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RECORD OF DECISION AT SITE 17 NSWC INDIAN HEAD MD

1/1/2010

U S NAVY

RECORD OF DECISION

Site 17 - Disposed Metal Parts Along Shoreline

for

Naval Support Facility, Indian Head
Indian Head, Maryland

January 2010

Contents

Tables

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Photograph

Acronyms and Abbreviations

μg/kg	microgram(s) per kilogram
μg/L	microgram(s) per liter
AA	area of attainment
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
bgs	below ground surface
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
cis-1,2-DCE	cis-1,2-dichloroethene
COC	constituent of concern
COPC	constituent of potential concern
CSF	carcinogenic slope factor
CSM	conceptual site model
CTE	central tendency exposure
DNAPL	dense non-aqueous phase liquid
DPT	direct-push technology
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IAS	Initial Assessment Study
IC	institutional control
IR	Installation Restoration
ISCO	*in situ* chemical oxidation
ISCR	*in situ* chemical reduction
MCL	maximum contaminant level
MDE	Maryland Department of the Environment
MEC	munitions and explosives of concern
MEE	methane, ethane, ethene
MIP	membrane interface probe
MNA	monitored natural attenuation

mg/kg	milligram(s) per kilogram
NA	natural attenuation
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effects level
NPL	National Priorities List
NSF-IH	Naval Support Facility Indian Head
NTCRA	non-time-critical removal action
O&M	operation and maintenance
PAH	polycyclic aromatic hydrocarbon
PRG	preliminary remediation goal
RA	remedial alternative
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDX	royal demolition explosive
RFA	RCRA Facility Assessment
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SERA	screening-level ecological risk assessment
SRG	site remediation goal
SVOC	semivolatile organic compound
TAL	target analyte list
TCE	trichloroethene
TCL	target compound list
TNT	trinitrotoluene
TOC	total organic carbon
VC	vinyl chloride
VOC	volatile organic compound
VSI	visual site inspection
ZVI	zero valent iron

SECTION 1

Declaration

1.1 Site Name and Location

Site 17, Disposed Metal Parts Along Shoreline
Naval Support Facility, Indian Head
Indian Head, Maryland
CERCLIS ID No. MD 170024684

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Selected Remedy for Site 17, Disposed Metal Parts Along Shoreline, at the Naval Support Facility Indian Head (NSF-IH) in Indian Head, Maryland. The locations of NSF-IH and Site 17 are shown in Figure 1-1. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practical, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for NSF-IH.

The response action presented in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The Department of the Navy (Navy) and the U.S. Environmental Protection Agency (EPA) jointly selected the remedy, and the Maryland Department of the Environment (MDE) concurs with the Selected Remedy.

1.3 Description of the Selected Remedy

The Selected Remedy is *in situ* chemical reduction (ISCR) of shallow groundwater in the source zone area, monitored natural attenuation (MNA) in the remaining area where the site remediation goals (SRGs) are exceeded, and institutional controls (ICs). The ISCR will be conducted via one-time soil mixing in the area where the concentration of trichloroethene (TCE), the principal threat, exceeds or is equal to 1,000 microgram(s) per liter (µg/L). Based on the human health and ecological risk assessments performed during the Remedial Investigation (RI) (CH2M HILL, 2004a) and the Baseline Ecological Risk Assessment (BERA) (CH2M HILL, 2005), no constituents of concern (COCs) were identified for the subsurface soil, surface water, and sediment; therefore, no action is warranted for these media. Unacceptable risks were identified for ecological receptor exposure to surface soil and for human exposure to shallow groundwater. The ecological risks associated with the soil were mitigated through excavation of surface soil and removal of drums during a removal action that was conducted in 2005; therefore, no action is warranted for the surface soil.

The components of this remedy include the following:

- Clearing and removal of munitions and explosives of concern (MEC) and non-MEC objects prior to soil mixing.
- Applying granular zero valent iron (ZVI) via soil mixing in the area where the TCE concentration exceeds or equals 1,000 µg/L.
- Conducting 5-year reviews.
- Implementing and enforcing ICs in the form of land and groundwater use restrictions.

1.4 Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with applicable or relevant and appropriate federal and state requirements (ARARs), is cost-effective, and utilizes permanent solutions and treatment technologies to the maximum extent possible. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of this remedy to ensure that it is, or will be, protective of human health and the environment.

1.5 ROD Data Certification Checklist

The following information is presented in Section 2, the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for Site 17:

- COCs requiring remediation and their respective concentrations (Section 2.5.3).
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6).
- Baseline risk represented by all COCs (Sections 2.7.1 and 2.7.2).
- Cleanup levels established for constituents requiring remediation and the basis for these levels (Section 2.8).
- Key factor(s) that led to the selected remedy (Section 2.10).
- How source materials constituting principal threats are addressed (Section 2.11)
- Estimated capital, annual operation and maintenance (O&M), and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.12.3).

1.6 Authorizing Signatures

Catherine T. Hanft
Captain, USN
Commanding Officer

2 Oct 09
Date

Kathryn A. Hodgkiss, Acting Director
Hazardous Site Cleanup Division
U.S. EPA - Region III

1/13/10
Date

\\aphrodite\proj\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 1-1 - Facility Location.mxd

Legend

- Approximate Site Boundary
- Streams
- Topographic Contours
- NSF-IH Base Boundary
- Buildings
- Roads and Paved Areas
- Wooded Area
- Densely Wooded Area
- Water Bodies
- NSF-IH Base Boundary

N

0 1,875 3,750 Feet

Figure 1-1
Facility Location
Record of Decision - Site 17
NSF-IH, Indian Head,
Maryland

CH2MHILL

SECTION 2

Decision Summary

This ROD presents the Navy's and EPA's Selected Remedy for Site 17, Disposed Metal Parts Along Shoreline. MDE concurs with the Selected Remedy.

2.1 Site Name, Location, and Description

NSF-IH is in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, DC. NSF-IH is a Navy facility consisting of the Main Installation on the Cornwallis Neck Peninsula and the Stump Neck Annex on the Stump Neck peninsula. The Main Installation contains approximately 2,500 acres and 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. Included as part of the Main Installation are Marsh Island and Thoroughfare Island, which are in Mattawoman Creek. Site 17 is a 1,000-foot stretch of shoreline along Mattawoman Creek (Figure 1-1).

The Navy is the lead agency for site activities and provides funding for site cleanups at NSF-IH. EPA and MDE are support agencies.

2.2 Site History and Previous Investigations

2.2.1 Site History

Site 17 is a 1,000-foot stretch of shoreline along the Mattawoman Creek, where metal parts were discarded from the 1960s until the early 1980s. The photograph on the next page shows a view of the site in a southeast direction towards Mattawoman Creek. The discarded materials included rocket motor casings, shipping containers, empty drums, and various metal parts. The Initial Assessment Study (IAS) (Fred C. Hart Associates, 1983) for Site 17 reported the presence of rusted metal parts in the vicinity of the reported disposal area. The study also noted the submerged materials were covered with bottom sediments.

In 1997, the area of the site was expanded to include the forested area 100 feet from the shoreline, where dozens of rusted drums were identified. During a site reconnaissance conducted in January 2000, disintegrated drums containing a yellow, wax-like material were observed at the site. NSF-IH personnel analyzed the contents and concluded that the substance was wax and was safe to handle. Base personnel could not verify the origin of the drums.

Photograph 1: Looking Southeast Across Site 17 towards Mattawoman Creek (11/25/08)

2.2.2 Previous Investigations

Initial Assessment Study

An IAS was conducted to identify and assess sites posing a threat to human health or to the environment because of contamination from past operations involving hazardous materials. The IAS identified the area now known as Site 17 as the location of discarded metal parts. The study did not recommend a Confirmation Study for the site because of the inert nature of the materials (Fred C. Hart Associates, 1983).

Phase II RCRA Facility Assessment

A Phase II Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was conducted, consisting of a preliminary review of available documents and a visual site inspection (VSI) that included Site 17 (A.T. Kearny, Inc. and K.W. Brown & Associates, Inc., 1988). During the VSI, rusted large metal parts, many of which were covered with sediment, were noted in the reported disposal area. The RFA reported that Naval Ordnance Station representatives stated the metal parts would be removed in late 1988 or early 1989 under the direction of the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Remedial Investigation

An RI was conducted at Site 17 in 2000. The objectives of the RI were to: (1) determine whether the metal parts disposed of along the shoreline of Mattawoman Creek had contaminated sediment and surface water in the creek, and (2) determine whether the drums and/or their contents had contaminated the surface and subsurface soil and groundwater in the surrounding area. Because no sampling had been conducted at this site before the Phase II RFA, sampling of groundwater, surface soil, subsurface soil, surface water, and sediment was conducted in 2000 as part of the RI (CH2M HILL, 2004a). Three groundwater monitoring wells (IS17MW01 – total depth of 12.5 feet below ground surface (bgs), IS17MW02 – total depth of 12 feet bgs, and IS17MW03 – total depth of 19 feet bgs) were installed in the shallow aquifer to assess groundwater contamination. Well IS17MW03 was installed hydraulically upgradient of the site.

Fifteen surface soil and 15 subsurface soil samples, including samples in areas considered to be uncontaminated (called background samples), were collected and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), target analyte list (TAL) inorganics, and explosives. Several samples were also sampled for total organic carbon (TOC) and pH. All surface and subsurface soil samples were collected from the western part of the site, around the former discarded drums area, and from the intermittent swale. Groundwater samples were collected from the three monitoring wells and analyzed for VOCs, SVOCs, total and filtered TAL inorganics, and explosives. Six sediment samples were analyzed for TAL inorganics, explosives, TOC, and pH. Six surface water samples were analyzed for total and filtered TAL inorganics, explosives, and hardness. Figure 2-1 illustrates the locations of all the RI sampling points.

A baseline human health risk assessment (HHRA) and a screening-level ecological risk assessment (SERA) were performed as part of the RI. These concluded that there were risks associated with soil, sediment, and groundwater at Site 17. The RI recommended that a Feasibility Study (FS) be performed for the site, and additional data were collected to define the bounds of contamination in groundwater for the purposes of the FS.

Pre-Feasibility Study

Following the RI, a Pre-Feasibility Study was conducted in 2002 to define the distribution of VOCs (specifically, TCE, cis-1,2-dichloroethene [cis-1,2-DCE], and vinyl chloride [VC]) in groundwater, to determine if VOCs in groundwater are adversely affecting Mattawoman Creek, and to assess the viability of MNA as a remedial alternative for groundwater (CH2M HILL, 2002). A tidal study was also conducted to evaluate the influence of the tides on groundwater levels. To achieve the objectives, membrane interface probe/electrical conductivity data from 11 locations were collected (MIP1 – MIP11). From these locations, 12 groundwater samples (IS17GW01 – IS17GW12) were collected using direct-push technology (DPT) and analyzed for VOCs. Three surface water samples (IS17SW04, IS17SW07, and IS17SW08) were collected and analyzed for VOCs to assess the impact of groundwater contamination on the surface water quality. Key findings were that the TCE concentration from IS17GW02 is indicative of dense non-aqueous phase liquid (DNAPL), VOCs in groundwater are not adversely affecting Mattawoman Creek, and natural biodegradation processes of VOCs are occurring.

Engineering Evaluation/Cost Analysis and Non Time-Critical Removal Action

An Engineering Evaluation/Cost Analysis (EE/CA) was completed in August 2004 (CH2M HILL, 2004b), which resulted in a non-time-critical removal action (NTCRA) of soil and rusted drums that was completed in December 2005 (FSSI, 2006). The purpose of the removal action was to mitigate the risks to ecological receptors associated with surface soil to acceptable levels through excavation and removal of the soil and drums from the site. After the removal action, the site was restored as an open grassy area. Figure 2-2 shows the drum removal and excavation areas.

Baseline Ecological Risk Assessment

A BERA was conducted in 2004 to further evaluate potential ecological risks from metals, polycyclic aromatic hydrocarbons (PAHs), and explosive compounds in the nearshore sediment resulting from the historical disposal of metal parts and other debris along the Mattawoman Creek shoreline within Sites 11 and 17 (CH2M HILL, 2005). The results showed that no unacceptable risk was associated with the sediment at Site 17.

Additional Investigation

The *Pre-Draft Focused Feasibility Study for Site 17 Groundwater* (CH2M HILL, 2004c) recommended an additional investigation to address data gaps before finalizing the FS. The objectives of this additional investigation were as follows: 1) define the boundary and estimate the mass of the chlorinated VOCs in groundwater for *in situ* chemical oxidation (ISCO) treatment; 2) evaluate natural attenuation (NA) characteristics of groundwater; and 3) determine temporal trends in chlorinated VOC concentration in groundwater.

These objectives were met through the following activities:

- Membrane Interface Probe (MIP) investigation – MIP advancement at four locations (MIPA4, MIPB4, MIPC4, and MIPD3) to a depth range of 14 and 22 feet bgs. Refusal was encountered at the fifth location (MIPD4).
- Monitoring well sampling – measurement of water levels and field parameters and collection of three primary samples and a duplicate sample for target compound list (TCL) VOCs, filtered organic carbon, iron and manganese, chloride, nitrate/nitrite, sulfate, and methane, ethane, ethene (MEE).
- Hydraulic conductivity test - measurement of hydraulic conductivity from all three monitoring wells by a slug test.
- DPT groundwater sampling - Forty-one groundwater grab samples were collected from 30 locations (IS17DP21 through IS17DP50) using a DPT rig from February 22, 2005, through March 2, 2005. Twenty-eight shallow (2-foot depth interval below the water table) groundwater samples were collected from all locations except locations IS17DP30 and IS17DP43 because groundwater was not encountered at these locations. Eleven deep (2-foot depth interval above the low-conductivity clay layer) groundwater samples were collected from locations IS17DP22 through 24, IS17DP26 through 28, IS17DP32 through 34, IS17DP36, and IS17DP40.

- Ten shallow and deep groundwater samples were further analyzed for filtered organic carbon. These samples were collected from six locations: IS17DP32, IS17DP35, IS17DP37, IS17DP40, IS17DP42, and IS17DP48.

Figure 2-2 shows the sampling locations during the Additional Investigation.

Upgradient Investigation

The results of the 2004-2005 additional investigation indicated that the extent of chlorinated VOCs west of the site was not delineated. Consequently, upgradient MIP and DPT sampling occurred from August 29, 2005, through September 1, 2005. The objectives of the upgradient investigation were to: 1) determine if there is an upgradient source of chlorinated VOCs, and 2) delineate the chlorinated VOCs on the western portion of the site. Figure 2-2 shows the sampling locations during the Upgradient Investigation.

A total of 17 DPT groundwater samples were collected from 12 locations and analyzed for TCL VOCs. Of the 17 samples collected, 12 samples were collected from one depth interval at each location; 3 samples were collected from a second depth interval at three locations (IS17DP54, IS17DP55, and IS17DP56); and 2 samples were duplicate samples. In general, the DPT groundwater results delineated the VOC plume to the west of the site.

VOCs were detected in 11 of the 17 groundwater samples collected. The most commonly detected VOC was TCE, which was detected in seven of the samples. The next most commonly occurring VOC detections were total 1,2-DCE, 2-butanone, and cis-1,2-DCE, with five detections each.

Bench-scale Studies

The draft version of the FS (CH2M HILL, 2006) identified uncertainties associated with the effectiveness of *in situ* chemical oxidation (ISCO) technologies for treating TCE. Subsequently, bench-scale studies were conducted to evaluate the effectiveness of certain ISCO technologies (CH2M HILL, 2008a). The specific objectives of the bench-scale studies were to: 1) evaluate the effectiveness of ISCO technologies in treating TCE; 2) determine the site-specific demand of reagents; and 3) identify potential side effects of the select technologies that may not be compatible with the current site use.

The overall findings of the bench-scale studies suggest that: 1) the VOC contamination primarily lies within the saturated vertical interval of approximately 8 to 18 feet bgs in the silty clay soil; 2) both unactivated and iron-activated persulfate as oxidants were equally effective and efficient for treating TCE; and 3) soil mixing should be considered for the treatment reagent delivery method because of the tight soil.

Feasibility Study

An FS was completed to address potential sources of contamination at the site and to evaluate remedial alternatives to mitigate potential hazards associated with the shallow groundwater (CH2M HILL, 2008b).

2.2.3 Enforcement Activities

In September 1995, NSF-IH facility, including Site 17, was placed on the National Priorities List (NPL), but to date no enforcement actions have occurred at the site. The Federal Facility

Agreement provides for CERCLA-directed enforcement activities at the site. As a result, an RI, FS, and Proposed Plan have been completed for Site 17.

2.3 Community Participation

The NSF-IH Restoration Advisory Board is made up of representatives from the community, EPA, MDE, and the Navy. Meetings are held three times a year to provide a forum for the exchange of information among all parties regarding Installation Restoration (IR) activities.

In accordance with the requirements established in Sections 113 and 117(a) of CERCLA and the NCP at 40 CFR §300.430(f)(2), the RI report (CH2M HILL, 2004a), FS report (CH2M HILL, 2008b), and Proposed Plan (CH2M HILL, 2008c) were made available to the public in May 2004, October 2008, and November 2008, respectively. These documents, which are included in the Administrative Record file, can be found in the Information Repositories maintained at the following locations:

Indian Head Town Hall	Charles County Public Library	NSF-IH General Library
4195 Indian Head Hwy.	2 Garrett Ave.	Building 620 (The Crossroads
Indian Head, MD 20640	La Plata, MD 20646-5959	Indian Head, MD 20640)

The notice of the availability of the Proposed Plan was published in the *Maryland Independent* on February 6, 2009. A public comment period was held from February 9, 2009 to March 9, 2009. In addition, a public meeting was held on February 19, 2009, to present the Proposed Plan to a broader community audience.

At this meeting, representatives from the Navy, EPA, and MDE answered questions about the site and the remedial alternative. No written comments were received during the public comment period.

2.4 Scope and Role of Response Action

Site 17 is included in the NSF-IH IR Program. Based on the human health and ecological risk assessments performed during the RI and BERA, no further action is warranted for the subsurface soil, surface water, and sediment at the site. The RI and BERA identified unacceptable risks for ecological receptor exposure to surface soil, and for human exposure to shallow groundwater. The ecological risks associated with the soil were mitigated through a removal of surface soil and drums that was conducted in 2005; therefore, no action is warranted for the surface soil. This response action addresses the shallow groundwater at the site using ISCR, MNA, and ICs.

