessment.

2) Growth, survival, and reproduction of benthic invertebrate communities — Healthy, viable sediment invertebrate communities are necessary for a well-developed and balanced aquatic ecosystem. Benthic invertebrates influence nutrient cycling and availability, and sediment condition. By serving as prey species for many upper trophic predators, they are critical to the sustenance of the communities of upper trophic level species. The sediments at the site will support fewer animals if chemical concentrations are limiting the survival and reproduction of benthic invertebrates.

The corresponding measurement endpoint is as follows:

Comparison of HQs for benthic invertebrates to a target HQ of 1. Medium-specific HQs are calculated for individual contaminants by dividing the sediment concentration by a sediment benchmark that is intended to be protective of benthic invertebrates.

A Toxicity Identification Evaluation (TIE) study was recently completed on sediment pore water from Site 42 (SAIC, 2001). As appropriate, results of that study will be incorporated into the Site 5 ERA. In general, silver was not found to be the causative agent in toxicity tests. Concentrations of silver in Site 42 sediments will be compared against those observed in Site 5 sediment. The TIE study and the HQ approach will be used in a weight of evidence approach.

3) Growth, survival, and reproduction of terrestrial soil invertebrate communities — Soil invertebrates promote soil fertility by breaking down organic matter and releasing nutrients. They also improve aeration, drainage and aggregation of soils, and serve as a forage base for many terrestrial species. The soils at the site will support fewer birds and mammals if chemical concentrations are limiting the survival and reproduction of soil invertebrates.

4) Growth, survival, and reproduction of wetland omnivorous mammals — These receptors are third order consumers and are thus more susceptible to bioaccumulative chemicals, especially those that have the potential to biomagnify in food webs. The raccoon (*Procyon lotor*) was chosen to represent this endpoint. The raccoon is the most abundant and widespread medium-sized omnivore in North America (USEPA, 1993). They are opportunistic feeders and eat fruits, nuts, insects, frogs, eggs, and virtually any other edible material that is available.

The corresponding measurement endpoint is as follows:

Comparison of HQs for raccoon to a target HQ of 1. Receptor-specific HQs are calculated for individual contaminants by dividing an estimated level of exposure (dose) by toxicity values that are

associated with no and lowest observed adverse effect levels. Exposure estimates will include contributions from the consumption of aquatic invertebrates, amphibians, aquatic and terrestrial plants, and soil.

3.5 Work Plan

Past remedial efforts as presented in reports of previous investigations at Site 5 have evaluated and addressed silver contamination found in the soils, sediments, and surface waters of Swale 1 and the northern portion of Swale 2. Previous investigations, however, have not assessed the impact of metals, VOCs, and SVOCs in the shallow groundwater nor characterized silver contamination in the southern portion of Swale 2. The intent of this investigation is to evaluate if any metals, VOCs, and SVOCs are present in the shallow groundwater and to examine sediment and surface water quality with respect to silver in the southern portion of Swale 2.

The proposed scope of work will accomplish the above objectives through the following activities: (1) installation of three monitoring wells in the shallow aquifer to set up a five monitoring well network consisting of the three proposed monitoring wells and two existing wells for sampling; (2) collection of groundwater samples from the five monitoring well network to assess groundwater quality with respect to metals, VOCs, and SVOCs; (3) measurement of water levels in the five monitoring well network to determine groundwater flow direction; (4) collection of sediment samples to determine the lateral extent of contamination; and (5) collection and analysis of surface water from the southern portion of Swale 2 to assess surface water quality with respect to silver. The field investigation activities are discussed in detail below.

3.5.1 Monitoring Well Network

The monitoring well network will be made up of the three new wells (IS05MW01, IS05MW02, and IS05MW03) and two existing wells (42MW-2 and 42MW-7). The new monitoring wells will be installed upgradient of the swales, IS05MW01 (north of Building 731); at a bend and close to the origin of Swale 1 where process waste water discharged in Swale 1 would likely accumulate, IS05MW02; and in the south-central vicinity of Swale 2, IS05MW03. The existing and proposed monitoring well locations are shown on Figure 3-1. The locations of the wells were chosen for their proximity to the swales and the probable groundwater flow direction. The upgradient well, IS05MW01, will allow for a reference of ambient groundwater conditions to compare results to the other wells and will provide additional groundwater level data.

