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FINAL SITE INVESTIGATION REPORT FOR SITE 32 SEWAGE TREATEMENT PLANT 2 NWS YORKTOWN VA

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Final

Site Investigation Report
Site 32—Sewage Treatment Plant #2

Naval Weapons Station Yorktown
Yorktown, Virginia

Contract Task Order WE50

May 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract No. N62470-11-D-8012

Prepared by

Virginia Beach, Virginia

Decision Statement

Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Background

Site 32 was initially identified as the wetland area (sediments and surface water) immediately downgradient of the outfall from the former Sewage Treatment Plant (STP) #2. The wetland area was investigated, a sediment removal action completed, and a Record of Decision (ROD) signed in 2011 indicating no further actions or restrictions were needed for the protection of human health or the environment. The footprint of the former STP #2 (soils and groundwater) was not initially considered part of the site based on the no action decision in the 1996 Site Screening Process (SSP) Report. However, with limited existing analytical data to support the 1996 SSP decision that soils and groundwater within the footprint of the former STP #2 area are not contaminated, the Yorktown Partnering Team agreed to conduct a Site Investigation (SI) in 2012. This SI concludes that no further actions or restrictions were needed for the soils and groundwater within the footprint of the former STP #2 for the protection of human health or the environment.

Decision

No further actions or restrictions are needed for protection of human health or the environment for soils and groundwater within the footprint of the former STP #2 based on this SI Report, or for wetland sediments or surface water based on the 2011 ROD. The Department of the Navy, United States Environmental Protection Agency, and Virginia Department of Environmental Quality concur that all media at Site 32 are closed, and the site meets criteria for unlimited use and unrestricted exposure.

James Gravette
NAVFAC Mid-Atlantic

Moshood Oduwole
United States Environmental Protection Agency

Wade Smith
Virginia Department of Environmental Quality

Executive Summary

This site investigation (SI) report presents the data and findings obtained from the 2012 field investigation activities conducted at Site 32, located at Naval Weapons Station (WPNSTA) Yorktown. Data collected during the SI and used in the data evaluation and analysis process were collected in accordance with the *Sampling and Analysis Plan (SAP) for Site 32 Sewage Treatment Plant (STP) #2, Sludge Drying Bed, Naval Weapons Station Yorktown, Yorktown, Virginia* (CH2M HILL, 2012).

Site 32 (STP #2) was initially identified as only the wetland area where wastewater from a pipe leading from the site's former trickling filter was discharged. The remainder of the area, STP #2, was identified as requiring no further action based on the 1999 Site Screening Process. Previous investigations have fully characterized the wetland portions of the site, a sediment removal action was completed, and a Record of Decision was signed (2011) indicating there are no restrictions needed for this wetland area for protection of human health or the environment. However, additional investigation was requested by the United States Environmental Protection Agency (USEPA) to evaluate the potential for releases from the activities previously conducted in the upland portions of STP #2. Therefore, the objectives of this SI are to determine whether a release of hazardous constituents occurred from past Comprehensive Environmental Response, Compensation, and Liability Act-regulated activities only in the upland portion of the site, and if so, to determine whether the suspected release warrants further investigation. In order accomplish the objectives, surface soil, subsurface soil, and groundwater samples were collected, and a human health risk screening (HHRS) and ecological risk assessment (ERA) were conducted using the collected data in order to determine if any potential unacceptable human health or ecological risks are present at Site 32 as a result of past historical activities at the site.

Soil and groundwater samples were collected within and downgradient of the footprints of the former STP structures in accordance with the Uniform Federal Policy-Sampling and Analysis Plan (UFP-SAP) (CH2M HILL, 2012), developed with and approved by USEPA and the Virginia Department of Environmental Quality. All samples were analyzed for constituents previously identified as constituents of concern in the downgradient wetland area sediment: mercury, cadmium, and silver. However, one surface and one subsurface composite soil samples within the former footprint of the sludge drying bed were collected and analyzed for additional parameters to confirm that a release of a wider range of contaminants has not occurred in the area. Analytical results were compared to the screening criteria identified in the UFP-SAP as project action limits.

Based on the process laid out in the UFP-SAP, constituents in soil that exceeded the screening criteria and background were considered as analytes in groundwater samples. Based on the results of the soil samples, the Yorktown Partnering Team selected only cadmium, mercury, and silver as analytes in the groundwater samples. None of the constituents were detected in the groundwater samples during this investigation.

In discrete surface soil samples, cadmium and mercury exceeded one or more screening criteria. In discrete subsurface soil samples, cadmium, mercury, and silver exceeded one or more screening criteria. For the five-point composite surface soil sample, no volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs) were detected, one pesticide (4,4'-dichlorodiphenyldichloroethylene) was detected, and 14 metals were detected at concentrations that exceeded one or more screening criteria; however, only 7 of the 14 metals concentrations exceeded background levels. For the five-point composite subsurface soil samples, no VOCs were detected, two SVOCs, three pesticides, and 13 metals were detected at concentrations that exceeded one or more screening criteria; however, only 5 of the 13 metals concentrations exceeded background levels identified at WPNSTA Yorktown.