2.5 Site Characteristics

A description of the site is provided in Section 2.2.1. Characteristics of the site, the nature and extent of contamination, and the human health and ecological risk assessments are presented in greater detail in the RI report (CH2M HILL, 2004a) and in the FS report (CH2M HILL, 2008b), and are summarized in the following sections.

2.5.1 Geology and Hydrogeology

Soil at the site consists of fill material from the ground surface down to an approximate depth of 10 to 12 feet bgs. The fill is characterized by a mixture of silty sand, sandy silt, and wood fragments. The fill layer is underlain by a silty clay layer from 10-12 feet bgs to 18-20 feet bgs. Underlying the silt is a clay layer from an approximate depth of 18-20 feet bgs to depths greater than 25 feet bgs; the total thickness of the clay layer was not assessed.

The groundwater table elevation ranges from 0.8 foot above mean sea level (amsl) to 3.1 feet amsl along the shoreline, and from 4.5 feet amsl to 8.6 feet amsl upgradient of the site. Groundwater flow is from northwest to southeast towards Mattawoman Creek.

2.5.2 Conceptual Site Model

The conceptual site model (CSM) integrates information regarding the physical characteristics of the site, potentially exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify exposure routes and receptors evaluated in the risk assessment. A well-defined CSM allows for a better understanding of the risks at a site and aids in evaluating the potential need for remediation. The potential for the materials disposed of at the site to leach into the soil, and then leach from the soil to the shallow groundwater is the source of contamination for the site.

Figure 2-3 presents the CSM for human receptors at Site 17. The site is not currently used or fenced, and is maintained as open space. There are no other current or projected future land uses for this site. Human receptors under the current land use may come in contact with surface soil and surface water. Exposure routes may include incidental ingestion of and dermal contact with the surface soil and surface water, and inhalation of volatile and particulate emissions from the surface soil. Sediment at the site is completely covered with water, and there is no exposed sediment at the shoreline. Therefore, any sediment contacted would wash off the skin, so exposure to sediment was not considered a complete exposure pathway.

Potential future receptors include the current receptors, and, although unlikely based on projected future land use for the site, future residents, construction workers, and site workers. Future receptors could be exposed to surface and subsurface soil if future residential structures or industrial buildings or piping/utilities are constructed at the site and the soil is re-worked, mixing the subsurface soil with the surface soil. Exposure routes for future exposure to the surface and subsurface soil are the same as those for current surface soil: incidental ingestion of and dermal contact with the soil, and inhalation of particulate emissions from the soil.

Potable water supplies for Indian Head and the surrounding residential area are provided by water supply wells that pump groundwater from the Patapsco formation, and, therefore, there is no current exposure to shallow groundwater at Site 17. The groundwater use patterns are already established for the Base and area around the site, so use of shallow groundwater from the site for industrial or residential purposes is unlikely. However, state and federal governing policies assume that underground fresh water resources are potable and should be maintained as such. Therefore, a potable use scenario was evaluated in the risk assessment. It was conservatively assumed if future residential development of the site occurs, the residents could use the shallow groundwater as a potable water supply. The residents would also be exposed through ingestion, dermal contact, and inhalation while bathing. Additionally, because of the groundwater depth (from 0.8 foot amsl to 3.1 feet amsl along the shoreline and from 4.5 feet amsl to 8.6 feet amsl upgradient of Site 17), construction workers could be exposed to the groundwater through dermal contact in an excavation during construction activities and inhalation of volatiles from the groundwater.

2.5.3 Nature and Extent of Contamination

The summary of the nature and extent of contamination at Site 17 described below is based on the RI (2000), Pre-FS (2002), Additional Investigation (2004-2005), and Upgradient Investigation (2005) and is described in detail in Section 6.4 of the RI report (CH2M HILL, 2004a) and Sections 2.2.6 and 2.4.2 of the FS report (CH2M HILL, 2008b).

Surface Soil

The extent of contamination in the surface soil was based on the samples collected during the RI. Surface soil contained a few VOCs and SVOCs, particularly in the western part of the site, but only at low levels. VOCs and SVOCs were detected in 11 and 10 surface soil samples, respectively. VOCs detected include TCE, cyclohexane, ethylbenzene, toluene, and xylenes. Most commonly detected SVOCs include benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene. Twenty-four inorganics, most commonly arsenic, iron, lead, and manganese, were detected at concentrations above the facility-wide background concentrations. Low concentrations of explosives were detected in four surface soil samples.

Subsurface Soil

During the RI, low concentrations of VOCs were detected in the subsurface soil, primarily around the former discarded drums area. As part of the additional investigation, VOC analysis was performed on subsurface soil samples below the water table collected from six locations: IS17DP32, IS17DP35, IS17DP37, IS17DP40, IS17DP42, and IS17DP48. Low concentrations of VOCs were also observed at the six locations. The highest VOC concentrations in the subsurface soil appear to be collocated with the higher VOC concentrations in groundwater and may indicate the source area for the groundwater contamination.

High concentrations of a large variety of SVOCs were detected in five RI samples; most of them were "J" (estimated) qualified, except for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, fluoranthene, and pyrene. Twenty-three inorganic analytes were detected in subsurface soil RI samples; 10 were detected in one or more samples at concentrations above the facility-wide background, most commonly arsenic, iron, lead, and manganese. Very low concentrations of explosives were detected in five RI subsurface soil samples.

Groundwater

VOCs: During the RI, a total of four samples were collected, consisting of three parent samples and a duplicate. Detections were observed in all monitoring wells for VOCs, explosives, and metals. High concentrations of VOCs (limited to cis-1,2-DCE and VC) were observed in well IS17MW02. Other VOCs were detected at low concentrations. Because of the low concentration of TCE that was observed in soil, TCE was identified as the parent compound of cis-1,2-DCE and VC. The source area, however, was not known. The Pre-FS sampling was designed to further understand the VOC distribution. The results indicated maximum TCE, cis-1,2-DCE, and VC concentrations of 310,000 μg/L, 75,000μg/L, and 50,000 μg/L, respectively, from the sample location IS17GW02. The TCE concentration is indicative of DNAPL. The value represents 28.2 percent of the pure-phase solubility of TCE (1.1×106 μg/L), which suggests the presence of DNAPL (EPA, 1994). Key natural attenuation indicators and favorable geochemical conditions for natural biodegradation were found to be present. The additional and upgradient investigations in 2004–2005, further refined the nature and extent of VOCs in the shallow groundwater. VOCs were detected in all groundwater samples collected. The most commonly detected VOCs (detected in more than 50 percent of the samples) were cis-1,2-DCE, total 1,2-DCE, VC, and TCE. Both cis-1,2-DCE and total 1,2-DCE were detected in 37 of the samples, in concentrations ranging from 1 μg/L to 220,000 μg/L and 1 μg/L to 170,000 μg/L, respectively. VC concentrations ranged from 1 μg/L to 80,000 μg/L in 33 of the samples. Detections of TCE ranged from 2 μg/L to 490,000 μg/L in 26 of the samples; this confirms the presence of DNAPL. The distribution of TCE, cis-1,2-DCE, and VC in the shallow aquifer are shown in Figures 2-4 through 2-6.

SVOCs: Very low concentrations of SVOCs (4-methylphenol and phenol) were detected in one well, IS17MW01.

Metals: The monitoring well groundwater samples collected during the RI in 2000 were analyzed for total and filtered (dissolved) TAL metals, whereas the samples collected during the additional investigation (2004-2005) were analyzed only for total iron and total manganese. Twenty-four inorganics, most commonly aluminum, arsenic, chromium, iron, manganese, and vanadium, were detected at concentrations above the facility-wide background concentrations. The facility-wide background concentrations used were the 95 percent upper confidence limit values for the non-turbid unfiltered groundwater samples (Table A-8 in Appendix A, TTNUS, 2002).Figure 2-7 presents the distribution of select metals in Site 17 groundwater, which are: aluminum, arsenic, chromium, iron, manganese, and vanadium.

Explosives: Very low concentrations of explosives (a maximum of 5.8 J μg/L) were detected in all monitoring wells.

Sediment

A total of six sediment samples (no duplicates) were collected along the shoreline of Site 17. Low concentrations of explosives were detected at three locations. Twenty-one inorganics were detected from all sampling locations. Thirteen of these, most commonly arsenic, iron, lead, and manganese, were detected in one or more samples at a concentration above their facility-wide back-ground concentrations. In general, downstream samples (from locations IS17SD05 and IS17SD06) exhibited the highest concentrations and most frequent detections of metals among all the sediment samples. These samples were collected closest to Site 11, which has been shown to be a source of metals to sediment at that site.

Surface Water

A total of seven surface water samples (including one duplicate) were collected along the shoreline of Site 17, at the locations where the sediment samples were collected. Very low concentrations were observed for all analytes.

The results of the surface water sampling during the Pre-FS indicated no detections of TCE, cis-1,2-DCE, and VC in surface water samples taken from Mattawoman Creek. This suggests that VOCs in groundwater are not adversely affecting Mattawoman Creek.

2.6 Current and Potential Future Land and Resource Uses

Site 17 is currently maintained as open space. No future land use changes are projected for Site 17, and no other land use for this site is planned by the Navy. Shallow groundwater beneath the site is not used for any purpose. The Navy has no plans to develop the groundwater resource in the future. It is unlikely that Site 17 would be developed for residential use. However, hypothetical future residential use of the site was evaluated in the risk assessment to determine if land use restrictions would be necessary at the site.

2.7 Summary of Site Risks

Detailed discussions of risks and the risk evaluation process are presented in the RI report (CH2M HILL, 2004a), BERA report (CH2M HILL, 2005), and FS report (CH2M HILL, 2008b).

2.7.1 Human Health Risk Assessment

As part of the RI, a baseline HHRA was performed for soil, surface water, and groundwater to evaluate the current and future effects of constituents in site media on human health. A detailed discussion of the HHRA is provided in Sections 3.3 and 6.6 in the RI report and Section 2.3 of the FS report. Table 6-10 of the RI report summarizes the calculated risks.

The receptors evaluated in the risk assessment were as follows:

- For current uses—adolescent trespassers/visitors, adult trespassers/visitors
- For future uses—adult resident, child resident, lifetime resident, adolescent trespassers/visitors, adult trespassers/visitors, industrial workers, and construction workers

As noted in Section 2.6, the site is currently maintained as open space. There are no other current or projected future land uses for this site. However, the Navy evaluated the residential exposure scenario to determine if land use restrictions would be necessary at the site. The HHRA is composed of four parts, as discussed below – identification of constituents of potential concern (COPCs), exposure assessment, toxicity assessment, and risk characterization.

Identification of COPCs

The identification of COPCs was a conservative screening process that identified chemicals that may be present at the site at concentrations that could result in risks to exposed receptors. Because the screening process is conservative, the identification of COPCs does not necessarily mean that a risk exists. These COPCs are further evaluated in subsequent steps in the HHRA process to identify the COCs for each medium evaluated. During the FS process, the HHRA COCs are then further evaluated to identify which COCs would require remediation. Tables 2-1 and 2-2 present the evaluation process to determine COCs and COCs requiring remediation, respectively.

The maximum detected concentration of each constituent in each medium (surface and subsurface soil, surface water, and groundwater) was compared to a human health risk-based screening value to select the COPCs. If the maximum detected concentration of a constituent exceeded the screening value, the constituent was selected as a COPC and retained for further evaluation. The EPA Region III risk-based concentrations (RBCs) for residential receptors were used as the screening levels to identify COPCs (EPA, 1997a). The residential soil RBCs were used to screen the soil data, the ambient air RBCs were used to screen the soil data for the soil-to-air exposure pathway, the tap water RBCs were used to screen the groundwater data, and ten times the tap water RBCs were used to screen the surface water data. The RBCs that are based on cancer risk are conservatively set to represent an excess lifetime cancer risk (ELCR) of $1x10^{-6}$, or a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. The RBCs that are based on non-cancer effects are based on a target hazard index (HI) of 1. Therefore, to conservatively account for exposure to more than one non-cancer constituent that affects the same target organ (i.e., liver), the EPA Region III RBCs that were based on non-cancer effects were divided by 10. Constituents eliminated from further evaluation at this step present minimal risks to exposed human receptors.

Section 6.6.2 of the RI report discusses the identification of COPCs and presents the list of COPCs for Site 17. The COPCs for soil were PAHs and metals, and one VOC for the volatile and particulate emissions from soil to the air exposure pathway. The COPCs for groundwater were VOCs, explosives, and metals. There were no COPCs identified for surface water because all of the detected concentrations were below the screening levels.

Exposure Assessment

The exposure assessment defines and evaluates the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations, and estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures are based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: a source of chemicals that can be released into the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor (Figure 2-3).

Onsite exposure points are surface and subsurface soil, surface water, and groundwater beneath the site. Exposure to surface water was not quantified, as there were no COPCs identified for the surface water. It is assumed that current trespassers/visitors could be exposed to surface soil through dermal absorption and incidental ingestion. Future receptors could be exposed to future exposed soils (a mixture of surface soil and subsurface soil) through dermal absorption and incidental ingestion. Inhalation of fugitive and volatile emissions from both current and future soil was not evaluated because no COPCs were retained for these pathways.

Groundwater from Site 17 is not currently used as a potable water supply at NSF-IH, nor is it expected to be used as such in the future[1]. However, groundwater data from the site were used in a conservative assessment of groundwater quality for future offsite or onsite residents. Additionally, exposure to shallow groundwater in an excavation pit during construction activities was evaluated for future construction workers.

Pathway-specific information for these receptors, such as the values of exposure parameters used to quantify exposure, is presented in Section 6.6.3 of the RI report.

Toxicity Assessment

Toxicity assessment weighs the available evidence regarding the potential for a particular chemical to cause adverse effects in exposed individuals and provides a numerical estimate of the relationship between the extent of exposure and possible severity of adverse effects. Toxicity assessment consists of two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining the potential adverse effects from exposure to a chemical. Dose-response assessment is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values (e.g., non-cancer reference doses [RfDs] and carcinogenic slope factors [CSFs]) are derived. These are the toxicity values, used in conjunction with the exposure assessment, to estimate non-cancer hazards and cancer risks associated with exposure to the site media.

EPA has assessed the toxicity of many chemicals and has published the resulting toxicity information and toxicity values in the Integrated Risk Information System and Health Effects Assessment Summary Tables databases (EPA, 1997b). Additionally, toxicity information is available from EPA's National Center for Environmental Assessment.

Health effects are divided into two broad groups: non-cancer effects and cancer effects. This division is based on the different mechanisms of action currently associated with each category. Chemicals causing non-cancer health effects were evaluated independently from those having cancer effects. Some chemicals may produce both non-cancer and cancer effects, and were evaluated in both groups. Non-cancer health effects are evaluated using the RfDs. Cancer risks are evaluated using CSFs. Section 3.3.3 in the RI report provides more detail about the toxicity assessment.

Risk Characterization - Methodology

The risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risks. For carcinogens, risk is generally expressed as the incremental probability of an individual developing cancer over a lifetime of exposure to the carcinogen. ELCR is calculated from the following equation:

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[1] The shallow groundwater at the site would not qualify under MDE regulations as an aquifer. The water supply well must be capable of a sustained yield of at least 1 gallon per minute and be able to produce 500 gallons in a 2-hour period at least once per 24-hour period (COMAR 26.04.04.07.P) and less than 20 feet of casing may not be used in any area (COMAR 26.04.04.07.D.3.c).

$$ELCR = CDI \times CSF$$

where:

ELCR = a unitless probability (e.g., 33 percent) of an individual’s developing cancer that is in addition to the incidence of cancer in the general population unaffected by these releases

CDI = chronic daily intake averaged over 70 years (milligrams per kilogram [mg/kg]-day)

CSF = carcinogenic slope factor, (cancer potency factor), expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that are usually expressed in scientific notation. An ELCR of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. The RME is the highest exposure that is reasonably expected to occur at a site. This is referred to as an ELCR because exposure to site conditions results in an additional risk in addition to the risks of cancer from other causes, such as smoking. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three (33 percent or 3E-1) for women and one in two (50 percent or 5E-1) for men. EPA’s generally acceptable ELCR range for site-related exposure is 1E-04 to 1E-06 (i.e., 1 in 10,000 to 1 in 1,000,000).

The potential for non-cancer effects is evaluated by comparing an exposure level over a specified time period with an RfD, the dose at which no adverse health effects are expected to occur, derived for a similar exposure period. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ of less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-cancer effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COPCs that affect the same target organ (e.g., liver) or that act through the same mechanisms of action within a medium or across all media to which a given individual may reasonably be exposed. An HI of less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-cancer effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present an unacceptable risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer } HQ = CDI/RfD$$

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short term). The CDI for HQ calculations may not be the same as that used in the ELCR calculations.

A detailed discussion of the risk characterization is provided in Sections 3.3.4 and 6.6.4 of the RI report. Section 3.3.5 in the RI report presents the uncertainty analysis for the HHRA. RME non-cancer hazards and cancer risks were calculated for all receptors identified in the exposure assessment. Central tendency exposure (CTE) hazards were calculated when the RME hazards were above 1, CTE cancer risks were calculated when the RME cancer risks were above 10^{-4}. The CTE is an estimate of the average exposure that could be experienced by a receptor at the site.

Risk Characterization - Results

The risk assessment calculation tables are provided in Appendix G of the RI report. Tables 7.1.RME through 7.24.CTE calculate the non-cancer hazards to each receptor. Tables 8.1.RME through 8.17.CTE calculate the cancer risks to each receptor. Tables 9.1.RME through 9.13.CTE summarize the non-cancer hazards and cancer risks. Tables 10.1.RME through 10.7.CTE show only the constituents that contribute an HI greater than 0.1 or a cancer risk greater than 10^{-6} to receptors. In addition, Tables 2-14 and 2-15 summarize the media-specific risks and hazards for RME and CTE, respectively.