Field activities for this task will include installing the three wells to an estimated depth of 20 feet bgs, characterizing lithology during drilling, collecting and containing IDW from drilling-related activities, and surveying the horizontal and vertical coordinates of the wells.

3.5.2 Groundwater Sampling and Analyses

After the newly installed wells have been adequately developed and allowed to equilibrate with surrounding conditions, the five wells in the network will be sampled and analyzed for total and dissolved TAL metals, TCL VOCs, TCL SVOCs, total organic carbon on filtered

samples, and pH and hardness on unfiltered samples. In addition, field measurements of turbidity, DO, pH, ORP, temperature, and conductivity will be made.

3.5.3 Sediment Sampling and Analyses

Sediment samples IS05SD01, IS05SD02, and IS05SD03 will be collected from the three locations shown on Figure 3-1. This portion of Swale 2 had previously not been sampled and hence, it is not known if any metals are present in the sediment. To address this data gap, three samples will be collected from three locations. At each location, samples will be collected from 0 to 6 inches bgs and the samples will be analyzed for total silver, total organic carbon, pH, and grain size.

3.5.4 Surface Water Sampling and Analyses

Surface water samples IS05SW01, IS05SW02, and IS05SW03 will be collected from the corresponding three sediment locations shown on Figure 3-1. At each location, a surface water sample will be collected first before collection of the sediment sample. Samples will be collected from a downstream to upstream direction to ensure collection of undisturbed samples. The samples will be analyzed for total and dissolved silver, total organic carbon, pH, and hardness. In addition, field measurements of DO, pH, and conductivity will be made.

For all media sampled, that is, groundwater, sediment, and surface water, the appropriate number of field QA/QC samples, including field blanks, equipment blanks, and duplicates, will be analyzed in addition to laboratory QA/QC samples, including matrix spike/matrix spike duplicate (MS/MSD) samples. Analysis of the samples will be performed in accordance with the Navy guidance for Level D. Sample collection and handling will be conducted following in-place SOPs. Field measurements of DO, pH, and conductivity for groundwater and surface water samples also will be performed following in-place SOPs. Decontamination of field equipment within and between boreholes will be performed following IHDIV-NSWC SOP SA-13. Table 3-2 summarizes the sampling and analysis program, and Table 3-3 provides the sample bottleware, preservation, and holding time requirements.

3.5.5 IDW Sampling and Analyses

Investigation derived waste composite samples will be collected for solid and liquid media and analyzed for toxicity characteristic leaching procedure (TCLP), ignitability, corrosivity, and reactivity for disposal purposes.

TABLE 3-2
Summary of Sampling Program
Site 5: Building 731, X-ray Building
Indian Head, Maryland

Sample Media/Type	Sample ID Number	Sample Location	Sample Analyses
Groundwater			
Primary	IS05MW01##01	IS05MW01	Laboratory Analyses:
	IS05MW02##01	IS05MW02	Total TAL Metals (unfiltered); Dissolved TAL Metals (filtered); TCL VOCs, TCL SVOCs, TOC on filtered samples; pH and hardness on unfiltered samples
	IS05MW03##01	IS05MW03	
	IS05MW04##01	42MW-2	
	IS05MW05##01	42MW-7	
Duplicate	IS05MW06##01	To be determined by field personnel*	Field Analyses:
Field Blank	IS05FB####01	Site 5, during sampling activities	DO, pH, conductivity, ORP, temperature, and turbidity
Equipment Blank	IS05EB####01GW	DI water collected through pump used for sampling activities	
MS/MSD	IS05MW01##01	IS05MW01	
Trip Blank	IS05TB####01	None	
Sediment			
Primary	IS05SD010001	IS05SD01	Laboratory Analyses:
	IS05SD020001	IS05SD02	Total Silver, TOC, Grain Size, and pH
	IS05SD030001	IS05SD03	
MS/MSD	IS05SD010001	IS05SD01	
Duplicate	IS05SD040001	IS05SD02	
Equipment Blank	IS05EB####01SD	DI water collected after washing and rinsing sampling equipment	
Surface Water			
Primary	IS05SW01	IS05SW01	Laboratory Analyses:
	IS05SW02	IS05SW02	Total Silver; Dissolved Silver; TOC on filtered samples; pH and hardness on unfiltered samples
	IS05SW03	IS05SW03	
Duplicate	IS05SW04	IS05SW03	
MS/MSD	IS05SW01	IS05SW01	
Equipment Blank	IS05EB####01SW	DI water collected using equipment during sampling activities	Field Analyses: DO, pH, and conductivity
Investigation Derived Waste			
	IS05IDWS	55-gallon drums	TCLP, ignitability, corrosivity, and reactivity
	IS05IDWL	55-gallon drums	