The HHRS identified no potential unacceptable human health risk associated with groundwater at Site 32 because no constituents were detected. In soil, iron and the polychlorinated biphenyl (PCB) congener grouping Aroclor-1268 were detected above HHRS levels. No potential unacceptable risks were identified for iron, as it is an essential human nutrient, and the concentrations detected would result in an exposure concentration below the recommended dietary allowance for adults and children. No potential unacceptable risks were identified from

Arolclor-1268 because the potential risk is within the USEPA's acceptable risk level of 10^{-6} to 10^{-4}, and the concentration is below 10 times the RSL. In addition, Aroclor-1268 is a relatively rare PCB, which was generally used as a plasticizer in caulking and roofing compounds, and is not believed to be related to the historical use of Site 32. The HHRS concluded that no potential unacceptable human health risks are currently present at Site 32, and no further action (NFA) is warranted.

An ERA was performed to assess the potential for ecological risks associated with exposure to soil and groundwater near the former STP #2 in the terrestrial upland portion at Site 32, which consisted of Steps 1 and 2 of the screening level ecological risk assessment (SERA) and Step 3A of the baseline ecological risk assessment (referred to as the SERA + 3A). Mercury and iron in soils exceeded ecological screening values protective of terrestrial plants and invertebrates and/or background. However, the magnitudes of the exceedances were determined to be minimal and potential risks acceptable on a site-wide basis. No constituent had a Maximum Acceptable Toxicant Concentration hazard quotient exceeding one based upon the 95 percent upper confidence limit exposure dose. Risks from terrestrial food web exposures were, therefore, also considered acceptable. No constituents were identified as ecological constituents of potential concern in groundwater since no constituents were detected. The ERA concluded that no potential unacceptable ecological risks are currently present at Site 32, and NFA is warranted.

A series of environmental questions and project quality objectives (PQOs) were developed for this project during the scoping sessions and were documented in the UFP-SAP. The data collected during the field investigation were sufficient to characterize the transport and exposure pathways and to evaluate and answer the questions and PQOs. The site history, data collection activities, results of the data evaluation, and conclusions and recommendations presented in this SI report support the determination of NFA for Site 32. This SI will act as the final closure document for the STP area at Site 32, and the NFA status for all media at the site will be documented in the 2014-2015 Site Management Plan.

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Acronyms and Abbreviations

°F	degree Fahrenheit
µg/L	microgram per liter
amsl	above mean sea level
Baker	Baker Environmental, Inc.
BERA	baseline ecological risk assessment
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	constituent of concern
COPC	constituent of potential concern
CSM	conceptual site model
CTO	Contract Task Order
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DL	detection limit
DO	dissolved oxygen
EE/CA	engineering evaluation/cost analysis
ERA	Ecological Risk Assessment
ESV	ecological screening value
ft/day	foot per day
GPS	global positioning system
HHRS	human health risk screening
HQ	hazard quotient
HSA	hollow-stem auger
ID	inside diameter
IDW	investigation-derived waste
LOD	limit of detection
LTM	long-term monitoring
MATC	maximum acceptable toxicant concentration
MCL	maximum contaminant level
mg/day	milligram per day
mg/kg	milligram per kilogram
MS	matrix spike
MSD	matrix spike duplicate
NAS	National Academy of Sciences
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NFA	no further action
NTCRA	non-time-critical removal action
ORP	oxidation-reduction potential

PAL	project action limit
PCB	polychlorinated biphenyl
PPE	personal protective equipment
ppm	part per million
ppt	part per thousand
PQO	project quality objective
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RDA	recommended dietary allowance
ROD	Record of Decision
RSL	regional screening level
SAP	Sampling and Analysis Plan
SERA	Screening Level Ecological Risk Assessment
Shaw	Shaw Environmental & Infrastructure, Inc.
SI	site investigation
SMP	Site Management Plan
SOP	standard operating procedure
SSA	Site Screening Area
SSL	soil screening level
STP	sewage treatment plant
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
U.S.	United States
UCL	upper confidence limit
UFP-SAP	Uniform Federal Policy - Sampling and Analysis Plan
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
VPISU	Virginia Polytechnic Institute and State University
WPNSTA	Naval Weapons Station

SECTION 1

Introduction

This site investigation (SI) report presents the data and findings obtained from field investigation activities conducted at Site 32 upland area, located at Naval Weapons Station (WPNSTA) Yorktown in Yorktown, Virginia. This report was prepared under the United States (U.S.) Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Comprehensive Long-term Environmental Action—Navy (CLEAN) contract number N62470-11-D-8012, Contract Task Order (CTO) WE50, for submittal to NAVFAC, the United States Environmental Protection Agency (USEPA) Region 3, and the Virginia Department of Environmental Quality (VDEQ). The Navy, USEPA, and VDEQ work jointly as the WPNSTA Yorktown Tier I Partnering Team.