The HHRA concluded that there were no unacceptable cancer (risks above 10^{-4}) or non-cancer risks (hazards above 1) to current receptors (adult and adolescent trespassers/visitors exposed to surface soil) and to future receptors (industrial workers, adult trespassers/visitors, adolescent trespassers/visitors exposed to combined surface and subsurface soils). The HHRA further concluded that risks were primarily associated with future exposure (residential and construction worker) to groundwater and combined soil (surface and subsurface). The risks associated with future residential exposure to the combined soil, however, were found to be acceptable, based on the reasoning presented below. The results of the HHRA are presented below by medium.

Surface Soil: The baseline risk assessment concluded that under current site use conditions, surface soil does not represent an unacceptable risk to the adolescent trespassers/visitors and adult trespassers/visitors. The non-cancer HI was below 1 and the calculated cancer risk was within or below the EPA's acceptable range of 1×10^{-4} to 1×10^{-6}.

Combined Surface and Subsurface Soil: Under future land use conditions, combined surface and subsurface soil does not represent unacceptable risks (both non-cancer and cancer) to the adult resident, adolescent trespassers/visitors, adult trespassers/visitors, construction workers, and industrial workers. Soil, however, may pose unacceptable non-cancer risks to the child resident (HI = 2.7), based on the RME scenario. This HI is above the EPA's benchmark of 1, and is mostly attributable to incidental ingestion of iron. Based on current site conditions, this hazard is likely overestimated because the drums and surface soil (1-foot layer) that served as a continuing source of iron contamination were removed during the 2005 NTCRA. Additionally, iron is a required human nutrient, and the concentrations of iron detected in the soil would result in intake levels below the recommended dietary allowance for iron.

Surface Water: No COPCs were identified for surface water; therefore, exposure to surface water was not quantified in the risk assessment.

Sediment: Exposure to sediment is an incomplete exposure pathway because all sediment at the site is covered with water. Therefore, exposure to sediment was not quantified in the risk assessment and would not pose unacceptable risks.

Groundwater: The future potential receptors identified and evaluated in the risk assessment for exposure to groundwater included those associated with the following uses: adult resident, child resident, lifetime resident, and construction worker.

The potential unacceptable human health risks were associated with the following:

- Future adult resident non-cancer hazard (HI = 64) from the use of groundwater as a potable residential water supply; hazard is primarily associated with exposure to VC and cis-1,2-DCE, with a smaller contribution from iron, manganese, and vanadium.
- Future child resident non-cancer hazard (HI = 131) from the use of groundwater as a potable residential water supply; hazard is primarily associated with exposure to VC and cis-1,2-DCE, with a smaller contribution from aluminum, chromium, iron, manganese, and vanadium.
- Future lifetime resident cancer risk (6.9×10^{-2}) associated with exposure to VC.
- Future lifetime resident cancer risk (10^{-4}) associated with exposure to arsenic, trinitrotoluene (TNT), and hexahydro-1,3,5-trinitro-1,3,5-triazine (also known as royal demolition explosive [RDX])
- Future construction worker non-cancer hazard (HI = 1.7) associated with exposure to VC in groundwater during excavation.

2.7.2 Ecological Risk Assessment

An SERA was conducted for Site 17 to estimate the risks the site would pose to ecological receptors if no action were taken. The SERA provides a conservative assessment of potential ecological risk. The general approach and site-specific approach for the ecological risk assessment are provided in Sections 3.4 and 6.7, respectively, of the RI report.

Identification of COPCs

COPCs were identified at the conclusion of the SERA from the preliminary list of ecological COPCs. The COPC selection process involves consideration of the ecological HQs, based on refined exposure assumptions, frequency of detection, consideration of likely risk from chemicals without screening values, and consideration of background concentrations. If there are COPCs at the end of the SERA, the risk assessment process continues with a site-specific BERA to refine the screening-level risk estimates. The BERA begins with Step 3B (revised problem formulation) and Step 4 (BERA work plan). Because COPCs were identified after Step 3A for Site 17, a BERA was performed. Detailed steps for identifying the COPCs are provided in Sections, 3.4.3, 3.4.4, 4.7.3, and 4.7.4 of the RI report.

Exposure Assessment

This step is conducted to estimate the chemical concentration to which various ecological receptors will be exposed through either direct exposure at the site or through bioaccumulation/food chain dynamics.

Site 17 is defined as a 1,000-foot stretch of shoreline along the Mattawoman Creek where metal parts were discarded, including the forested area 100 feet from the shoreline where dozens of rusted drums were identified. The riparian forested buffer is sparsely vegetated with black locust (*R. pseudoacacia*) and sweet gum (*L. styraciflua*). Japanese honeysuckle (*Lonicera japonica*) is also common within the buffer. Wild rye (*E. villosus*) dominates the herbaceous layer. The shoreline of the site is eroded with discarded metal parts, concrete, and other debris used for erosion control. Vegetation within the intertidal shore includes wild rye (*E. villosus*) and rose-mallow (*H. palustris*).

Potential Receptors

Receptors potentially exposed to soil contaminants at Site 17 include organisms that have significant direct contact with soil or consume prey that live in the soil or leaf litter. These could include plants, soil invertebrates, and birds or mammals that consume plants or invertebrates. Top consumers such as raptors or foxes also could be potentially exposed to bioaccumulative chemicals in the soil. Potential aquatic receptors include aquatic plants, invertebrates, and fish. Semi-aquatic organisms that feed along the shoreline of Site 17 (e.g., raccoon and great blue heron) also may be potentially exposed to bioaccumulative chemicals in the sediment.

Exposure Pathways

Key exposure routes for ecological receptors include ingestion of chemicals adsorbed to soil (invertebrates) and direct contact with chemicals in the soil (invertebrates and plants). Other organisms that forage in the area are potentially exposed to chemicals by direct contact, incidental ingestion of soil, and ingestion of invertebrates and/or plants that have accumulated chemicals in their tissues. Receptors are potentially exposed to chemicals in the sediment at Site 17 through direct contact ingestion, and receptors using the shoreline area, such as herons and raccoons, could be exposed to chemicals through the ingestion of plant or animal tissues with chemical burdens.

Exposure Point Concentrations

Maximum detected concentrations in soil and sediment were used as the basis for estimating the chemical exposure to receptor communities and species. Exposure point concentrations for food web modeling of exposure for upper trophic-level receptors were estimated using the methodology and models described in Section 3.4.2.2 of the RI Report. Dietary items for which tissue concentrations were modeled included terrestrial plants, soil invertebrates (earthworms), small mammals, aquatic plants, aquatic invertebrates, and fish/ frogs.

According to Superfund guidance (EPA, 1997a), Step 3 initiates the problem formulation phase of the BERA. Under Navy guidance (Chief of Naval Operations, 1999), the BERA is defined as Tier 2, and the first activity under Tier 2 is Step 3A. In Step 3A, the conservative assumptions employed in Tier 1 are refined and risk estimates are recalculated using the same CSM for the site.

In some cases, additional information is presented that has bearing on whether a chemical is identified as a potential risk driver. Risk estimates were based on maximum concentrations in Step 2 and average concentrations in Step 3A. For upper–trophic-level receptors (i.e., carnivorous animals), average chemical concentrations provide a more representative estimate of the likely level of chemical exposure because the local population (and, in many cases, individual organisms for highly mobile species with large home ranges relative to the size of the site) would be expected to occur throughout the site (where suitable habitat is present) and, in many cases, off the site. Mean concentrations (or some other estimate of central tendency) may also be appropriate for evaluating potential risks to populations of lower–trophic-level terrestrial and aquatic receptors because the members of the population are expected to be found throughout the site (where suitable habitat is present), rather than concentrated in one particular area.

While effects on individual organisms might be important for some receptors, such as rare and endangered species, population- and community-level effects are typically more relevant to ecosystems. In many cases, the average concentration is a conservative representation of the true site average because samples are generally biased toward areas of known or suspected contamination.

Ecological Effects Assessment

The purpose of the effects evaluation is to establish chemical exposure levels (screening values) that represent conservative thresholds for adverse ecological effects. Direct contact screening values were used to assess potential risks to the soil invertebrate and terrestrial plant communities. Ingestion screening values for dietary exposures were derived for each avian and mammalian receptor species and chemical evaluated in the assessment. Section 3.4.2.1 of the RI report provides a detailed description of the screening values used in the ecological risk assessment.

Ecological Risk Characterization

Screening-level Risk Characterization. Section 4.7.4.3 of the RI report provides a detailed description of the ecological risk characterization. A summary of the ecological risks identified at the conservative screening stage (i.e., the SERA) are described below by environmental medium.

Surface Soil: The concentrations of aluminum, cadmium, chromium, copper, iron, lead, mercury, silver, vanadium, and zinc exceeded soil screening values. Of these, aluminum and vanadium were present at concentrations that are consistent with NSF-IH background levels. Cadmium, chromium, copper, iron, lead, mercury, silver, and zinc were present at higher concentrations than those in the NSF-IH background data set and therefore were identified as COPCs.

An SERA was prepared for Sites 11 and 17 together because of their proximity to each other. This approach made sense from an ecological exposure perspective because of the potential combined exposure to ecological receptors from COPCs at both sites. However, in the interim, a drum removal action was planned for Site 17; therefore, the Site 17 surface soil data were re-evaluated separately to guide the soil removal action concurrent with the drum removal. The evaluation of the Site 17 surface soil data revealed that the mean concentrations of seven metals and two PAHs, benzo(b)fluoranthene and pyrene, exceeded ecological screening values (Table 2-3); however, three of the seven metals (aluminum, chromium, and vanadium) were present at concentrations similar to background levels. The remaining four metals (iron, lead, mercury, and zinc) were present at concentrations substantially above background concentrations. The two PAHs that exceeded screening values were found in scattered locations, with a low frequency of exceedence: benzo(b)fluoranthene (3 of 15), pyrene (3 of 15).

In support of the soil removal action, literature-based preliminary remediation goals (PRGs) were identified for lead, mercury, and zinc that were protective of small mammals and soil invertebrates. Considering the soil conditions at the site (within a pH range of 5.3 to 7.2 and well-drained) and the iron concentrations in the surface soil (8,950 to 224,000 mg/kg) it is unlikely that iron poses a significant ecological risk. Therefore, iron was not considered a risk-driving COPC.

Sediment: A similar background comparison was conducted for sediment. Concentrations of arsenic, manganese, mercury, and nickel were consistent with background levels. The other inorganics that exceeded screening values (barium, cadmium, copper, cyanide, lead, silver, and zinc) were all selected as COPCs. Each may pose a risk to sediment invertebrates or aquatic plants.

Benzo(a)anthracene (HQ=1.4) was detected at two locations (IS11SD02 at 250 microgram(s) per kilogram (µg/kg) and IS11SD06 at 91 µg/kg). Benzo(k)fluoranthene (HQ=1.2) was detected at location IS11SD02 at a concentration of 170 µg/kg. In each case, only the maximum detected concentration exceeded the screening value, and both locations of maximum detection were at IS11SD02 in the Mattawoman Creek. Two additional PAHs were detected at location IS11SD02, with average site concentrations in excess of the screening value. The location of maximum detection for four of the seven detected explosives was also at IS11SD02. Two of these detections exceeded the screening value. Because of the number of exceedances of PAH and explosives benchmarks, these groups were selected as COPCs in the area between IS11SD01 and IS11SD03, encompassing sample location IS11SD02. Acetone was also detected in three of seven sediment samples (HQ=3.3). Because acetone is a common laboratory contaminant and was not stored at the site, it was not selected as a COPC.

Surface Water: Ecological receptors are not exposed directly to contaminants in groundwater, but are exposed directly to contaminants in surface water. Therefore the assessment of surface water risks also provided an assessment of ecological risk from contaminants in the groundwater. Manganese was the only detected constituent in surface water with an HQ in excess of 1. The total manganese concentration was consistent across all samples, ranging from 87.4 µg/L to 134 µg/L. The dissolved concentration exceeded the screening value of 10 µg/L in four of the six detections. Three of the exceedances were samples taken from the stream and tidal wetland west of Site 11 (IS11SW05, IS11SW06, and IS11SW07). Water depth was shallow (4 to 6 inches) at these locations, increasing the chance of obtaining a sample with more suspended solids. Because the concentrations of total manganese were consistent across the site and manganese is not a COPC in soil or sediment, it likely poses minimal risks to ecological receptor populations. It was, therefore, not selected as a COPC.

Baseline Risk Characterization. The results of the SERA identified several inorganics in sediment and soil as COPCs that could pose a risk to invertebrates, plants, insectivorous birds and mammals, carnivorous terrestrial birds, and piscivorous (fish-eating) birds. Sections 4.7.4.4 and 4.7.4.5 of the RI report present the uncertainty and conclusions, respectively, of the ecological risk assessment. Lead, mercury, and zinc risks in surface soil were addressed through the removal action that was completed in December 2005.

Following the SERA, a BERA was performed because the results of the SERA indicated there were potentially unacceptable risks to ecological receptors from exposures to the sediment along Mattawoman Creek. Soil at Site 17 was not included in the BERA because the soil remaining after the removal action met the regulatory agency-approved ecological risk action levels. The spatial distribution of the COPCs at Site 17 and a toxicity evaluation of the risk-driving COPCs are discussed in the BERA report. The BERA evaluated sediment in the unnamed creek and Mattawoman Creek adjacent to Site 17 (CH2M HILL, 2005a).

To further refine the risk estimates, additional data were collected and analyses were conducted to support the BERA for Site 17 and the unnamed creek. The COPC list for upper-trophic-level receptors was expanded to include zinc because it was estimated to exceed the no observed adverse effects level (NOAEL) -based toxicity threshold for piscivorous birds and insectivorous wetland birds. Additionally, silver was added as a COPC for upper–trophic-level receptors to reduce the uncertainty in the risk estimate for this metal, although silver was not identified as exceeding the NOAEL-based toxicity value.

Potential risks to fish from site-related chemicals in the sediments were not evaluated directly in the SERA. To address this data gap, epibenthic fishes were included in the BERA as potential receptors. Potential risks to epibenthic fishes were evaluated for the four bioaccumulative metals (lead, mercury, silver, and zinc) identified for other upper-trophic-level receptors. Benzo(a)anthracene and explosives-related chemicals were detected at low frequencies and at low concentrations. PAHs, in general, are metabolized and excreted rapidly. The fate and transport information for the nitroaromatic (explosives-related) compounds suggests their limited persistence in aquatic environments. Therefore, PAHs and nitroaromatics are unlikely to pose a significant risk to mobile aquatic receptors and were not included as COPCs for fish.

The results of the BERA showed that: (1) conditions in the unnamed creek pose an unacceptable risk to benthic invertebrates, but evidence suggests that the risk is not related to COPCs from Site 17; (2) the bioaccumulative COPCs (lead, mercury, silver, and zinc) do not pose unacceptable risk to piscivorous birds and wetland insectivorous birds; and, (3) the COPCs in the sediments along the shoreline of Site 17 do not pose an unacceptable risk to the benthic invertebrate community.

The degraded benthic invertebrate community in the unnamed creek is not related to COPCs from Site 17. The physical nature of the creek (high biological oxygen demand and low dissolved oxygen) may be contributing to the degraded condition of the benthic invertebrate community, in addition to a potential upstream contaminant source, which will be addressed under Site 66. Sections 8.7.4.4 and 8.7.4.5 of the BERA report present the uncertainty and conclusions, respectively.

2.8 Remedial Action Objectives

The HHRA discussed in Section 2.7.1 and the subsequent BERA concluded that no unacceptable risk is posed by contamination in the subsurface soil, surface water, and sediment. The SERA concluded that an ecological risk was posed by contamination in the surface soil and this was addressed through the 2005 NTCRA. Therefore, the unacceptable risks to be mitigated are limited to those caused by human exposure to the shallow groundwater. The human health risk-based COCs include cis-1,2-DCE, VC, TNT, RDX, aluminum, arsenic, chromium, iron, manganese, and vanadium. TCE is also included as a COC because the results of a follow-up sampling post HHRA showed that TCE concentrations are indicative of DNAPL. TCE is likely the source of cis-1,2-DCE and VC The FS addressed the human health risk-based COCs and TCE, which were then referred to as FS COCs.

Based on the evaluation of site conditions, an understanding of the contaminants, the physical properties in media of concern, the results of risk assessments, and an analysis of ARARs, the following remedial action objectives (RAOs) for Site 17 shallow groundwater were developed:

- Prevent unacceptable risks to human receptors from exposure to contaminants in the shallow groundwater.
- Prevent migration or discharge of groundwater with FS COCs above SRGs to Mattawoman Creek.
- Return the shallow groundwater to its beneficial use to the extent practicable.

The SRGs for the FS COCs, except for TCE, were developed based on the greater of the site-specific, risk-based PRGs, facility-wide background concentrations (95 percent Upper Confidence Limit), or State of Maryland or federal groundwater maximum contaminant levels (MCLs), unless this value was deemed to provide insufficient protection of human health, in which case an SRG that was protective and/or conforms with EPA, MDE, and Navy environmental restoration guidance was selected by risk managers. The SRG for TCE was based on the MCL.

For the FS COCs other than TCE, PRGs were calculated for the potential future adult resident, future child resident, future lifetime resident, and future construction worker, although it is unlikely that the site will become a residential area. Appendix H of the FS report (CH2M HILL, 2008) provides details on the site-specific PRGs calculated for groundwater.

To evaluate the FS COCs that require remediation, their respective maximum concentration was compared to the SRGs. If the maximum concentration was greater than the SRG, then the FS COC was retained for remediation; if the maximum concentration was less than the SRG, then the FS COC was eliminated from remediation. Iron and manganese exceeded their respective SRG values and should have been retained as FS COCs for remediation; however, they were eliminated because the highest concentrations of these metals that exceeded the SRGs were in locations where the NTCRA had occurred. The NTCRA removed the potential source of iron and manganese, thereby eliminating further impact to the soil. The maximum concentration of vanadium exceeded the SRG, but it was not retained as an FS COC for remediation because the maximum concentration was detected in the upgradient site-specific background monitoring well IS17MW03. The concentrations of vanadium within the area of attainment (AA) were less than the SRG; therefore, vanadium was eliminated as an FS COC for remediation.