Notes:

represents the 2-digit month in which sample was collected.
represents the 4-digit value for day and month in which QC sample was collected

* Field personnel will determine duplicate sample location based on well recharge.

The first two digits and the last two digits of the four digits at the end of the sediment sample identification number correspond to the surface and subsurface sampling depth intervals, respectively.

TABLE 3-3
Bottleware, Preservation, and Holding Time Requirements
Site 5: Building 731, X-ray Building
Indian Head, Maryland

Media	Analysis	Total Number of Samples*	Number of Containers per Sample	Container Type	Preservation	Holding Time
Groundwater	Total TAL Metals (unfiltered) CLP ILMO4.0	10	1	500 ml HDPE	HNO_3 to pH < 2 and cool to < 4°C	28 days for Mercury with all others 6 months to analysis
	Dissolved TAL Metals (filtered) CLP ILMO4.0	9	1	500 ml HDPE	Same as for total TAL metals	14 days
	TCL VOCs CLP OLM03.0	11	1	40 ml glass	HCl to pH<2 and cool to 4°C	14 days to analysis
	TCL SVOCs CLP OLM03.0	10	1	1 L amber glass	Cool to 4°C	7 days to extract; 40 days to analysis
	TOC SW-846 9060	10	1	500 ml HDPE	HCl or H_2SO_4 to pH<2 and cool to <4ºC	28 days to analysis
	pH SW-846 9045C	10	1	60 ml HDPE	None required	Analyze immediately
	Hardness EPA 130.2	10	1	250 ml HDPE	HNO_3 to pH <2 and cool to <4ºC	6 months to analysis
Sediment	Total Silver SW-846 6010B	7	1	8 oz. Sampling jar with Teflon liner	None required	6 months to analysis
	TOC SW-846 9060	7	1	4 oz. Sampling jar with Teflon liner	None required	28 days to analysis
	pH SW-846 9045C	7	1	4 oz. Sampling jar with Teflon liner	None required	Analyze ASAP
	Grain Size ASTM D422	6	1**	8 oz. Sampling jar with Teflon liner	None required	No holding time

TABLE 3-3
Bottleware, Preservation, and Holding Time Requirements
Site 5: Building 731, X-ray Building
Indian Head, Maryland

Media	Analysis	Total Number of Samples*	Number of Containers per Sample	Container Type	Preservation	Holding Time
Surface Water	Total Silver (unfiltered) SW-846 6010B	6	1	500 ml HDPE	HNO_3 to pH < 2 and cool to < 4ºC	6 months to analysis
	Dissolved Silver (filtered) SW-846 6010B	7	1	500 ml HDPE	Same as for total silver	14 days
	TOC SW-846 9060	7	1	500 ml HDPE	HCl or H_2SO_4 to pH<2 and cool to <4ºC	28 days to analysis
	pH SW-846 9045C	6	1	60 ml HDPE	None required	Analyze Immediately
	Hardness EPA 130.2	6	1	250 ml HDPE	HNO_3 to pH < 2 and cool to <4ºC	6 months to analysis

Notes:

Bottle sizes may vary from laboratory to laboratory.
* Includes primary and QC samples.
** Primary samples only.

4.0 References

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