1.1 Problem Definition and Objectives

The purpose of this SI is to determine if a release of hazardous constituents has occurred as a result of past Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-regulated activities and whether contamination is present at levels posing potentially unacceptable risk in soil and groundwater at WPNSTA Yorktown Site 32, Sewage Treatment Plant (STP) #2. Previous investigation activities at Site 32 have focused exclusively on surface water and sediment in the downgradient wetland area (formerly referred to as Site Screening Area [SSA] 25). The suspected release associated with STP #2 occurred directly to the wetland through a discharge pipe that led from the former trickling filter at the site. As a result, previous investigations focused on the point of known discharge and the extent of downstream surface water and sediment contamination in the wetland. There is no record of any soil or groundwater analytical samples having been collected at Site 32 to characterize these media. During the demolition of the former STP #2 in 2000, a total of 12 drums of elemental-mercury-contaminated soils was excavated and removed from under the trickling filter; however, the absence of documentation surrounding the removal action resulted in a data gap regarding the completeness of the removal of contaminated soil and potential leaching to groundwater. Consequently, it was determined that additional investigation was warranted with respect to the potential for contamination to remain in the upland area.

This investigation provides sampling data within the footprint and downgradient of the former STP buildings, structures, and treatment areas (where contamination from past releases is most likely to be found, if present). Analytical samples for soil and groundwater were collected to complete the characterization of the site and to determine if any contamination remains at Site 32 from the former STP, and, if so, whether the residual contaminant levels pose potentially unacceptable human health and/or ecological risks. In accordance with the Sampling and Analysis Plan (SAP) (CH2M HILL, 2012), the focus of this investigation is on the following constituents previously identified as constituents of concern (COCs) in the downgradient wetland area sediment: mercury, cadmium, and silver. However, one surface and one subsurface composite soil sample within the former footprint of the sludge drying bed were collected and analyzed for additional parameters to confirm that a release of a wider range of contaminants has not occurred in the area.

1.2 Environmental Questions to be Answered

In order to accomplish the investigation objectives, the following five primary environmental questions that were developed as part of the SAP (CH2M HILL, 2012) are evaluated in this report using the results of the soil and groundwater sampling from March and May 2012:

- **Has there been a release of contaminants to soils due to historical activities associated with STP #2?**
  - In order to evaluate potential soil contamination due to historical activities at Site 32, seven colocated surface and subsurface soil samples were collected in the vicinity of the former STP #2 and analyzed for mercury, cadmium, and silver, and one composite surface soil (0 to 6 inches below ground surface [bgs]) and one composite subsurface soil sample (6 to 24 inches bgs) were collected and analyzed for target

analyte list (TAL) metals, target compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs), TCL pesticides, and polychlorinated biphenyls (PCBs).

- **Has there been a release of contaminants to groundwater due to leaching from soil at the site?**
  - Four groundwater monitoring wells were installed at Site 32 in the vicinity of STP #2, and one groundwater monitoring well was installed upgradient of the site. Groundwater samples were collected and analyzed for mercury, cadmium, and silver.
- **Do site-related soil and groundwater contaminant concentrations (if present) pose a potentially unacceptable human health or ecological risk?**
  - Results from the soil and groundwater samples were screened against human health and ecological risk-based screening values and site-specific and basewide background criteria to determine if any unacceptable human health or ecological risk is associated with Site 32.
- **What are the likely contaminant transport pathways at the site?**
  - In order to evaluate potential transport pathways at Site 32, continuous macro-core soil samples were collected and logged for soil descriptions during monitoring well installation, and a water-level elevation survey was performed at each well to determine groundwater flow direction.
- **Is further investigation (i.e., further data collection and evaluation) warranted at the site based on the results of this study?**
  - If a site-related release posing potentially unacceptable risks to human health or the environment is identified, the team will discuss the need for additional data collection (if the extent of contamination is not well-defined) or completion of a non-time-critical removal action (NTCRA). If no site-related release is identified, or if no unacceptable risks are found associated with an identified release, no additional investigation or action will be necessary. The final determination for the path forward will be made through discussion and concurrence among the Navy, USEPA, and VDEQ upon evaluation of the data and recommendations presented in this SI Report.

1.3 Report Organization

The SI Report is organized as follows:

- **Section 1, Introduction,** provides the objectives and decision-analysis process of the SI.
- **Section 2, Site Background and History,** provides the background and history of WPNSTA Yorktown and Site 32 (formerly SSA 25), including current and potential future land use and previous investigations.
- **Section 3, Environmental Setting,** presents the regional and site-specific environmental setting for WPNSTA Yorktown and Site 32, including the climate, topography and surface water, hydrogeology, and ecological resources.
- **Section 4, Investigation Methodology,** summarizes the 2012 SI field investigation and data collection activities.
- **Section 5, Investigation Results,** includes the evaluation of the collected soil and groundwater samples, a discussion of any potential human health and ecological risks associated with the site (if present), and the decision analysis for Site 32.
- **Section 6, Conclusions and Recommendations,** summarizes the findings of the report and presents the recommended path forward.
- **Section 7, References,** lists the documents used in preparation of this report.

Tables and figures are presented at the end of each section, as applicable.

SECTION 2

Site Background and History

Section 2 summarizes the site background and history of WPNSTA Yorktown and Site 32, including a description of the history, land use, and previous investigations at Site 32.

2.1 Naval Weapons Station Yorktown Description and History

WPNSTA Yorktown is a 10,624-acre installation located on the Virginia Peninsula in York and James City counties, Virginia (**Figure 2-1**). WPNSTA Yorktown is bounded to the northwest by Cheatham Annex, to the northeast by the York River and the Colonial National Historic Parkway, to the southwest by Route 143 and Interstate 64, and to the southeast by Route 238 and the town of Lackey.