Consequently, the FS COCs requiring remediation are TCE, cis-1,2-DCE, and VC based on their exceedance of the SRGs. Table 2-1 summarizes the process for determining the FS COCs that require remediation. Table 2-2 lists the FS COCs and their respective SRGs that drive the remediation for the shallow groundwater. Figure 2-8 shows the AA, which is defined as the area where SRGs are exceeded. Based on the RAOs, applicable remedial alternatives (RAs) were developed.

2.9 Summary Descriptions of Remedial Alternatives

A detailed description of each RA is available in Section 5.1 of the FS report. A summary of the five alternatives is presented below. In addition, the summary of estimated remediation costs and timeframes is presented in Table 2-4.

Alternative 1—No Action: This alternative is required by NCP §300.430(e)(3)(ii) to be evaluated as a baseline. Under this alternative, no remediation is planned.

Alternative 2—MNA and ICs: This alternative consists of:

- Designating Site 17 as "restricted use" area in the base geographic information system (GIS) database, which would prohibit intrusive activities, such as excavation, residential development, or use of groundwater. This designation would remain in place until groundwater monitoring indicates that the SRGs have been met. The IC area encompasses the AA, which is depicted on Figure 2-8.
- Conducting groundwater sampling using a network of three existing and five new monitoring wells. It is anticipated that samples would be collected biannually for the first 3 years, annually for the following 5 years, and then once every 5 years for the remaining years until SRGs are met. All samples will be analyzed for the COCs and other geochemical and NA indicators. The frequency and duration of the sampling events may be altered based on the results of the 5-year reviews.
- Implementing surface water monitoring at three locations along the shore of Mattawoman Creek; surface water samples would be analyzed for VOCs at each sampling event coinciding with each groundwater sampling event.

These components represent a conceptual approach to Alternative 2; long-term monitoring and IC plans that describe the detailed components of the MNA and ICs will be prepared after this ROD is signed.

Alternative 3—Source Zone Treatment Using ISCO, MNA, and ICs: This alternative consists of:

- Implementing ISCO in the source zone (TCE>1,000 µg/L) using iron-activated sodium persulfate
- Using NA processes for the remaining dissolved plume within the South and North Plumes and the source zone following the active treatment
- Conducting long-term groundwater and surface water monitoring, as described in Alternative 2
- Implementing ICs in the form of groundwater use restrictions, as described in Alternative 2

Alternative 4—Source Zone Treatment using ISCR, MNA, and ICs: This alternative consists of:

- Implementing ISCR using the granular ZVI within the source zone

- Using NA processes for the remaining dissolved plume within the AA and the source zone following the active treatment; conducting long-term groundwater and surface water monitoring as described in Alternative 2
- Implementing ICs in the form of groundwater use restrictions as described in Alternative 2

Alternative 5—Source Zone Removal and Offsite Disposal, MNA, and ICs: This alternative involves the removal (excavation and dewatering) of the soil and groundwater within the source zone, transportation and disposal of excavated soil and groundwater to an offsite facility, and NA monitoring for the remaining AA, in conjunction with implementation and enforcement of ICs as described in Alternative 2.

2.10 Summary of Comparative Analysis of Alternatives

The NCP outlines the approach for comparing remedial alternatives, 40 CFR §300.430(f)(5)(i). Evaluation of the alternatives uses "threshold," "primary balancing," and "modifying" criteria. To be considered for remedy selection, an alternative must meet the following threshold criteria:

- Overall protection of human health and the environment - This criterion addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.
- Compliance with the applicable or relevant and appropriate requirements (ARARs) - Section 121(d) of CERCLA and 40 CFR §300.430(f)(1)(i)(A) require that remedial actions at CERCLA sites at least attain federal and state ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4).

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

- Long-term effectiveness and permanence - This criterion refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. It also considers residual risk that will remain onsite following remediation and the adequacy and reliability of controls.
- Reduction in toxicity, mobility, or volume through treatment - This criterion refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.
- Implementability - This criterion addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other entities are considered.

- Short-term effectiveness - This criterion addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.
- Cost – This criterion refers to costs associated with construction and operation of the remedy; these include capital costs, operation and maintenance costs, and present worth costs.

The alternatives are evaluated further against the two modifying criteria:

- Acceptance by the state
- Acceptance by the community

A comparative analysis for the threshold and primary balancing criteria was conducted in the FS for the five remedial alternatives for groundwater. These alternatives were analyzed based on the criteria set forth by the NCP. Alternatives 3 and 4 satisfy all of the threshold and the primary balancing criteria. Alternatives 3 and 4 are equally protective of human health and the environment because they would actively treat the residual DNAPL and the high concentrations of dissolved COCs as the source of groundwater contamination. However, Alternative 3 would be more expensive than Alternative 4 because of the persulfate natural oxidant demand, as determined during the bench-scale studies. Alternative 5 provides the greatest protection for human health and the environment because the source zone area (TCE>1,000 µg/L) would be removed; this alternative, however, entails the highest cost and greatest short-term risks to the remediation workers and the environment because of the management and handling of MEC, as well as the greatest disruption to the daily operation of the facility and surrounding community. Alternative 2 is the least expensive and easily implementable, but the remedial timeframe is the longest and it only minimally satisfies the threshold criteria or other balancing criteria.

Table 2-4 presents the comparative analysis for the threshold and primary balancing criteria for the five remedial alternatives for shallow groundwater. Section 5 of the FS report provides a detailed description of the comparative analysis of the remedial alternatives.

2.11 Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address "principal threats" posed by a site wherever practicable (40 CFR Section 300.430 (a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is one that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or act as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, DNAPL in groundwater may be viewed as source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

The TCE which is inferred to be present as DNAPL represents the principal threat for the shallow groundwater at Site 17. The DNAPL is "highly toxic" and serves as a continuing source for the contamination in the shallow groundwater. A remedial alternative involving treatment will be used to eliminate this significant risk to human health.

2.12 Selected Remedy

The Selected Remedy for Site 17 is Alternative 4 – Source Zone Treatment using ISCR, MNA, and ICs.

2.12.1 Summary of the Rationale for the Selected Remedy

The rationale for selecting Alternative 4 is documented in Section 2.10.

2.12.2 Description of the Selected Remedy

The components of this alternative include the following:

- Clearing and removal of MEC and non-MEC metallic objects before soil mixing.
- Applying granular ZVI via soil mixing in the area where the TCE concentration exceeds or equals 1,000 µg/L.
- Conducting short-term performance sampling events at baseline (before soil mixing), 6, 9, and 12 months after soil mixing. The cost estimate assumed that during each sampling event, soil and groundwater samples from DPT locations and monitoring wells, as well as surface water samples from Mattawoman Creek, would be collected. Soil, grab groundwater, and surface water samples would be analyzed for VOCs that have been identified as the COCs requiring remediation (Table 2-2), and monitoring well groundwater samples would be analyzed for the COCs and NA indicator parameters, such as ferrous iron, sulfate, nitrate/nitrite, MEE, alkalinity, dissolved oxygen, oxidation- reduction potential, pH, electrical conductivity, and temperature. Details of the short-term sampling and analysis will be provided in the Uniform Federal Policy Sampling and Analysis Plan that will be prepared as part of the remedial action plan for soil mixing.
- Conducting long-term groundwater monitoring for an assumed duration of 29 years after completing the short-term performance sampling. The cost estimate assumed that sampling and analyses of groundwater (from eight monitoring wells) and surface water samples (from three locations in Mattawoman Creek) would be conducted biannually during years 2 through 3, annually for years 4 and 5, and every 5 years thereafter through year 30. Details of the long-term sampling and analysis will be provided in a long-term monitoring plan that will be prepared after the ROD is signed.
- Conducting 5-year reviews.
- Designating Site 17 as "restricted use" area in the base GIS database, which would prohibit intrusive activities, such as excavation, residential development, or use of groundwater. This designation would remain in place until groundwater monitoring

indicates that the SRGs have been met. The IC area encompasses the AA, which is depicted on Figure 2-8.

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After the ROD is signed, as part of the remedial design, the Navy will also prepare the IC plan and the long-term monitoring plan. Both plans will be submitted to EPA and MDE for review before implementing the Selected Remedy.

The Navy will be responsible for implementing, maintaining, periodic reporting on, and enforcing the ICs in accordance with the IC plan. Although the Navy may transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall remain ultimately responsible for the remedy integrity and shall: 1) perform CERCLA 121(c) 5-year reviews; 2) notify the appropriate regulators and/or local government representatives of any known IC deficiencies or violations; 3) provide access to the property to conduct any necessary responses; 4) retain the ability to change, modify, or terminate ICs and any related deed or lease provisions; and 5) ensure that IC objectives are met to maintain remedy protectiveness.

2.12.3 Summary of Estimated Remedy Costs

A summary of the estimated costs for the Selected Remedy is presented in Tables 2-5 and 2-6. The capital cost of approximately $1.4 million is associated with the implementation of groundwater use restrictions as part of the ICs, drilling new groundwater monitoring wells, submitting the work and sampling plans, injecting and mixing the ZVI, and monitoring and reporting. As shown in Table 2-5, the theoretical iron demand is approximately 36,000 pounds. O&M activities are mostly associated with the long-term groundwater and surface water monitoring to assess the performance of the ISCR technology and the rate of NA processes. Periodic costs incurred are primarily associated with the 5-year reviews. The present-worth lifetime O&M cost is approximately $348,200, and the total present-worth value of this alternative is estimated at $1.74 million (Table 2-6).

2.12.4 Estimated Outcomes of Selected Remedy

No future land use changes are projected for Site 17. In accordance with the IC objectives, the Navy shall restrict future groundwater use at the site as described in Section 2.12.1. The groundwater at Site 17 is currently not used for any beneficial uses and will not likely be used as a potable water supply in the future. No community impacts from the selected remedy are expected. The anticipated environmental benefit of the Selected Remedy is the restoration of shallow groundwater within 30 years, such that no risks will be presented under conditions of unlimited use/unrestricted exposure.

2.13 Statutory Determinations

Remedial actions must meet the statutory requirements of Section 121 of CERCLA. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA states a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element and a bias against offsite disposal of untreated wastes. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

2.13.1 Protection of Human Health and the Environment

The Selected Remedy is considered protective of human health and the environment. This alternative would actively treat the COC mass in the source area. This alternative also would minimize the migration or discharge of unacceptable COC concentrations into the creek. Following the completion of the active treatment, NA processes would be used as the primary treatment mechanism to degrade the COCs to achieve the SRGs. Under this alternative, the RAOs, and therefore the SRGs, would be achieved within a period of 30 years or less. The estimated timeframe is considered reasonable for Site 17 because the groundwater is not currently used.

2.13.2 Compliance with ARARs

The Selected Remedy will comply with all identified ARARs. Federal and state ARARs are provided by classification in Tables 2-7 to 2-9. The classifications of ARARs identified include chemical-specific (Table 2-7), location-specific (Table 2-8), and action-specific (Table 2-9).

2.13.3 Cost-Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (40 CFR §300.430(f)(1)(ii)(D)). This conclusion was reached by evaluating the overall effectiveness of the alternatives that satisfied the threshold criteria. Overall effectiveness was evaluated by assessing the five balancing criteria in combination. Overall effectiveness was then compared to cost to assess cost-effectiveness. The relationship of the overall effectiveness of the Selected Remedy was found to be proportional to its cost, and, therefore, represents a reasonable value for the money to be spent.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The Navy, EPA, and MDE have concluded that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practical manner at Site 17. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Navy, EPA, and MDE believe that the Selected Remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against offsite treatment and disposal, and considering state and community acceptance.

In addition, the Selected Remedy provides the best balance of tradeoffs compared to the other alternatives that were determined to be protective of human health. In particular, the

Selected Remedy provides a level of long-term protection equivalent to the other alternatives, but at a greatly reduced cost.

2.13.5 Preference for Treatment as a Principal Element

The Selected Remedy uses treatment and, therefore, satisfies the statutory preference for treatment as a principal element.

2.13.6 5-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, pursuant to 40 CFR §300.430(f)(4)(ii), the Navy will conduct a statutory remedy review within 5 years after initiating the remedial action and every 5 years thereafter to ensure that the remedy continues to provide adequate protection of human health and the environment.

2.14 Documentation of Significant Changes

The Selected Remedy is the same alternative as the recommended alternative in the Proposed Plan that was presented at a public meeting on February 19, 2009.

Table 2-1
Evaluation Process to Determine FS COCs
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Contaminant of Concern	SRG (µg/L)	Maximum Concentration (µg/L)	Considered for Remediation?
Trichloroethylene	5	490,000	Yes
cis-1,2-Dichloroethylene	150	4,200	Yes
Vinyl chloride	2	3,000	Yes
2,4,6-Trinitrotoluene	22	5.8	No – maximum concentration lower than SRG
Hexahydro-1,3,5-trinitro-1,3,5-triazine (Royal Demolition Explosive - RDX)	6	3.3	No – maximum concentration lower than SRG
Aluminum	9,620	31,500	No – mostly exists as sorbed phase, thus low mobility
Arsenic	10	4	No – maximum concentration lower than SRG
Chromium	100	86.9	No – maximum concentration lower than SRG
Iron	19,900	71,000	No – non-time critical removal of the soil and remaining drums in December 2005 removed the source
Manganese	824	2,620	No – non-time critical removal of the soil and remaining drums in December 2005 removed the source
Vanadium	20.9	49	No – maximum concentration was detected in the site's upgradient well IS17MW03. The concentrations within the contamination area are lower than SRG.

Notes
1. SRG - Site Remediation Goal
2. µg/L - micrograms per liter
3. The maximum concentration of TCE is from a DPT groundwater sample whereas the maximum concentrations of all other parameters are from monitoring well groundwater samples.

Table 2-2
COCs Requiring Remediation
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

COCc	SRG (µg/L)	Comment
Trichloroethylene (TCE)	5	Technically not a COC because maximum TCE concentration was not used in HHRA. TCE is presumed to present unacceptable risks to human health and is the presumed source for cis-1,2-DCE and VC.
cis-1,2-Dichloroethylene (cis-1,2-DCE)	150	Risk-driving COC
Vinyl chloride (VC)	2	Risk-driving COC

Notes
SRG - Site Remediation Goal
µg/L - micrograms per liter

Table 2-3
Step 3 Ecological Risk Screening
Record of Decision - Site 17
NSF-IH, Indian Head, MD

Chemical	Reporting Limit Range	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Arithmetic Mean	Standard Deviation of Mean	Screening Value	Frequency of Exceedance	Mean Hazard Quotient
Inorganics (MG/KG)									
Aluminum	4.40 - 6.80	15 / 15	10,500	IS17SS150001	7,275	1,834	50.0	15 / 15	145.49
Chromium	0.25 - 1.50	15 / 15	32.9	IS17SS010001	16.0	6.05	0.40	15 / 15	39.95
Iron	3.60 - 19.8	15 / 15	224,000	IS17SS060001	32,830	53,636	200	15 / 15	164.15
Lead	0.33 - 0.94	15 / 15	602	IS17SS010001	73.1	150	50.0	4 / 15	1.46
Mercury	0.056 - 0.091	6 / 15	0.41	IS17SS060001	0.12	0.13	0.10	6 / 15	1.18
Vanadium	0.17 - 1.00	15 / 15	29.4	IS17SS100001	21.7	4.33	2.00	15 / 15	10.83
Zinc	0.15 - 0.44	15 / 15	1,140	IS17SS080001	211	306	50.0	10 / 15	4.23
Semivolatile Organic Compounds (UG/KG)									
Benzo(b)fluoranthene	370 - 600	4 / 15	970	IS17SS010001	308	254	100	3 / 15	3.08
Pyrene	370 - 600	8 / 15	740	IS17SS080001	218	176	100	4 / 15	2.18