Originally named the U.S. Mine Depot, WPNSTA Yorktown was established in 1918 to support the laying of mines in the North Sea during World War I. For 20 years after World War I, the depot continued to receive, reclaim, store, and issue mines, depth charges, and related materials. During World War II, the facility was expanded to include three trinitrotoluene (TNT) loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944. In 1947, a quality evaluation laboratory was developed to monitor special tasks assigned to the facility, which included the design and development of depth charges and advanced underwater weapons. On August 7, 1959, the depot was renamed the U.S. WPNSTA. Today, the primary mission of WPNSTA Yorktown is to provide ordnance, technical support, and related services to sustain the war-fighting capability of the armed forces in support of national military strategy.

2.2 Site 32 Description and History

The wetland portion of Site 32 was formerly identified as SSA 25. The site was later expanded to include the other areas previously used as STP #2. The Site 32 study area is located in the easternmost portion of WPNSTA Yorktown, bordered by dense tree cover to the north, the York River further to the east, and Ballard Creek to the south (**Figure 2-1**). The approximate centerline of Ballard Creek, which meanders throughout the downgradient wetland portion of Site 32, represents the property boundary between WPNSTA Yorktown and the National Park Service's Colonial National Historic Park (**Figure 2-2**) (CH2M HILL, 2008a).

The terrestrial portion of Site 32 encompasses the footprint of the former STP #2 and is approximately 1.4 acres, while the total site study area is approximately 5.6 acres. Currently, the study area is cleared and slopes moderately from the north to the south at elevations ranging from 30 to 20 feet above mean sea level (amsl). Beyond the WPNSTA Yorktown perimeter fenceline, the site slopes steeply towards the downgradient wetlands (**Figure 2-2**). The wetland area represents a freshwater, low-energy, bottomland depositional habitat, and is characterized by a broad, flat area between steep, upland slopes (CH2M HILL, 2008a).

STP #2 was installed in 1952, and formerly consisted of a clarifier tank (Imhoff) with two chambers, a trickling filter, chlorination unit, and sludge-drying beds, located on the upland portion of the site, north of Impoundment No. 1 (**Figure 2-2**). STP #2 reportedly received and managed only sanitary wastewater from the base (CH2M HILL, 2012). Wastewater first entered the plant through the Imhoff tank, where it passed through the grit chamber before continuing into the primary Imhoff chamber, which operated as a primary settling basin for the waste. The wastewater was passed through either the secondary Imhoff chamber or the trickling filter for biological treatment. The wastewater was then chlorinated in the chlorination unit and discharged directly to Ballard Creek through a regulated outfall. Sludge that had settled in the Imhoff tank was periodically removed and placed in the sludge-drying bed. It is believed that treatment plant operations ceased before the early 1970s, prior to the promulgation of the Clean Water Act.

During its operational period, the STP #2 trickling filter discharged directly to Site 32 through a regulated discharge pipe (**Figure 2-2**) (CH2M HILL, 2011a). The trickling filter used elemental mercury (approximately 4 to 6 ounces) as a water seal in the pivot point. Though the seal was maintained, it is likely that mercury leaked into the trickling filter tank and was subsequently discharged to Site 32 through the regulated discharge pipe. This discharge was the basis for the initial investigation of the sediment and surface water associated with the downgradient wetland area at Site 32. The use of mercury seals on trickling filters, like that used at STP #2, have been prohibited in Virginia since 1971 (9 Virginia Administrative Code 25-790).

Although no historical releases were reported or documented during the operation of the STP, beaded elemental mercury was discovered at the base of the trickling filter when STP #2 was dismantled and removed in 2000. The source of the mercury was likely the mercury-containing bearings located in the distributor arms of the trickling-filter tank. Based on anecdotal evidence, a total of 12 drums of mercury-contaminated soils was excavated and disposed of during the removal of the trickling filter, and the site was backfilled and regraded. No documentation of the removal activities, confirmation samples, or the depth of fill currently exists; however, anecdotal information reports that post-removal confirmation samples were collected, and results indicated that no residual mercury-contaminated soil remained following the removal action.

2.3 Current and Potential Future Land Use

Land use at WPNSTA Yorktown is categorized as Military Use according to the York County Planning Division 2025 Land Use Map (York County, Virginia, Planning Division, 2005). The future land use at WPNSTA Yorktown is expected to remain unchanged. Land uses of surrounding areas include conservation and recreation, commercial, residential, industrial, public, and agricultural (Baker, 2003).

The upland portion of Site 32 consist of a cleared area in the former footprint of the STP. The downgradient portion of Site 32 functions as a wetland. It is anticipated that WPNSTA Yorktown will remain a military installation for the foreseeable future, and use of Site 32 will remain the same. Groundwater at the base flows towards the York River and its tributaries, such as Ballard Creek. There are no drinking water wells at WPNSTA Yorktown; four previous water supply wells have been abandoned. Groundwater use as a drinking water supply is not associated with Site 32, and there is no current or expected future use for groundwater in the immediate area of Site 32 due to general low quality and yield and more readily available potable water. The sole source of domestic water supply for WPNSTA Yorktown and its surrounding communities is supplied by the City of Newport News Waterworks.

2.4 Previous Investigations

Site 12, the Barracks Road Landfill, is located upstream of Site 32 along Ballard Creek. Sediment and surface water from the Ballard Creek wetlands area downgradient of STP #2 area was first investigated as part of the Site 12 Long-term Monitoring (LTM) Program. Sediment samples collected from 1998 to 2003 as part of the LTM suggested a potential source of mercury other than Site 12 (Baker, 2005a) and prompted a limited field investigation in August 2003 to delineate total mercury concentrations in sediment at Site 32. Based on the results of this investigation, the Yorktown Partnering Team signed a consensus statement (5-18-04-37) agreeing to proceed with additional investigations of sediment and surface water at Site 32. Subsequent investigations at Site 32, culminating in a baseline ecological risk assessment (BERA), focused solely on surface water and sediment in the wetlands downgradient of STP #2, and identified cadmium, mercury, and silver as COCs in these media (CH2M HILL, 2008a).

An engineering evaluation/cost analysis (EE/CA) for the wetlands area downgradient of STP #2 was completed in 2008 (CH2M HILL, 2008b). The EE/CA identified wetland sediment excavation and offsite disposal as the recommended alternative in order to address potential ecological risks associated with cadmium, mercury, and silver in the wetland sediment downgradient of STP #2. The NTCRA was conducted from July to October 2009, and approximately 2,041 tons of contaminated sediment was removed from Site 32, as documented in the Construction Completion Report (Shaw, 2010). Following excavation, confirmation samples were collected and

analyzed for cadmium, mercury, and silver, and additional excavation was conducted until the confirmation sample results confirmed that the remediation goals established in the EE/CA had been achieved (Shaw, 2010). During the removal action, a mixing cell was constructed near the former trickling filter and sludge drying bed to support dewatering of the excavated sediments **(Figure 2-2)**. During the deconstruction of the mixing cell, one composite confirmation sample taken of the mixing cell material was collected, and the results were non-detect or below the laboratory reporting limit for each of the sediment COCs (cadmium at 0.51U milligrams per kilogram [mg/kg], mercury at 0.022 B mg/kg, and silver at 0.061U mg/kg). The data represent the only analytical data available from the upland portion of the site, though it was reported that all material used to construct the mixing cell was removed from the site.

Following the NTCRA, no unacceptable risk to human health or the environment associated with exposure to surface water or sediment remained at Site 32. No further action (NFA) for surface water and sediment at Site 32 was required and NFA was selected as the remedy, as documented in the Record of Decision (ROD) for Site 32 Wetlands Area Downgradient of Beaver Pond, which was signed in August 2011 (CH2M HILL, 2011a).

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WPNSTA Yorktown
Cheatham Annex

Kings Creek
Commerce Park

York River

Gloucester
County

Felgates Creek

CROAKER FLAT

LACKEY PLAIN

Colonial National Historic Parkway

Site 32

York
County

James City
County

64

Route 143

Lackey

Route 238

Colonial National
Historic Park

York
County

Newport News

James River

Legend

- Study Area Boundary
- Buildings and Structures
- Yorktown Naval Weapons Station Base Boundary
- Kings Creek Commerce Park
- Camp Peary Scarp
- Shoreline and Water Bodies
- Interstate 64
- Magazines
- County Boundary

*All study area boundaries are solely for the purpose of showing general site locations. They are not intended to connote the extent of contamination, boundaries of investigation, or delineation of media associated with a particular site.