Notes:
mg/kg = milligram per kilogram
ug/kg = microgram per kilogram

Table 2-4
Comparative Analysis of Remedial Alternatives
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Evaluation Criteria	Alternative 1 No Action	Alternative 2 MNA and ICs	Alternative 3 Source Zone Treatment Using ISCO, MNA, and ICs	Alternative 4 Source Zone AreaTreatment Using ISCR, MNA, and ICs	Alternative 5 Source Zone Area Excavation and Off-site Disposal, MNA, and ICs	Qualitative Rank
Overall Protection of Human Health and the Environment		Alternative 2 provides minimal protection of human health through ICs and inadequate protection of the environment. It is incapable of preventing migration or discharge of groundwater with unacceptable COC concentrations to the creek.	Alternative 3 provides good protection of human health and the environment because DNAPL and the hot spot area representing the contamination sources would be treated, reducing contaminant mass significantly. ICs will provide protection of human health during the implementation of the remedy until RAOs are met.	Alternative 4 provides good protection of human health and the environment because DNAPL and the hot spot area representing the contamination sources would be treated, reducing contaminant mass significantly. ICs will provide protection of human health during the implementation of the remedy until RAOs are met.	Alternative 5 provides the best protection of human health and the environment because DNAPL and the hot spot area representing the contamination sources would be removed, reducing contaminant mass significantly. ICs will provide protection of human health during the implementation of the remedy until RAOs are met.	Alternative 5 provides the best protection, followed equally by Alternatives 3 and 4, and then Alternative 2. Alternative 1 is not protective.
Compliance With ARARs	This criterion is not applicable to Alternative 1.	Alternative 2 would require 100 years or longer to comply with the chemical-specific ARARs, but it will comply with location- and action-specific ARARs.	Alternative 3 would comply with the chemical-, location-, and action-specific ARARs. Compliance with the chemical-specific ARARs is projected within 30 years or less.	Alternative 4 would comply with the chemical-, location-, and action-specific ARARs. Compliance with the chemical-specific ARARs is projected within 30 years or less.	Alternative 5 would comply with the chemical-, location-, and action-specific ARARs. Compliance with the chemical-specific ARARs is projected within 30 years or less.	Alternatives 3 through 5 equally comply with the chemical-specific ARARs within a projected remediation time frame of 30 years, followed by Alternative 2 within 100 years. Alternatives 2 through 5 equally comply with the location- and action-specific ARARs. Alternative 1 does involve any action; therefore, ARARs are not triggered.
Long-Term Effectiveness and Permanence	Magnitude of residual risk would diminish over a prolonged time frame as a result of unverified NA processes. Since no action will be taken, there are no controls.	Magnitude of residual risk would diminish but rate is limited by DNAPL dissolution and greatly depends on the rate of verifiable NA. Adequacy and reliability of controls are poor because of the reliance on slow natural processes to achieve the SRGs.	Magnitude of residual risk in the source zone area would diminish significantly within a shorter time frame (6 months). Adequacy and reliability of controls are high.	Magnitude of residual risk in the source zone area would diminish significantly within a shorter time frame (6 months). Adequacy and reliability of controls are high.	Magnitude of residual risk in the source zone area would diminish significantly within a shorter time frame (3 months or less). Adequacy and reliability of controls are high.	Alternatives 3 through 5 provide equal reduction of the residual risks within the source zone. The adequacy and reliability of controls for these three alternatives are equally high. Alternative 2 provides minimal reduction of the residual risk and minimal control. Alternative 1 is the least satisfactory.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment is involved in this No Action remedy.	MNA is not considered to be "treatment"; therefore, this criterion is not satisfied.	Reduction of toxicity, mobility, and volume occurs through ISCO for the COC mass within the source zone area (TCE>1,000 ug/L).	Reduction of toxicity, mobility, and volume occurs through ISCR for the COC mass within the source zone area (TCE>1,000 ug/L).	Alternative 5 would not reduce the toxicity, mobility, and volume of the COCs through treatment.	Alternatives 3 and 4 adequately satisfy this criterion. Alternatives 1, 2, and 5 do not satisfy this criterion.
Short-Term Effectiveness	There is no impact to the community, workers, and the environment from remedial activities because this alternative involves no action. RAOs would be achieved within 100 years or longer.	Alternative 2 entails very minimal impact to the remediation workers during the installation of new groundwater monitoring wells and the collection of samples. The potential risk can be mitigated with proper planning and safe practices. RAOs would be achieved within 100 years or longer.	Alternative 3 entails a moderate safety risk to the remediation workers during MEC clearing and recovery and oxidant mixing. These risks can be minimized or eliminated through stringent compliance with MEC procedures. RAOs would be achieved within 30 years or less.	Alternative 4 entails a moderate safety risk to the remediation workers during MEC clearing and recovery and ZVI mixing. These risks can be minimized or eliminated through stringent compliance with MEC procedures. RAOs would be achieved within 30 years or less.	Alternative 5 entails the highest safety risk to the remediation workers during the excavation activities because of the potential encounters with MEC. It also presents the most disturbance to the daily facility operations and the surrounding community from the potential traffic alteration during transportation of the excavated material to the offsite facility. RAOs would be achieved within 30 years or less.	Alternative 1 poses no short-term impact to the remediation workers and the surrounding community because no action is planned. Alternative 2 causes minimal short-term impact, followed by Alternatives 3 and 4. Alternative 5 has the highest short-term impact to the remediation workers and the surrounding community. Alternatives 3 through 5 are anticipated to achieve the SRGs within 30 years or less, while Alternatives 1 and 2 would achieve the SRGs in 100 years or longer.
Implementability	There is nothing to implement under Alternative 1.	Alternative 2 is easily implemented but requires a long-term administrative commitment to maintain ICs for 100 years or longer.	Alternative 3 is readily implementable but application of persulfate via soil mixing is not commonly used. Alternative 3 involves rigorous and stringent procedures for MEC clearing and recovery. Alternative 3 requires a long-term administrative commitment to maintain ICs for up to 30 years.	Alternative 4 is readily implementable; ZVI granular application via soil mixing has been demonstrated to be successful in full-scale applications. Alternative 4 involves rigorous and stringent procedures for MEC clearing and recovery. Alternative 4 requires a long-term administrative commitment to maintain ICs for up to 30 years.	Alternative 5 is readily implementable; however, its technical and administrative implementation is complicated by the potential needs for the removal, demilitarization, treatment, transportation, and offsite disposal of MEC. Alternative 5 requires a long-term administrative commitment to maintain ICs for up to 30 years.	Alternative 1 is the easiest to implement because no action is planned, followed by Alternative 2. Alternatives 3 and 4 are equal with respect to implementability. Alternative 5 involves the highest challenge in terms of its technical and administrative implementability.
Cost	$0-	**Capital: $24,300** Lifetime Present Worth O&M: $460,600 Total Present Worth: $484,900 Cost is based on 100-year time frame assumption. In reality, the time frame could be much longer.	**Capital: $1.53 million** Lifetime Present Worth O&M: $348,200 Total Present Worth: $1.87 million	**Capital: $1.4 million** Lifetime Present Worth O&M: $348,200 Total Present Worth: $1.74 million	**Capital: $2.9 million** Lifetime Present Worth O&M: $348,200 Total Present Worth: $3.2 million The capital cost does not account for the potential need for the removal, demilitarization, treatment, transportation, and offsite disposal of MEC. Because the same remediation time frame is likely required under this alternative as those required for Alternatives 3 and 4, this alternative appears to involve excessive costs with no improvement of the remediation time frame.	Alternative 1 has the least cost, followed by Alternatives 2, 4, 3, and 5.

Notes: NA = natural attenuation

TABLE 2-5
Detailed Cost Estimate of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SELECTED REMEDY	LOCATION:	MEDIA:	Construction time:	9 weeks
Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)	Site 17, Disposed Metal Parts Along Shoreline NSF-IH, Indian Head, Maryland	Groundwater	Operation time:	30 years
			Post Remediation Monitoring:	included in the operation time

DESCRIPTION OF ALTERNATIVE:

1) ISCR treatment area (TCE> 1,000 ppb) with 10% escalation factor: 3,885 SF

2) Thickness of: Top 8 ft: 8 ft; Contamination interval thickness: 10 ft

3) MEC clearance will be conducted during the excavation activities of the first 8-foot.
Cost and duration escalation factor to facilitate MEC clearance: 100%

4) 6-Foot Diameter crane-mounted auger is assumed for the soil mixing.

5) For the purpose of long-term monitoring, a total of 5 permanent MWs will be installed; 3 during the baseline and 2 at approximately 12 months after soil mixing.

6) The short-term performance sampling is assumed to consist of: baseline, 6-, 9-, and 12-month post-mixing monitoring events. Assumed analytical requirements are described in Section 5.1.4 of the FS report.

7) The long-term monitoring would consist of quarterly events for 2 years, biannual events for 1 year, annual events for the remaining years until 5 years, and every 5-year intervals for the remaining years. Assumed requirements are described in Section 5.1.4 of the FS report.

9)Five-year reviews would be performed throughout the duration of the remediation for up to 30 years and a site closure report would be developed.

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
CAPITAL COSTS												
Institutional Controls/Planning												**$5,000.00**
Site-Specific LUC	1	lump sum	Professional Judgment		$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
Site Preparation				**2**								**$2,200.00**
Site Clearing (very minimal - by hand)	0.5	acre	CCI, 2008	1	$2,000.00	$1,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,000.00
Survey (for locations of injection points and GW wells - 2 man crew)	1	day	CCI, 2008	1	$1,200.00	$1,200.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,200.00
Shallow Soil (0 - 8 ft bgs) Handling				**17**								**$123,216.13**
Dewatering - assume onsite treatment and disposal	1	lump sum	MTS, 2008.		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$87,479.20	$87,479.20
Excavation of top 8 feet (include 100% escalation factor for MEC clearance) Dozer 80 HP, 150', clay	2302	CY of soil	RMS 31 23 16.46.2240	12	$6.76	$15,563.82	$5.68	$13,077.30	$0.00	$0.00	$0.00	$28,641.12
Temporary staging/stockpiling (+ 15% swelling factor) Front end loader, wheel-mounted, 1.5 CY	2648	CY of soil	RMS 31 23 23.15 6040	12	$0.51	$1,350.32	$0.34	$900.22	$0.00	$0.00	$0.00	$2,250.54
Backfill - 80 HP 150', clay	2648	CY of soil	RMS 31 23 23.14 2240	5	$0.99	$2,621.21	$0.84	$2,224.06	$0.00	$0.00	$0.00	$4,845.28
Soil Mixing Activities (No MEC support is required)				**22**								**$188,813.00**
Installation of MWs	5	wells	BOA rates	3	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6,750.00	$6,750.00
Reagent (Granular peerless ZVI + shipping)	36,000	lbs	See Table 2-3		$0.00	$0.00	$0.00	$0.00	$0.47	$16,900.00	$0.00	$16,900.00
Technology Royalti	1309	CY of soil	7% per cubic yard of treated soil	4	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9,163.00	$9,163.00
ZVI soil mixing	1300	CY of soil	See Table 2-3	15	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$156,000.00	$156,000.00

TABLE 2-5
Detailed Cost Estimate of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SELECTED REMEDY	LOCATION:	MEDIA:		
Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)	**Site 17, Disposed Metal Parts Along Shoreline** **NSF-IH, Indian Head, Maryland**	**Groundwater**	**Construction time:**	**9** weeks
			Operation time:	**30** years
			Post Remediation Monitoring:	**included in the operation time**

DESCRIPTION OF ALTERNATIVE:

1) ISCR treatment area (TCE> 1,000 ppb) with 10% escalation factor: 3,885 SF

2) Thickness of:
- Top 8 ft: 8 ft
- Contamination interval thickness: 10 ft

3) MEC clearance will be conducted during the excavation activities of the first 8-foot.
Cost and duration escalation factor to facilitate MEC clearance: 100%

4) 6-Foot Diameter crane-mounted auger is assumed for the soil mixing.

5) For the purpose of long-term monitoring, a total of 5 permanent MWs will be installed; 3 during the baseline and 2 at approximately 12 months after soil mixing.

6) The short-term performance sampling is assumed to consist of: baseline, 6-, 9-, and 12-month post-mixing monitoring events. Assumed analytical requirements are described in Section 5.1.4 of the FS report.

7) The long-term monitoring would consist of quarterly events for 2 years, biannual events for 1 year, annual events for the remaining years until 5 years, and every 5-year intervals for the remaining years. Assumed requirements are described in Section 5.1.4 of the FS report.

9)Five-year reviews would be performed throughout the duration of the remediation for up to 30 years and a site closure report would be developed.

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
Site Restoration				**4**								**$5,754.17**
Compaction - riding sheepfoot, 6" lifts, 3 passes	2648	CY of soil	RMS 31 23 23.23 5620	2	$0.24	$635.45	$0.79	$2,091.68	$0.00	$0.00	$0.00	$2,727.12
Top soil, 6" layer	72	CY of soil	CCI, 2008	1	$0.00	$0.00	$0.00	$0.00	$30.00	$2,160.00	$0.00	$2,160.00
Fine grading and seeding, inc. lime, fertilizer & seed	144	SY	RMS 32 91 19.13 1000	1	$1.46	$210.24	$0.24	$34.56	$0.35	$50.40	$865.00	$867.05
MEC Clearance Support (only during the top 8-foot soil excavation activities and does not include cost for MEC handling and management)												**$93,596.00**
Mob/Demob	4	person	CH2M HILL Rates		$2,000.00	$8,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8,000.00
MEC Clearance ($100/hr; 10 hrs/day; 4 persons)	17	days/4 crew	CH2M HILL Rates		$4,000.00	$68,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$68,000.00
OE Clearance Report												
OE Clearance Plan (Draft and Final)	1	each	CH2M HILL Rates		$3,500.00	$3,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3,500.00
Health and Safety Plan (including briefing)	1	each	CH2M HILL Rates		$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,500.00
After Action Report	1	each	CH2M HILL Rates		$1,600.00	$1,600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,600.00
Lodging and Per diem	17	days/4 crews			$0.00	$0.00	$0.00	$0.00	$588.00	$9,996.00	$0.00	$9,996.00
Construction Oversight												**$126,117.00**
Field Superintendent	9.0	weeks	CH2M HILL Rate	c	$3,444.00	$30,996.00	$0.00	$0.00	$0.00	$0.00	$0.00	$30,996.00
Safety Engineer	9.0	weeks	CH2M HILL Rate	c	$3,936.00	$35,424.00	$0.00	$0.00	$0.00	$0.00	$0.00	$35,424.00
Site Project Manager	9.0	weeks	CH2M HILL Rate	c	$4,428.00	$39,852.00	$0.00	$0.00	$0.00	$0.00	$0.00	$39,852.00
Lodging and Per diem (3 persons)	135	days			$0.00	$0.00	$0.00	$0.00	$147.00	$19,845.00	$0.00	$19,845.00
Preconstruction Submittals												**$144,164.38**
Preconstruction survey, design basis, pre-draft, draft, and final design, specifications, and H&S plans	1	lump sum	15% of total construction cost		$80,091.32	$80,091.32	$0.00	$0.00	$0.00	$0.00	$0.00	$80,091.32

TABLE 2-5
Detailed Cost Estimate of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SELECTED REMEDY	**LOCATION:**	**MEDIA:**	**Construction time:** 9 weeks
Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)	**Site 17, Disposed Metal Parts Along Shoreline** **NSF-IH, Indian Head, Maryland**	**Groundwater**	**Operation time:** 30 years **Post Remediation Monitoring:** included in the operation time

DESCRIPTION OF ALTERNATIVE:

1) ISCR treatment area (TCE> 1,000 ppb) with 10% escalation factor: 3,885 SF
2) Thickness of: Top 8 ft: 8 ft; Contamination interval thickness: 10 ft
3) MEC clearance will be conducted during the excavation activities of the first 8-foot.
Cost and duration escalation factor to facilitate MEC clearance: 100%
4) 6-Foot Diameter crane-mounted auger is assumed for the soil mixing.
5) For the purpose of long-term monitoring, a total of 5 permanent MWs will be installed; 3 during the baseline and 2 at approximately 12 months after soil mixing.
6) The short-term performance sampling is assumed to consist of: baseline, 6-, 9-, and 12-month post-mixing monitoring events. Assumed analytical requirements are described in Section 5.1.4 of the FS report.
7) The long-term monitoring would consist of quarterly events for 2 years, biannual events for 1 year, annual events for the remaining years until 5 years, and every 5-year intervals for the remaining years. Assumed requirements are described in Section 5.1.4 of the FS report.
9)Five-year reviews would be performed throughout the duration of the remediation for up to 30 years and a site closure report would be developed.

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
ESS (draft, draft final, final)	1	lump sum	12% of total construction cost		$64,073.06	$64,073.06	$0.00	$0.00	$0.00	$0.00	$0.00	$64,073.06
Permitting												**$10,678.84**
GW MW permits	1	lump sum	1% of total construction cost		$10,678.84	$10,678.84	$0.00	$0.00	$0.00	$0.00	$0.00	$10,678.84
General Conditions												**$53,394.21**
Decontamination, temp. facilities, sed. & erosion control, temp. fence, etc.	1	lump sum	10% of total construction cost		$53,394.21	$53,394.21	$0.00	$0.00	$0.00	$0.00	$0.00	$53,394.21
Contractor Overhead and Profit												**$80,091.32**
Home office cost, etc.	1	lump sum	15% of total construction cost		$80,091.32	$80,091.32	$0.00	$0.00	$0.00	$0.00	$0.00	$80,091.32
Mob/Demob												**$53,394.21**
Assume 10% of total field activities	1	lump sum	Professional Judgment, excludes mixing subcontractor cost		$53,394.21	$53,394.21	$0.00	$0.00	$0.00	$0.00	$0.00	$53,394.21
SUBTOTAL CAPITAL COST						**$559,176.01**		**$18,327.81**		**$48,951.40**	**$260,257.20**	**$886,419.27**
Scope Contingency	40%											**$354,567.71**
Bid Contingency	10%											**$88,641.93**
TOTAL CAPITAL COST												**$1,329,628.91**
OPERATION & MAINTENANCE AND PERIODIC ACTIVITIES - PER EVENT COST												
Sampling and Analysis - Groundwater and Surface Water												
Sample Collection												**$4,205.94**
Sample collection - 2 crew, 10 hrs/day, $50/hr	3	days	Professional Judgment		$1,000.00	$3,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$3,000.00
Disposable and decon materials per sample	21	samples	E 33 02 0401, 33 02 0402, 33 02 0561		$0.00	$0.00	$0.00	$0.00	$24.90	$522.90	$0.00	$522.90
Equipment Rental	3	days	E 33 02 0573, 33 02 0578		$0.00	$0.00	$227.68	$683.04	$0.00	$0.00	$0.00	$683.04

TABLE 2-5
Detailed Cost Estimate of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SELECTED REMEDY	LOCATION:	MEDIA:	Construction time:	9 weeks
Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)	Site 17, Disposed Metal Parts Along Shoreline NSF-IH, Indian Head, Maryland	Groundwater	Operation time:	30 years
			Post Remediation Monitoring:	included in the operation time

DESCRIPTION OF ALTERNATIVE:

1) ISCR treatment area (TCE> 1,000 ppb) with 10% escalation factor:		3,885 SF
2) Thickness of:	Top 8 ft:	8 ft
	Contamination interval thickness:	10 ft
3) MEC clearance will be conducted during the excavation activities of the first 8-foot. Cost and duration escalation factor to facilitate MEC clearance:		100%

4) 6-Foot Diameter crane-mounted auger is assumed for the soil mixing.

5) For the purpose of long-term monitoring, a total of 5 permanent MWs will be installed; 3 during the baseline and 2 at approximately 12 months after soil mixing.

6) The short-term performance sampling is assumed to consist of: baseline, 6-, 9-, and 12-month post-mixing monitoring events. Assumed analytical requirements are described in Section 5.1.4 of the FS report.

7) The long-term monitoring would consist of quarterly events for 2 years, biannual events for 1 year, annual events for the remaining years until 5 years, and every 5-year intervals for the remaining years. Assumed requirements are described in Section 5.1.4 of the FS report.

9)Five-year reviews would be performed throughout the duration of the remediation for up to 30 years and a site closure report would be developed.