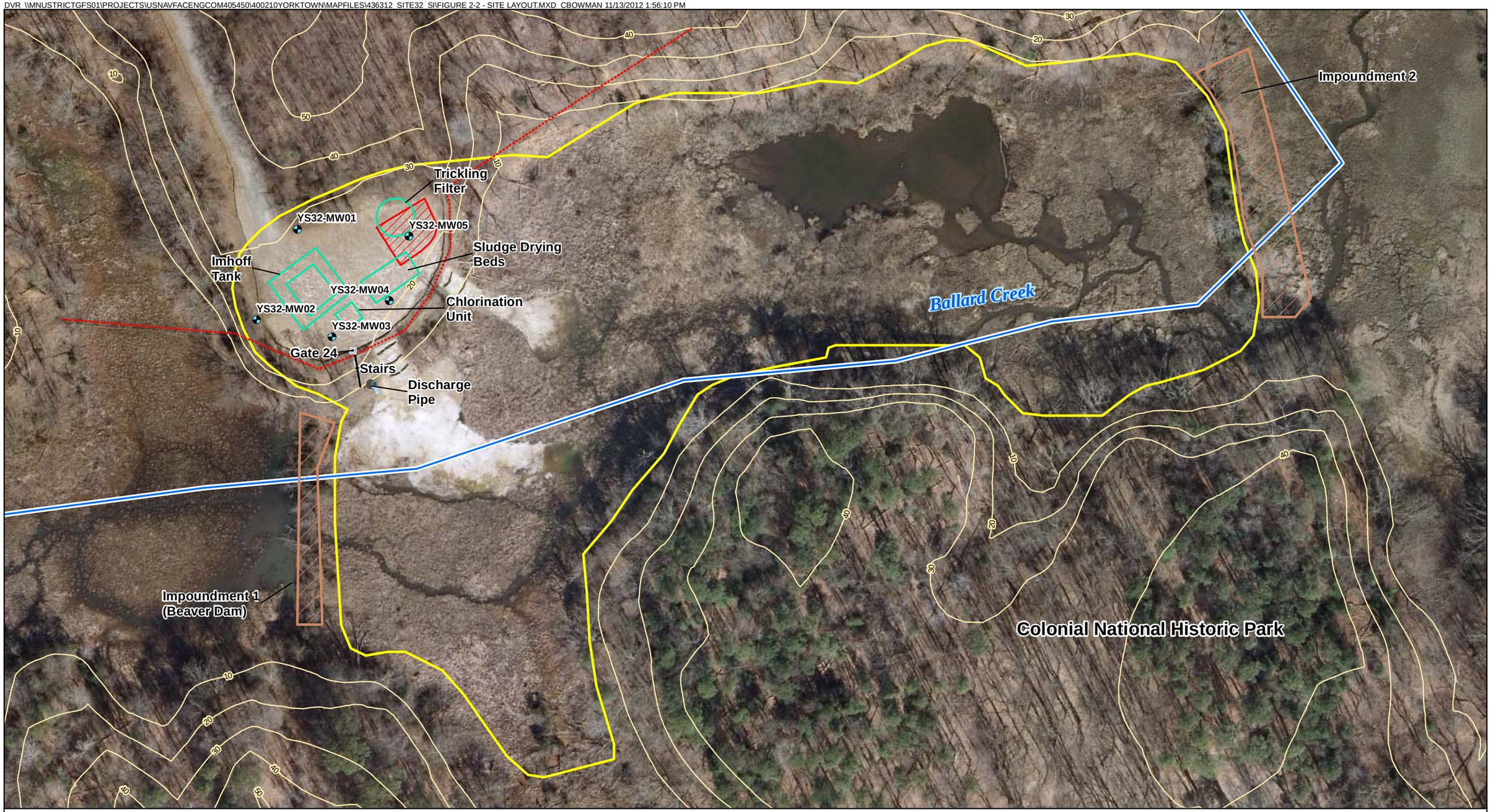
N
W E
S

0 3,500 7,000
Feet

Figure 2-1
Base and Site 32 Location Map
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 2-2 - SITE LAYOUT.MXD CBOWMAN 11/13/2012 1:56:10 PM



Legend

- Monitoring Well
- Fence
- Elevation Contour (10 ft interval)
- Former Structures
- Impoundment Area
- Property Boundary Line
- Study Area Boundary
- 2009 Removal Area Mixing Cell

N

0 50 100 Feet

1 inch = 100 feet

Figure 2-2
Site 32 Layout
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

SECTION 3

Environmental Setting

Section 3 summarizes the environmental setting of WPNSTA Yorktown and Site 32, including a description of the climate, topography, surface water, hydrogeology, and ecological resources, and presents an evaluation of the Site 32 physical characteristics pertaining to the surface features and conceptual hydrogeology of the site.

3.1 Climate

The climate of the Virginia Peninsula is influenced by the moderating effects of the Atlantic Ocean, resulting in mild winters and long, warm summers. High humidity occurs frequently along the coast and less frequently inland. The average relative humidity in mid-afternoon is approximately 60 percent. Humidity is higher at night, and the average humidity at dawn is approximately 80 percent. Ground fog is a frequent weather occurrence in late summer, especially during early morning hours.

Freezing temperatures occur intermittently from October through March. The average monthly temperatures in the area range from approximately 40 degrees Fahrenheit (°F) in January to 80°F in July.

York County is subject to easterly storms throughout late summer and early fall, which causes high tides and coastal flooding. Intense tropical hurricanes occasionally sweep the coast. Winter storms that move along the eastern seaboard are often associated with high winds and precipitation, occasionally in the form of snow, ice pellets, or rain; however, the snow is seldom prolonged or heavy. The average annual precipitation is approximately 45 inches, with the summer months being the wettest and the winter months being the driest.

3.2 Topography and Surface Water

The topography at WPNSTA Yorktown is characterized by gently rolling terrain dissected by ravines and stream valleys trending predominantly northeastward toward the York River. The maximum ground elevation of WPNSTA Yorktown, found on the western boundary, is approximately 50 feet amsl. Valleys consisting of 40- to 60-foot ravines with steep slopes (slopes exceeding 1:1) occur along the major creeks draining the area (Baker, 2003).

The northern and eastern portions of WPNSTA Yorktown are located within the York River Basin, with the southwestern portion of the property located in the James River Basin. The facility contains several tributaries of the York River, including Kings Creek, Felgates Creek, and Indian Field Creek to the north and Ballard Creek to the east. In addition, Blows Mill Run and several ponds (Lee Pond, Roosevelt Pond, and Ponds 10, 11, and 12) are tributaries to the James River. Wetlands have also been identified within WPNSTA Yorktown along the York and James River tributaries, as well as shoreline areas of the York River (CH2M HILL, 2011a).

Site 32 encompasses an upland area and portions of the wetlands area along Ballard Creek in the eastern corner of WPNSTA Yorktown. The upland area gently slopes from north to south across the site, ranging from approximately 30 feet amsl to 20 feet amsl, and then steeply slopes near the perimeter of where the former STP #2 was located to the wetlands area downgradient. The topography of this wetland area is characterized as a broad, flat area between steep upland slopes to the north and south, a natural beaver dam upstream of the site (to the west), and a second dam structure of unknown origin downstream (to the east). Ballard Creek flows around the northern edge of the beaver dam, through the wetland area, around the southern edge of the downstream dam, and eventually discharges to the York River. Although the second dam restricts tidal influences from the York River, the break allows some interaction; however, the extent of the interaction has varied over time (CH2M HILL, 2008a). Numerous, small braided surface water channels and small ponds are also present within the wetland area. Surface water levels are shallow and are primarily regulated by rainfall and runoff from upgradient areas (CH2M HILL, 2008a).

3.3 Hydrogeology

3.3.1 Geology

WPNSTA Yorktown is located in the Atlantic Coastal Plain Physiographic Province, which is underlain by multiple layers of unconsolidated sediments of Quaternary, Tertiary, and Cretaceous ages. The sediments thicken eastward from the Fall Line (approximately 70 miles west of WPNSTA) and are approximately 6,000 feet thick below the Eastern Shore Peninsula (Meng and Harsh, 1988).

Deposition and erosion associated with fluctuating sea levels resulted in terraces that decrease in topographic elevation in a stair-step pattern, with scarps oriented north to south, delineating the eroded shoreline along the toe of each terrace (Brockman et al., 1997). The Coastal Plain within the York-James Peninsula, on which WPNSTA Yorktown is located, includes the following four terraces: Lackey Plain, Croaker Flat, Huntington Flat, and Grafton Plain (from highest to lowest); and the following three scarps: Kingsmill, Lee Hall, and Camp Peary (Brockman et al., 1997). Most of WPNSTA Yorktown, including Site 32, lies within the Lackey Plain terrace, as shown on **Figure 3-1**. The Lackey Plain is bounded on the northeast by the Camp Peary Scarp, which trends roughly parallel to the York River (Brockman et al., 1997) and lies just south of the lower Croaker Flat terrace.

In terms of the uppermost soils, Site 32 is located within Soil Association Groups 1 and 3, two of the five soil association groups identified at WPNSTA Yorktown during a 1982 soil survey report as shown on **Figure 3-2** (VPISU [Virginia Polytechnic Institute and State University], 1982). Soils in Soil Association Group 1, the Bohicket, Johnston, and Axis Association, consist of sediments deposited in low-lying areas on marshes and floodplains by fluvial processes, and consist of silty, clayey, and sandy loam underlain by sandy clay, silty clay loam, and stratified sand and silt (CH2M HILL, 2011a). The sediment is poorly drained, with slow to moderate permeability. Soil Association Group 1 is associated with the low-lying downgradient area of Site 32, including Ballard Creek. Soils in Soil Association Group 3, the Emporia, Kempsville, and Craven-Uchee Complex Association, consist of deep Coastal Plain sediments that are moderate to well-drained sandy loam surface soil underlain by clay and sandy clay loam, with moderate to moderately low permeability. Soil Association Group 3 is associated with the terrestrial, upland area of Site 32 and is characteristic of areas upland from surface water bodies in ridges with steep side slopes. A more detailed description of the soils at WPNSTA Yorktown can be found in the soil survey (VPISU, 1982) or the Background Study Report (CH2M HILL, 2011b). Monitoring well lithologic data are presented in the SI report, which provides descriptions of the Site 32 subsurface geology. Soil boring logs are provided in **Appendix A**.

The uppermost subsurface geology in the area of Site 32 is characterized by the Bacon's Castle, Sedley, and Yorktown Formations. The Bacons Castle and Sedley Formations only occur within the topographically high areas of the site. The formations are composed of fine-grained orange silt and clay. The uppermost portion of the Yorktown Formation (Yorktown confining unit) consists of shell hash, clayey or sandy shell hash, very fine- to medium-grained sand, or shelly clay, and the layer makes up the majority of Site 32. The lower portion of the Yorktown Formation (Yorktown-Eastover aquifer) consists of very fine- to fine-grained sand, silt, or sandy clay.

3.3.2 Hydrostratigraphy

Although numerous geologic formations have been identified beneath WPNSTA Yorktown, nine geologic formations dating from the early Miocene to late Pleistocene age make up the shallow aquifer system underlying WPNSTA Yorktown. The formations consist of the Calvert, St. Marys, Eastover, Yorktown, Sedley, Bacons Castle, Windsor, Chuckatuck, and Shirley (Brockman et al., 1997). The deposits generally consist of interbedded sand, silt, clay, gravel, and shell material that together form a system of aquifers and confining units and are overlain by modern alluvial, colluvial, and marsh deposits, according to *Geohydrology of the Shallow Aquifer System* (Brockman et al., 1997).