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
Lab Analysis (including QA/QC samples)												**$5,713.68**
TAL Metals by CLP (ILM04) (filtered)	12	samples	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,643.04	$1,643.04
TAL Metals by CLP (ILM04) (unfiltered)	12	samples	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,643.04	$1,643.04
TCL Volatiles by CLP (OLM04) for groundwater and surface water	17	samples	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,615.00	$1,615.00
Chloride, nitrite/nitrate, sulfate (300.0)	12	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$585.84	$585.84
TOC	8	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$320.00	$320.00
Methane, ethane, ethene (RSK-175)	12	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,213.08	$1,213.08
Alkalinity (310.1)	8	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$105.44	$105.44
Ferrous Iron (Iron[II])	8	samples	BOA Rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$231.28	$231.28
Sampling and Analysis - Saturated Soil; Only for Baseline, 6- and 9-month Post-Soil Mixing												
Sample Collection												**$6,554.96**
DPT drilling (mob, daily rates, consumables) - 4 locations	2	days	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4,000.00	$4,000.00
Sample collection - 2 crew, 10 hrs/day, $50/hr	2	days	Professional Judgment		$1,000.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,000.00
Disposable and decon materials per sample	4	samples	E 33 02 0401, 33 02 0402, 33 02 0561		$0.00	$0.00	$0.00	$0.00	$24.90	$99.60	$0.00	$99.60
Equipment Rental	2	days	E 33 02 0573, 33 02 0578		$0.00	$0.00	$227.68	$455.36	$0.00	$0.00	$0.00	$455.36
Lab Analysis (including QA/QC samples)												**$1,855.36**

TABLE 2-5
Detailed Cost Estimate of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SELECTED REMEDY	LOCATION:	MEDIA:	Construction time: 9 weeks
Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)	**Site 17, Disposed Metal Parts Along Shoreline** **NSF-IH, Indian Head, Maryland**	**Groundwater**	**Operation time:** **30** years **Post Remediation Monitoring:** **included in the operation time**

DESCRIPTION OF ALTERNATIVE:

1) ISCR treatment area (TCE> 1,000 ppb) with 10% escalation factor: 3,885 SF

2) Thickness of:
- Top 8 ft: 8 ft
- Contamination interval thickness: 10 ft

3) MEC clearance will be conducted during the excavation activities of the first 8-foot.
Cost and duration escalation factor to facilitate MEC clearance: 100%

4) 6-Foot Diameter crane-mounted auger is assumed for the soil mixing.

5) For the purpose of long-term monitoring, a total of 5 permanent MWs will be installed; 3 during the baseline and 2 at approximately 12 months after soil mixing.

6) The short-term performance sampling is assumed to consist of: baseline, 6-, 9-, and 12-month post-mixing monitoring events. Assumed analytical requirements are described in Section 5.1.4 of the FS report.

7) The long-term monitoring would consist of quarterly events for 2 years, biannual events for 1 year, annual events for the remaining years until 5 years, and every 5-year intervals for the remaining years. Assumed requirements are described in Section 5.1.4 of the FS report.

9)Five-year reviews would be performed throughout the duration of the remediation for up to 30 years and a site closure report would be developed.

Cost Component	Qty	Unit	Cost Source	Estimated Activity Duration (day)	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Subcontractor	Total Cost
TAL Metals	8	samples	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,095.36	$1,095.36
TCL Volatiles	8	samples	BOA rates		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$760.00	$760.00
Data Interpretation												**$10,000.00**
Report (draft and final)	1	lump sum	Professional Judgment		$10,000.00	$10,000.00	$0.00		$0.00	$0.00	$0.00	$10,000.00
Five-Year Review												**$12,000.00**
Report (draft and final)	1	lump sum	Professional Judgment		$10,000.00	$10,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10,000.00
Field Inspection	1	lump sum	Professional Judgment		$2,000.00	$2,000.00	$0.00			$0.00	$0.00	$2,000.00
Site Closure												**$25,000.00**
Report development	1	lump sum	Professional Judgment		$25,000.00	$25,000.00	$0.00		$0.00	$0.00	$0.00	$25,000.00

TABLE 2-6
Present Worth Cost Analysis of Alternative 4
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

PRESENT WORTH CALCULATION					
SELECTED REMEDY	**Source Treatment Using ISCR, MNA, and ICs (One time mixing at TCE>1,000 ug/L area)**				
Location:	Site 17, Disposed Metal Parts Along Shoreline		Construction time:	9 weeks	
Media:	Shallow Groundwater		Operation time:	30 years	
			Discount Rate:	5.2%	
			O&M Contingency:	20%	

Year	Real Cost Incurred	Cost Description	Cost Type	Discount Factor	Present Worth
0	$1,394,619	Capital Cost + Baseline + 6-month + 9-month post-mixing sampling events + data evaluation report	Capital	1.00	$1,394,619
1	$95,614	4 quarterly sampling events	O&M	1.05	$90,888
2	$95,614	4 quarterly sampling events	O&M	1.11	$86,395
3	$47,807	2 biannual sampling events	O&M	1.16	$41,062
4	$23,904	annual sampling	O&M	1.22	$19,516
5	$38,304	5-Year groundwater sampling, and five-year review	O&M, Periodic	1.29	$29,728
6	$0			1.36	$0
7	$0			1.43	$0
8	$0			1.50	$0
9	$0			1.58	$0
10	$38,304	5-Year groundwater sampling, and five-year review	O&M, Periodic	1.66	$23,072
11	$0			1.75	$0
12	$0			1.84	$0
13	$0			1.93	$0
14	$0			2.03	$0
15	$38,304	5-Year groundwater sampling, and five-year review	O&M, Periodic	2.14	$17,906
16	$0			2.25	$0
17	$0			2.37	$0
18	$0			2.49	$0
19	$0			2.62	$0
20	$38,304	5-Year groundwater sampling, and five-year review	O&M, Periodic	2.76	$13,897
21	$0			2.90	$0
22	$0			3.05	$0
23	$0			3.21	$0
24	$0			3.38	$0
25	$38,304	5-Year groundwater sampling, and five-year review	O&M, Periodic	3.55	$10,786
26	$0			3.74	$0
27	$0			3.93	$0
28	$0			4.13	$0
29	$0			4.35	$0
30	$68,304	Closure sampling and Closure Report	O&M, Periodic	4.58	$14,927
CAPITAL COST	**$1,394,619**				
2008 Dollar LIFETIME O&M	**$522,760**		**Lifetime Present Worth O&M**		**$348,178**
TOTAL IMPLEMENTATION COST	**$1,917,379**		**TOTAL PRESENT WORTH**		**$1,742,796**

Table 2-7
Chemical-Specific ARARs
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Chemicals & Relevant Media	Requirement	Prerequisites	Citation	ARAR Determination	Comments
Groundwater, residential water supplies	Meet National Primary Standards for MCLs.	Drinking water source or potential source	SDWA National Primary Drinking Water Regulations at 40 CFR 141.61-62.	Relevant and appropriate	MCLs are considered in the determination of PRGs/SRGs for Site 17 groundwater.
Surface waters of the State	Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for discharges. Limitations and policy for antidegradation of the State's surface water.	Activities that will pollute the State's surface waters	The substantive requirements of COMAR 26.08.02.04-1 (antidegradation policy), 26.08.02.13 (general water quality certification for placement of rip rap for shoreline protection) (Mattawoman Creek is a Tier II water body per Maryland regulations)	Relevant and appropriate	Necessary measures will be implemented during the remediation activities to minimize impact to surface water quality.

table:
COMAR - Code of Maryland Regulations
CFR - Code of Federal Regulations
SDWA - Safe Drinking Water Act
MCLs - Maximum Contaminant Levels
PRGs - Preliminary Remediation Goals

Table 2-8
Location-Specific ARARs
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal Location-Specific ARARs					
Fish and Wildlife Coordination Act					
Area affecting streams or other water body	Provides protection for actions that would affect streams, wetlands, other water bodies or protected habitats. Any action taken should protect fish or wildlife.	Diversion, channeling or other activity that modifies a stream or other water body and affects fish or wildlife.	16 USC 662(a) and (b)	Relevant and Appropriate	Response actions will incorporate protection against any area water body, wetlands, or protected habitats.
Note: EO 11988 (Protection of Floodplains) states that activities occurring within floodplains should avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values. Although the EO is not an enforceable standard, this EO will be adhered to during CERCLA activities.					
Maryland State Location-Specific ARARs					
Construction on Nontidal Waters and Floodplains					
Nontidal waters and floodplains	Protect and maintain nontidal waterways and/or state of Maryland floodplains.	Activities that affect nontidal waterways and floodplains.	COMAR 26.17.04.01; COMAR 26.17.04.07; COMAR 26.17.04.08	Relevant and Appropriate	Any remedial actions involving alteration to the streams bounding the site or floodplains (including temporary construction) are subject to these requirements.
Maryland Water Pollution Control Regulations					
Surface waters of the State	Protect and maintain the quality of surface water in the State of Maryland. Criteria and standards for limitations and policy for antidegradation of the state's surface water.	Activities that will pollute the surface waters of the state.	COMAR 26.08.01.01 through COMAR 26.08.01.02; COMAR 26.08.02.02 through COMAR 26.08.02.03-4; COMAR 26.08.02.09; COMAR 26.08.03.01 and 26.08.03.07	Applicable	This regulation is applicable for remedial actions that may affect surface water quality in Maryland.

COMAR - Code of Maryland Regulations
EO - Executive Order
USC - United States Code

Table 2-9
Action-Specific ARARs
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Federal Action-Specific ARARs					
Resource Conservation and Recovery Act (RCRA) 42 USC 6901 et seq.*					
Excavation	Movement of excavated materials to new location and placement in or on land will trigger land disposal restrictions for the excavated waste or closure requirements for the unit in which the waste is being placed.	Materials containing RCRA hazardous wastes subject to land disposal restrictions are placed in another unit.	40 CFR 268.40	Applicable	Applicable to disposal of soil containing land-disposal-restricted RCRA hazardous waste to a new location and placement in or on land. The wastes generated from response actions at Site 17 may be RCRA hazardous wastes.
EPA Final Military Munitions Rule					
EPA Final Military Munitions Rule	Remedial actions generate munitions that are subject to RCRA requirements.	The Federal Facility Compliance Act (FFCA) of 1992 requires federal facilities to comply with all applicable hazardous waste laws, including hazardous waste management under RCRA. Specifically, Section 107 of FFCA mandates that EPA promulgates regulations identifying when military munitions become a hazardous waste subject to RCRA regulations. In response to this mandate, EPA established the Military Munitions Rule (MMR).	40 CFR 266.200 - 206	Applicable	The FS/remedial actions will likely generate military munitions waste that may be classified as hazardous.
Maryland State Action-Specific ARARs					
Air Quality					
Actions that involve emissions to air	Provides ambient air quality standards, general emissions standards and restrictions for air emissions from construction activities, vents, and treatment technologies such as incinerators. Also includes nuisance and odor control. Construction activities may emit particulate matter into the ambient air. Remedial activities must follow regulations.	Actions that involve emissions to air above specific limits.	COMAR 26.11.06.03	Applicable	May apply to earthwork activities that potentially generate particulate emissions.
Maryland Hazardous Waste Regulations					
Storage, treatment or disposal of hazardous waste	Requirements for the identifications, listing, treatment, storage, and disposal of hazardous wastes must be met.	Handling of hazardous wastes	COMAR 26.13.01.01; COMAR 26.13.01.03; COMAR 26.13.02.01 through COMAR 26.13.02.04-5; COMAR 26.13.02.06 through COMAR 26.13.02.15; COMAR 26.13.02.20 through COMAR 26.13.02.22; COMAR 26.13.03.01 through COMAR 26.13.03.06; COMAR 26.13.10.05 through COMAR 26.13.10.18; COMAR 26.13.10.27 through COMAR 26.13.10.31	Applicable	Any hazardous waste found during site remediation will be disposed of according to regulations. Any residues of byproducts from treatment systems that are hazardous must be disposed of properly.

Table 2-9
Action-Specific ARARs
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comments
Solid Waste and Water Supply Regulations					
Well Construction and Abandonment	Specifications for well construction and abandonment must be met. Also provides a mechanism to provide the State of Maryland with a database of existing and abandoned wells.		COMAR 26.04.04.02 and 26.04.04.03; COMAR 26.04.04.07 and 26.04.04.08; COMAR 26.04.04.10 and 26.04.04.11	Applicable	The requirements of this regulation are applicable to the response actions at the site if monitoring wells have to be installed or abandoned.
Stormwater Management					
Design and Construction	Regulations require the design and construction of a system necessary to control stormwater.	Design and construction activities.	COMAR 26.17.02.02; COMAR 26.17.02.06; COMAR 26.17.02.08; COMAR 26.17.02.09	Applicable	The remedial action will incorporate measures to control and manage stormwater as necessary.
Erosion and Sediment Control					
Land clearing, grading, and earth disturbances	Regulations require the preparation and implementation of a plan to control erosion and sediment for activities involving land clearing, grading, and earth disturbances. Erosion and sediment control criteria are also established.	Land clearing, grading, and earth distrubances.	COMAR 26.17.01.01; COMAR 26.17.01.05; COMAR 26.17.01.07(B), (C); COMAR 26.17.01.11	Applicable	The remedial action will incorporate the standards required for clearing, grading, and other earth distrubances, including compliance with county and municipal erosion and sediment control ordinances, and the Commission's erosion- and sedimentation-control regulations.
Groundwater and Surface Water					
Actions that will affect groundwater or surface water quality	Maryland Antidegradation Policy: actions cannot degrade State waters. Section 09(B) identifies Maryland groundwater classifications. Section 09(C) and (D) regulate discharges to the groundwater and surface water of the State.	Actions that will affect groundwater or surface water quality.	COMAR 26.08.02.04(A) through (C); COMAR 26.08.02.09(B) through (D); COMAR 26.08.02.03	Applicable	Remediation activities will affect groundwater and/or surface water quality.
Occupational, Industrial, and Residential Hazards					
Action that will generate noise	Limits set on the levels of noise must be met; these limits are protective of the health, welfare, and property of the people in the State of Maryland. The maximum permitted levels for construction activities may not exceed 90 dBA during the day and 75 dBA during the night.	Action that will generate noise.	COMAR 26.02.03.02A (2) and B(2); COMAR 26.02.03.03A	Applicable	During site remediation work, the maximum allowable noise levels will not be exceeded at site boundaries.

Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs. Specific potential ARARs are addressed in the table below each heading.
Acronyms used in the table:

ARAR - Applicable or relevant and appropriate requirement
COMAR - Code of Maryland Regulations
EPA - U.S. Environmental Protection Agency
RCRA - Resource Conservation and Recovery Act
CFR - Code of Federal Regulations
SMCLs - Secondary Maximum Contaminant Levels
TBC - To be considered

\\aphrodite\proj\USNavFaceNGCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-1 - Site 17 Sampling Locations.mxd

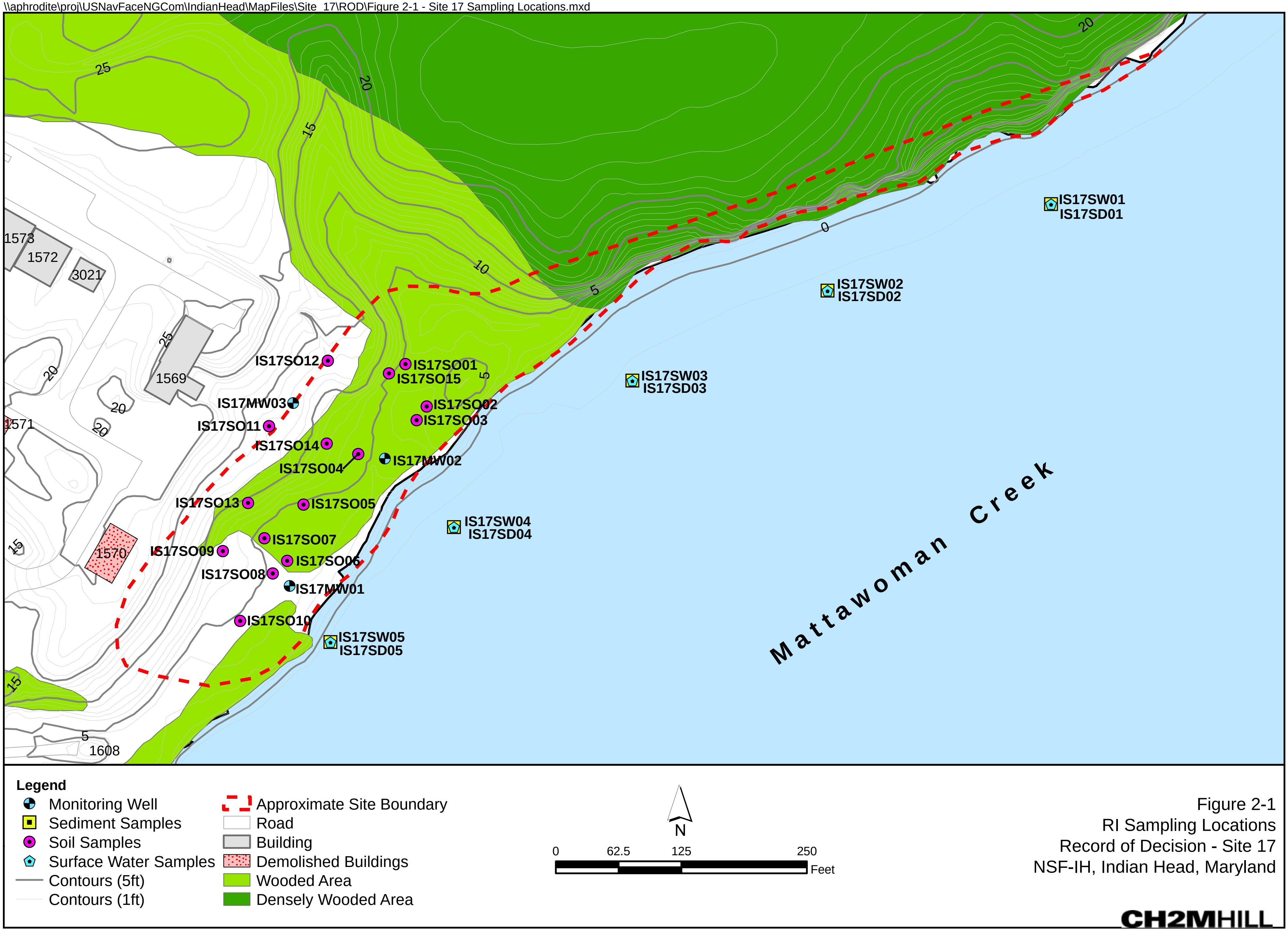

Figure 2-1
RI Sampling Locations
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

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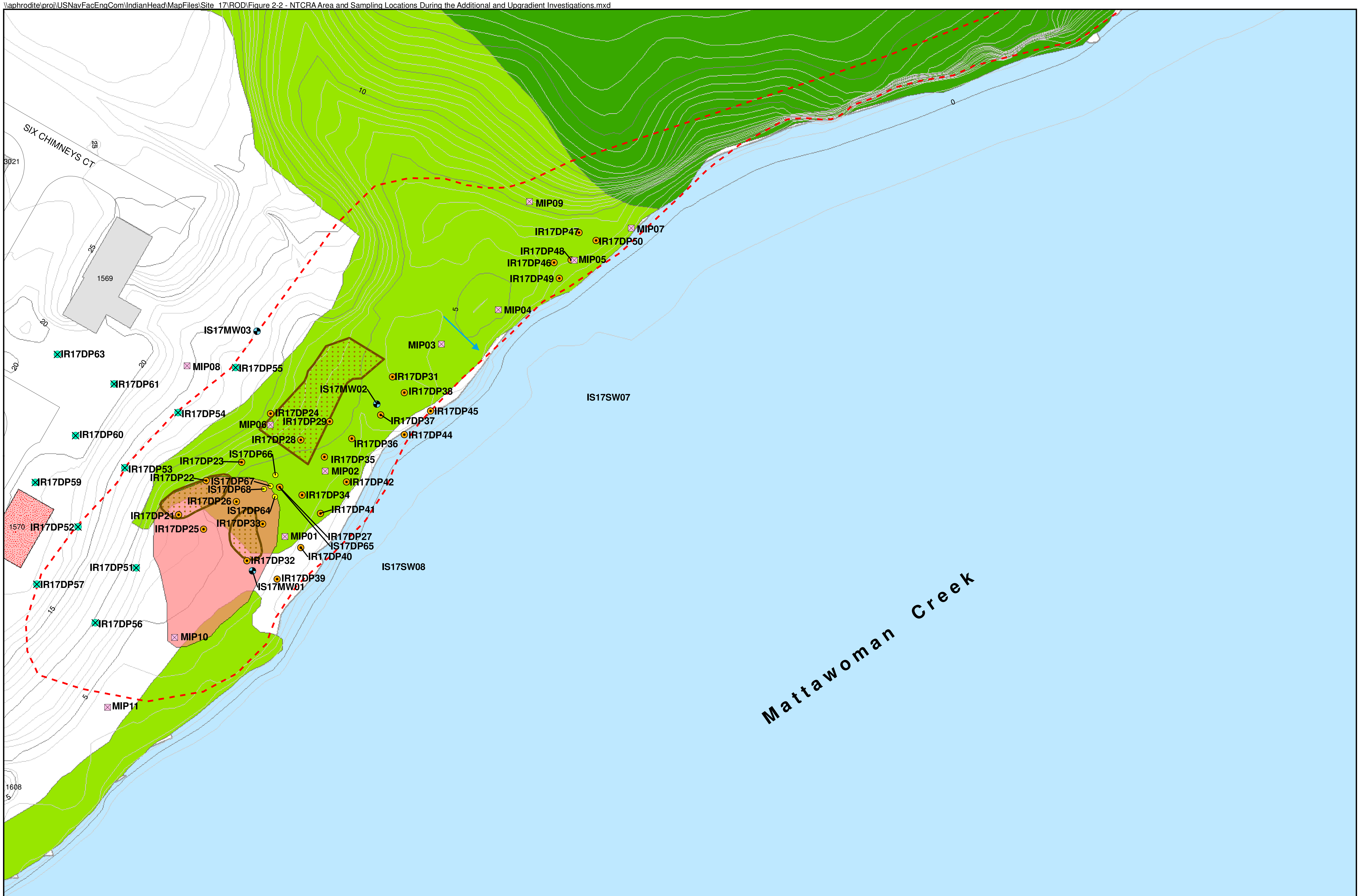
\\aphrodite\proj\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-2 - NTCRA Area and Sampling Locations During the Additional and Upgradient Investigations.mxd



Legend

- Monitoring Wells
- July 2002 MIP/DPT Locations
- December 2004 MIP/DPT and March 2005 DPT Locations
- August 2005 MIP/DPT Locations
- December 2006 DPT Locations
- Groundwater Flow Direction
- Road
- Topographic Elevation Contours (5ft)
- Topographic Elevation Contours (1ft)
- Approximate Site Boundary
- Drum Removal Area (2005 NTCRA; FSSI, 2006)
- Excavation Area; backfill with 1-foot layer of soil and 0.5-foot layer of gravel (2005 NTCRA; FSSI, 2006)
- Building
- Demolished Buildings
- Wooded Area
- Densely Wooded Area

N

0 25 50 100 Feet

Figure 2-2
NTCRA Area and Sampling Locations during the Additional and Upgradient Investigations
Record of Decision - Site 17NSF-IH, Indian Head

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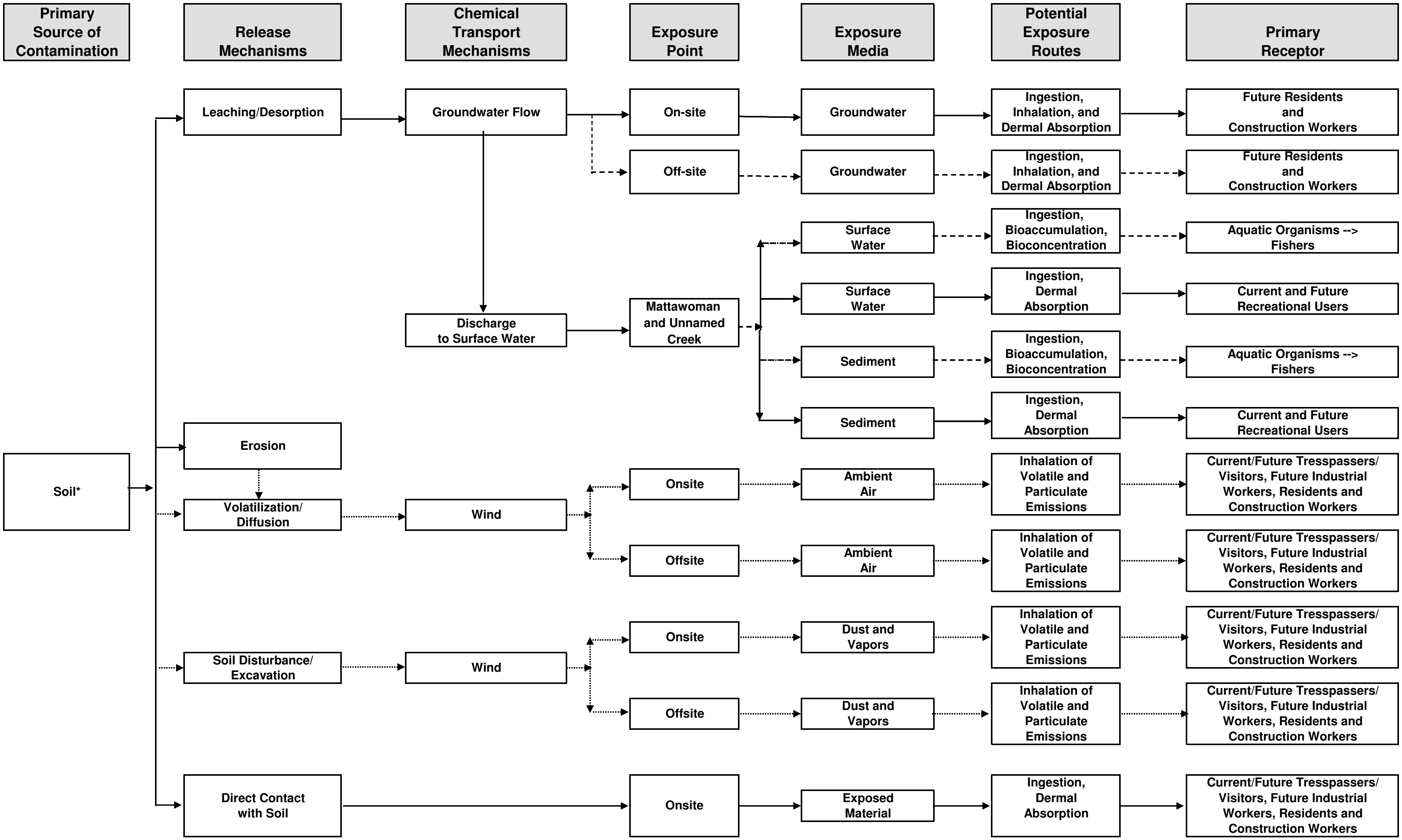
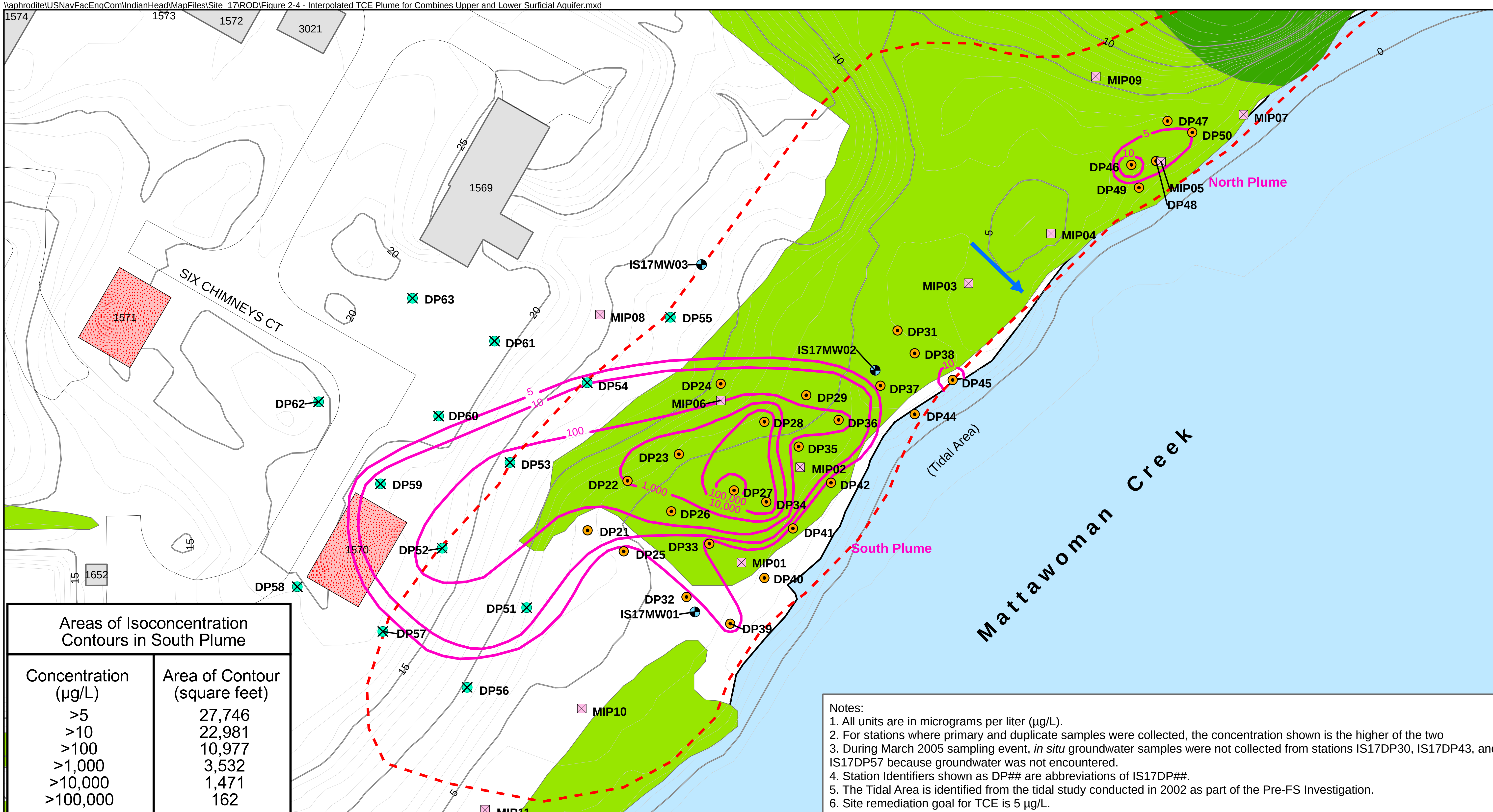
FIGURE 2-3
Conceptual Model for Potential Human Exposures
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland



* Current scenario is for surface soil and future scenarios are for surface and subsurface soil combined.

Complete Pathway
Incomplete Pathway
Pathway not evaluated because no CPOCs identified

\\aphrodite\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-4 - Interpolated TCE Plume for Combines Upper and Lower Surficial Aquifer.mxd



Areas of Isoconcentration Contours in South Plume	
Concentration (µg/L)	Area of Contour (square feet)
>5	27,746
>10	22,981
>100	10,977
>1,000	3,532
>10,000	1,471
>100,000	162

Notes:
1. All units are in micrograms per liter (µg/L).
2. For stations where primary and duplicate samples were collected, the concentration shown is the higher of the two
3. During March 2005 sampling event, *in situ* groundwater samples were not collected from stations IS17DP30, IS17DP43, and IS17DP57 because groundwater was not encountered.
4. Station Identifiers shown as DP## are abbreviations of IS17DP##.
5. The Tidal Area is identified from the tidal study conducted in 2002 as part of the Pre-FS Investigation.
6. Site remediation goal for TCE is 5 µg/L.

Legend
- Monitoring Well
- July 2002 MIP/DPT Locations with TCE Results
- December 2004 MIP/DPT and March 2005 DPT Locations with TCE Results
- August 2005 MIP/DPT Locations with TCE Results
- Isoconcentration Contour
- Groundwater Flow Direction
- Road
- Topographic Elevation Contours (1ft)
- Topographic Elevation Contours (5ft)
- Approximate Site Boundary
- Building
- Demolished Buildings
- Wooded Area
- Densely Wooded Area

N

0 25 50 100 Feet

Figure 2-4
Interpolated TCE Plume for Combined Upper and Lower Surficial Aquifers
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

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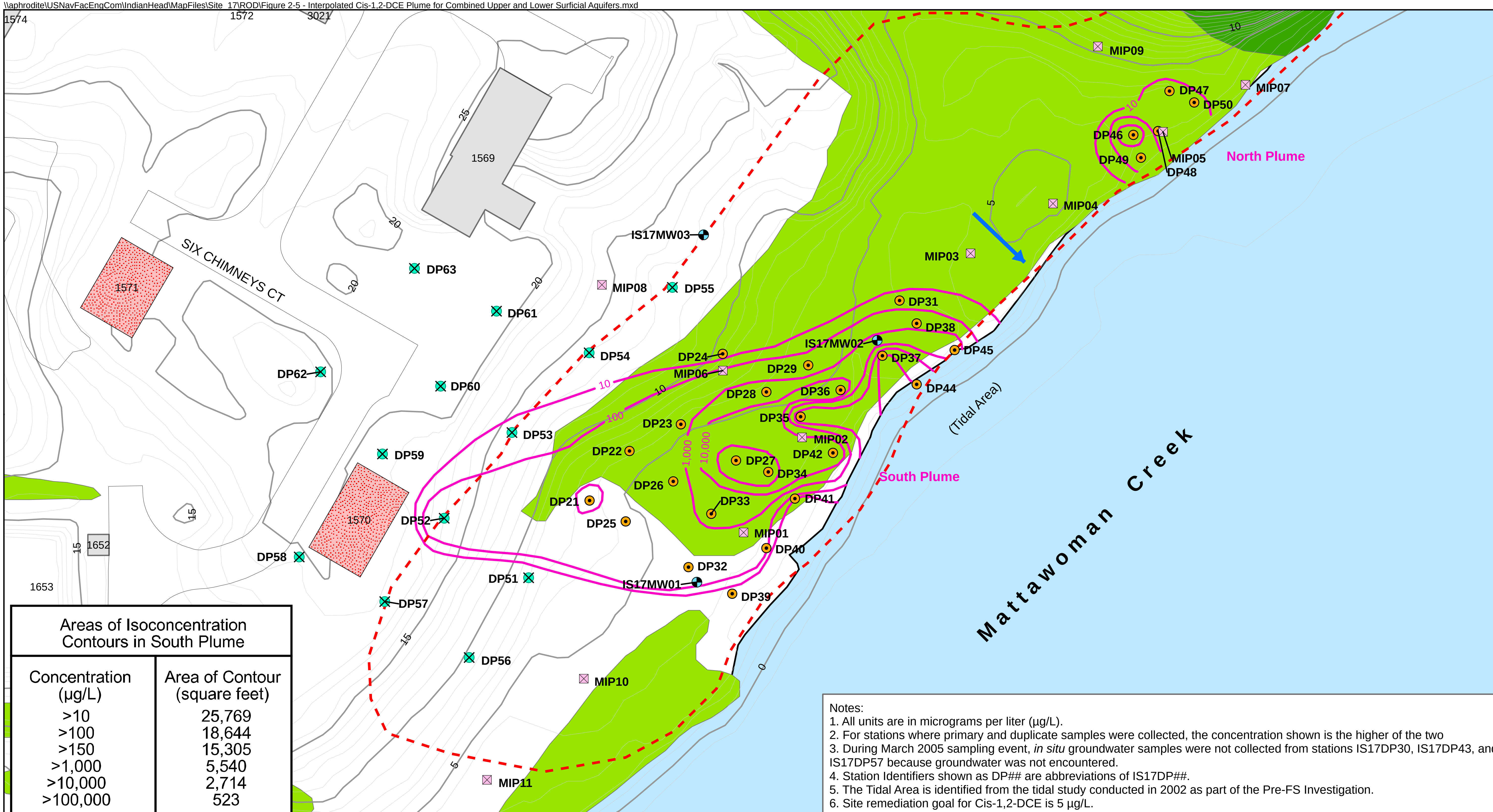
\\aphrodite\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-5 - Interpolated Cis-1,2-DCE Plume for Combined Upper and Lower Surficial Aquifers.mxd



Areas of Isoconcentration Contours in South Plume	
Concentration (µg/L)	Area of Contour (square feet)
>10	25,769
>100	18,644
>150	15,305
>1,000	5,540
>10,000	2,714
>100,000	523

Notes:
1. All units are in micrograms per liter (µg/L).
2. For stations where primary and duplicate samples were collected, the concentration shown is the higher of the two
3. During March 2005 sampling event, *in situ* groundwater samples were not collected from stations IS17DP30, IS17DP43, and IS17DP57 because groundwater was not encountered.
4. Station Identifiers shown as DP## are abbreviations of IS17DP##.
5. The Tidal Area is identified from the tidal study conducted in 2002 as part of the Pre-FS Investigation.
6. Site remediation goal for Cis-1,2-DCE is 5 µg/L.

Legend

- Monitoring Well
- July 2002 MIP/DPT Locations with Cis-1,2-DCE Results
- December 2004 MIP/DPT and March 2005 DPT Locations with Cis-1,2-DCE Results
- August 2005 MIP/DPT Locations with Cis-1,2-DCE Results
- Groundwater Flow Direction
- Isoconcentration Contour
- Road
- Topographic Elevation Contours (1ft)
- Topographic Elevation Contours (5ft)
- Approximate Site Boundary
- Building
- Demolished Buildings
- Wooded Area
- Densely Wooded Area

N

0 25 50 100 Feet

Figure 2-5
Interpolated Cis-1,2-DCE Plume for Combined Upper and Lower Surficial Aquifers
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

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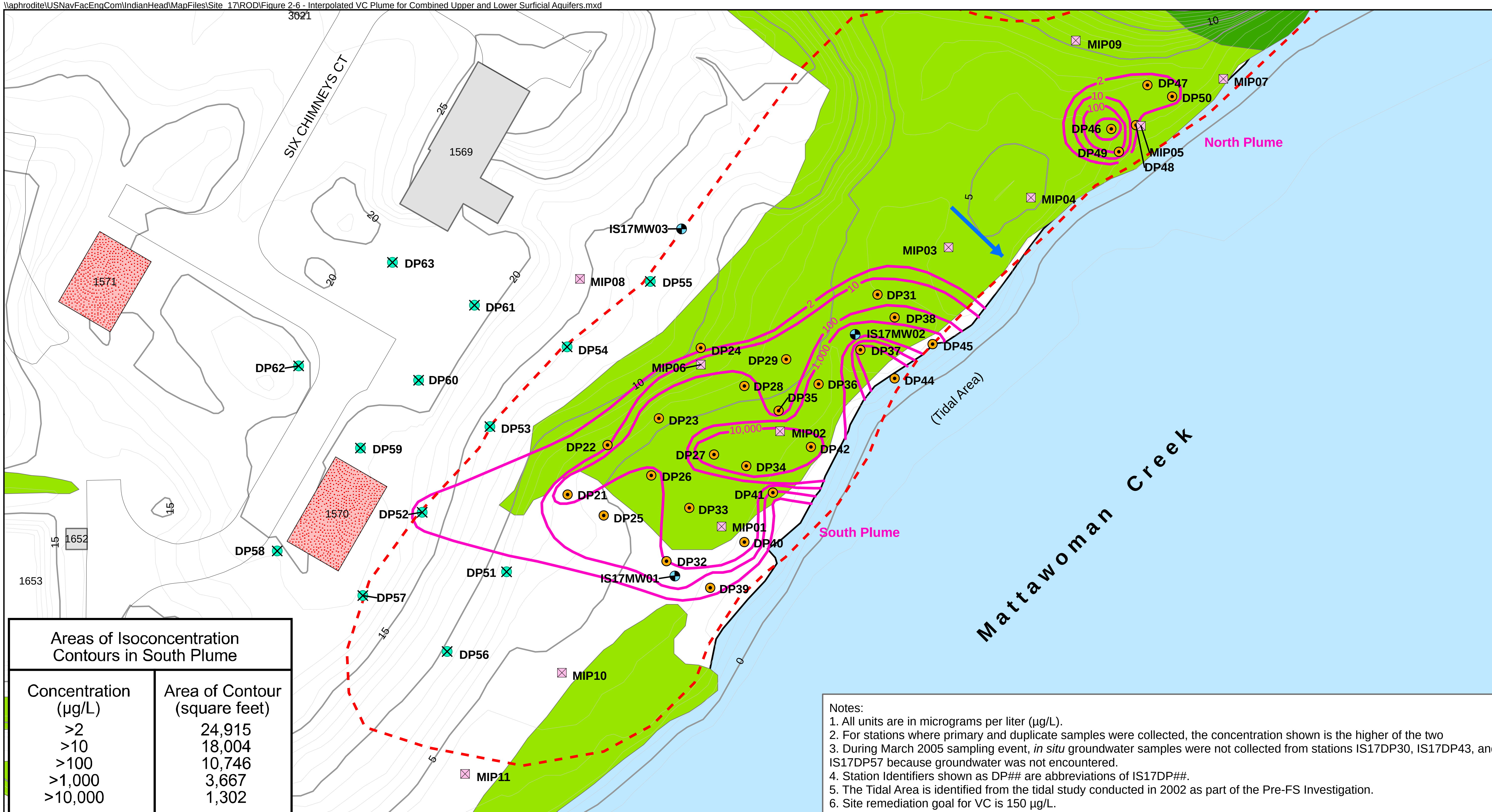
\\aphrodite\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-6 - Interpolated VC Plume for Combined Upper and Lower Surficial Aquifers.mxd



Areas of Isoconcentration Contours in South Plume

Concentration (µg/L)	Area of Contour (square feet)
>2	24,915
>10	18,004
>100	10,746
>1,000	3,667
>10,000	1,302

Notes:
1. All units are in micrograms per liter (µg/L).
2. For stations where primary and duplicate samples were collected, the concentration shown is the higher of the two
3. During March 2005 sampling event, *in situ* groundwater samples were not collected from stations IS17DP30, IS17DP43, and IS17DP57 because groundwater was not encountered.
4. Station Identifiers shown as DP## are abbreviations of IS17DP##.
5. The Tidal Area is identified from the tidal study conducted in 2002 as part of the Pre-FS Investigation.
6. Site remediation goal for VC is 150 µg/L.

Legend
- Monitoring Well
- July 2002 MIP/DPT Locations with VC Results
- December 2004 MIP/DPT and March 2005 DPT Locations with VC Results
- August 2005 MIP/DPT Locations with VC Results
- Isoconcentration Contour
- Groundwater Flow Direction
- Road
- Topographic Elevation Contours (1ft)
- Topographic Elevation Contours (5ft)
- Approximate Site Boundary
- Building
- Demolished Buildings
- Wooded Area
- Densely Wooded Area

N

0 25 50 100 Feet

Figure 2-6
Interpolated VC Plume for Combined Upper and Lower Surficial Aquifers
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

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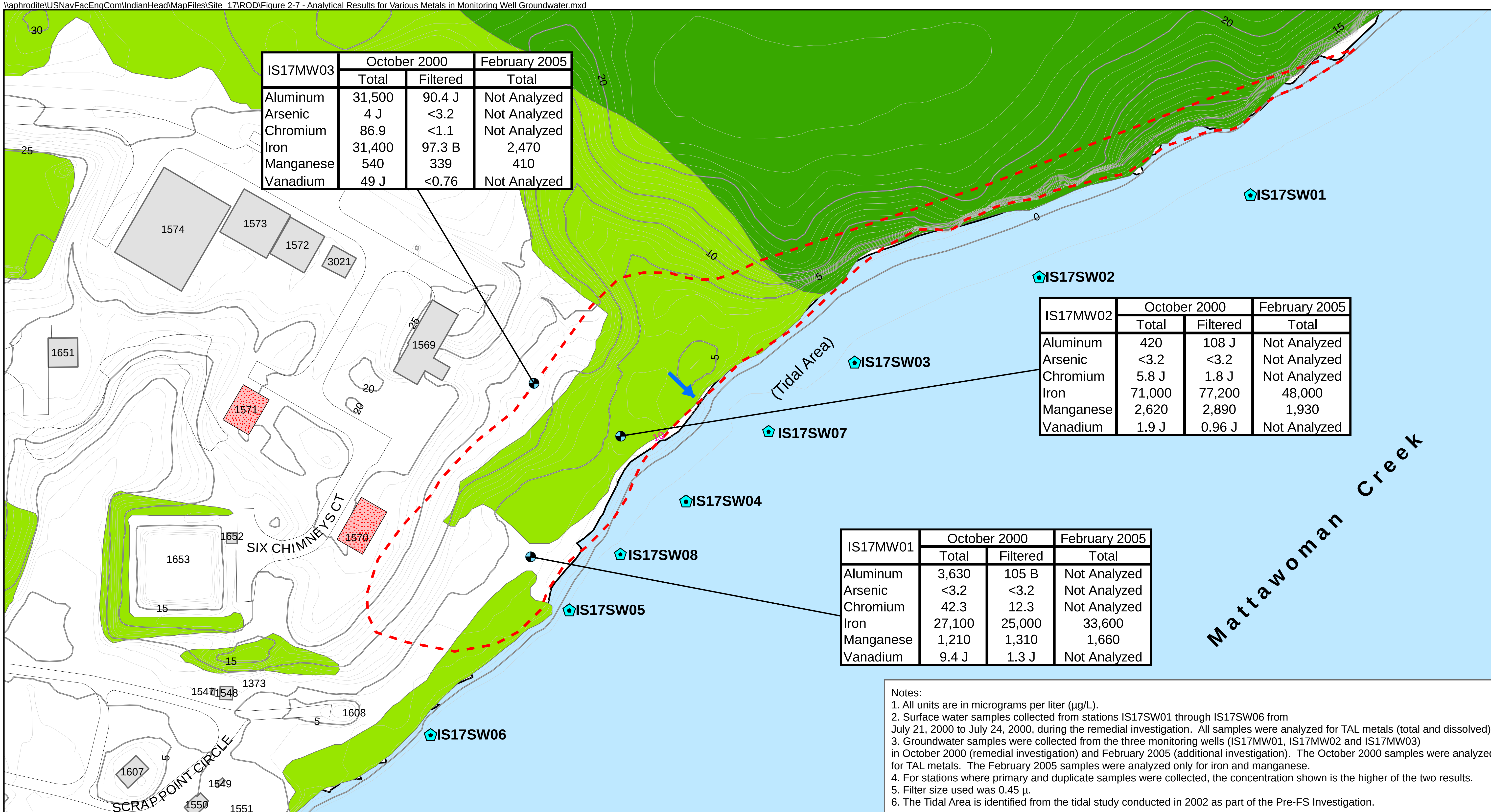
\\aphrodite\USNavFacEngCom\IndianHead\MapFiles\Site_17\ROD\Figure 2-7 - Analytical Results for Various Metals in Monitoring Well Groundwater.mxd



IS17MW03	October 2000		February 2005
	Total	Filtered	Total
Aluminum	31,500	90.4 J	Not Analyzed
Arsenic	4 J	<3.2	Not Analyzed
Chromium	86.9	<1.1	Not Analyzed
Iron	31,400	97.3 B	2,470
Manganese	540	339	410
Vanadium	49 J	<0.76	Not Analyzed

IS17MW02	October 2000		February 2005
	Total	Filtered	Total
Aluminum	420	108 J	Not Analyzed
Arsenic	<3.2	<3.2	Not Analyzed
Chromium	5.8 J	1.8 J	Not Analyzed
Iron	71,000	77,200	48,000
Manganese	2,620	2,890	1,930
Vanadium	1.9 J	0.96 J	Not Analyzed

IS17MW01	October 2000		February 2005
	Total	Filtered	Total
Aluminum	3,630	105 B	Not Analyzed
Arsenic	<3.2	<3.2	Not Analyzed
Chromium	42.3	12.3	Not Analyzed
Iron	27,100	25,000	33,600
Manganese	1,210	1,310	1,660
Vanadium	9.4 J	1.3 J	Not Analyzed

Notes:
1. All units are in micrograms per liter (µg/L).
2. Surface water samples collected from stations IS17SW01 through IS17SW06 from July 21, 2000 to July 24, 2000, during the remedial investigation. All samples were analyzed for TAL metals (total and dissolved).
3. Groundwater samples were collected from the three monitoring wells (IS17MW01, IS17MW02 and IS17MW03) in October 2000 (remedial investigation) and February 2005 (additional investigation). The October 2000 samples were analyzed for TAL metals. The February 2005 samples were analyzed only for iron and manganese.
4. For stations where primary and duplicate samples were collected, the concentration shown is the higher of the two results.
5. Filter size used was 0.45 µ.
6. The Tidal Area is identified from the tidal study conducted in 2002 as part of the Pre-FS Investigation.

Legend
- Monitoring Well
- Surface Water Sample Locations
- Groundwater Flow Direction
- Road
- Topographic Elevation Contours (1ft)
- Topographic Elevation Contours (5ft)
- Approximate Site Boundary
- Building
- Demolished Buildings
- Wooded Area
- Densely Wooded Area

N

0 50 100 200 Feet

Figure 2-7
Analytical Results for Various Metals in Monitoring Well Groundwater
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

CH2MHILL

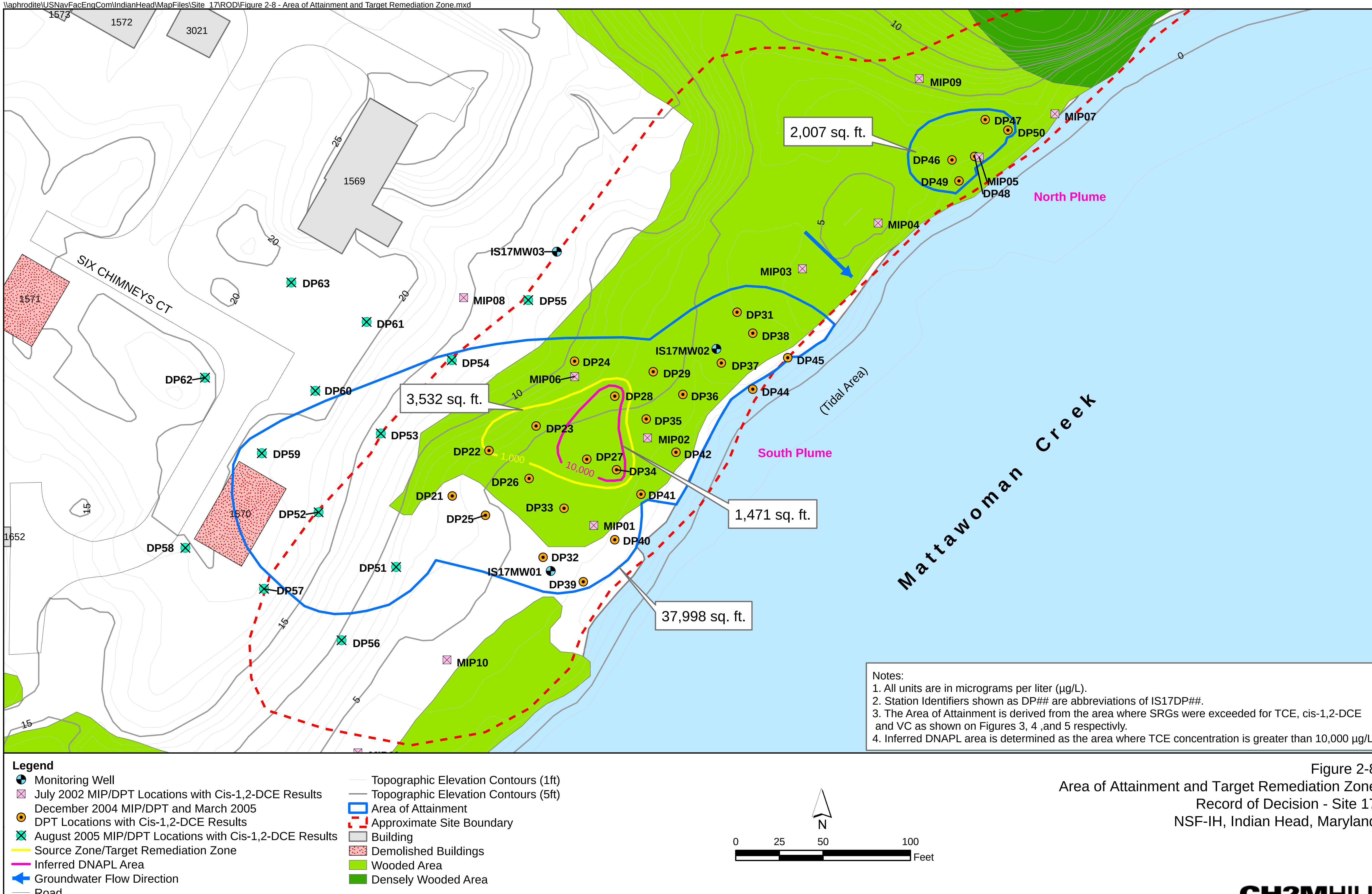


Figure 2-8
Area of Attainment and Target Remediation Zone
Record of Decision - Site 17
NSF-IH, Indian Head, Maryland

SECTION 3

Responsiveness Summary

This Responsiveness Summary represents a concise and complete summary of significant comments received from the public on the Proposed Plan and includes responses to these comments. It was prepared after the public comment period ended on March 9, 2009, in accordance with guidance in *Community Relations in Superfund: A Handbook* (EPA, 1992). This Responsiveness Summary provides the decision maker with information about the views of the community. It also documents how the Navy, EPA, and MDE considered public comments during the decision making process and provides answers to major comments.

3.1 Stakeholder Comments and Lead Agency Responses

The 30-day public comment period for the Selected Remedy for Site 17 began on February 9, 2009 and ended on March 9, 2009. A public meeting was held on February 19, 2009 at the Indian Head Senior Center, 100 Cornwallis Square, Indian Head, Maryland, to accept oral and written comments on this decision. No oral or written comments were received during the public comment period.

3.2 Technical and Legal Issues

No technical or legal issues have been identified for Site 17 with respect to this ROD.

SECTION 4

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