The geologic units beneath WPNSTA Yorktown are grouped into hydrostratigraphic units based on hydraulic characteristics (Lazniak and Meng, 1988; Brockman et al., 1997). Based upon the hydraulic characteristics of the geologic units present, the uppermost 8 (Cobham Bay Member of the Eastover Formation through the

Tabb Formation) of the 10 geologic formations have been identified as the York County Shallow Aquifer System. As shown on **Figure 3-3**, the following five hydrogeologic units make up the York County Shallow Aquifer System at WPNSTA Yorktown:

- Columbia aquifer (consisting of the Windsor through Tabb Formations)
- Cornwallis Cave confining unit (consisting of the Bacons Castle Formation)
- Cornwallis Cave aquifer (consisting of the upper Moore House Member of the Yorktown Formation and the Sedley Formation)
- Yorktown confining unit (consisting of the upper Morgarts Beach and lower Moore House Members of the Yorktown Formation)
- Yorktown-Eastover aquifer (consisting of the Cobham Bay through Rushmere Members of the Yorktown Formation)

Groundwater flow is locally controlled by topography, with discharge to nearby surface water bodies and a primary flow and discharge direction toward the York River. Where present, the Columbia aquifer ranges in thickness from 5 to 10 feet, with horizontal hydraulic conductivity between approximately 0.4 to 8 feet per day (ft/day) and vertical hydraulic conductivity between 1.7×10^{-4} to 1.7×10^{-1} ft/day (Brockman et al., 1997). The hydraulic properties of the Cornwallis Cave aquifer are highly variable due to depositional effects and physical and geochemical weathering. In general, horizontal hydraulic conductivity ranges from 0.3 to 9 ft/day, and vertical conductivity ranges from 6.2×10^{-4} to 2.4×10^{-1} ft/day (Speiran and Hughes, 2001). Finally, the thickness of the Yorktown-Eastover aquifer ranges from 60 to 100 feet. Horizontal hydraulic conductivity ranges from 0.004 to 3 ft/day, and vertical hydraulic conductivity ranges from 1.7×10^{-5} to 4.8×10^{-1} ft/day.

In the area of Site 32, the unit lithologically consistent with the Columbia aquifer was eroded away during sea-level changes, and materials associated with the Cornwallis Cave aquifer or Cornwallis Cave confining unit are present at the ground surface. In general, clay, consistent with the Cornwallis Cave confining unit, is present in the higher elevation portions of the site, while the underlying Cornwallis Cave aquifer material is present at the surface in the low-lying areas. The water table is present below the bottom of the clay, where present. As such, the Cornwallis Cave aquifer acts as the surficial (unconfined aquifer at the site). The maximum thickness of the surficial clay at the site is 16 feet.

During the March 2012 monitoring well installation at Site 32, no borings were installed to the depth of the Yorktown confining unit, which lies below the Cornwallis Cave aquifer. However, based on borings completed at adjacent Site 12, it is estimated that the Cornwallis Cave aquifer is between 40 and 60 feet thick. Details are presented in the soil boring logs in **Appendix A**.

3.3.3 Groundwater Flow

Site 32 is bordered on the west, south, and east by Ballard Creek, which flows into the York River less than 0.25-mile downstream from Site 32. The potentiometric surface contour map for the water table Cornwallis Cave aquifer is presented on **Figure 3-4**, which shows that groundwater flows radially toward the wetland area. Groundwater elevations measured during the SI are presented in **Table 3-1**.

3.4 Ecological Resources

3.4.1 Regional Ecological Resources

Woodland and marsh ecosystems are predominant throughout WPNSTA Yorktown. Small, undeveloped tracts of land at WPNSTA Yorktown and surrounding areas support a variety of indigenous wildlife species. White-tailed deer, beaver, skunk, bobcat, red and gray fox, squirrel, raccoon, opossum, and rabbit are present. Game birds, such as wild turkey, quail, duck, and pheasant, are also resident. Songbirds common to the eastern Virginia area are in abundance at WPNSTA Yorktown, along with a raptor population consisting of small hawks, owls, and

osprey. Carrion-feeding birds such as crows and turkey vultures are also common. The southern bald eagle (federally and state protected) is known to nest at WPNSTA Yorktown.

Salinities in the York River estuary bordering WPNSTA Yorktown can be characterized as mesohaline (from 15 to 20 parts per thousand [ppt]), and can fluctuate depending on seasonal impacts, runoff, and rainfall. Of the 295 fish species known from the Chesapeake Bay, only 32 are year-round residents. Nursery areas, foraging areas, and spawning ground attract the remaining species from the Atlantic Ocean and freshwater tributaries each year. In the York River, resident fish include hogchoker, weakfish, and oyster toadfish. Spot and croaker are common in nursery and foraging areas in the summer, and numerous anadromous and catadromous fish use the area during migration, including the alewife, American eel, American shad, blueback herring, striped bass, and white perch. Commercially and recreationally important species from the York River include American shad, bay anchovy, blue crab, bluefish, croaker, spot, striped bass, summer flounder, and weakfish. The York River near WPNSTA Yorktown is a designated crab pot fishery from March through November of each year; north of WPNSTA Yorktown is a spawning and nursery ground for blue crabs. Several species of endangered sea turtles (namely the green, hawksbill, leatherback, loggerhead, and Kemp's Ridley) are known to feed in the Chesapeake Bay and occasionally forage in the York River, including near WPNSTA Yorktown during the summer.

The York River is designated as Essential Fish Habitat for three species of fish managed by the Mid-Atlantic Fishery Management Council: summer flounder, bluefish, and butterfish. Though both the bluefish and butterfish use the more open, pelagic waters characteristic of the river, juvenile summer flounder often use unvegetated, near-shore sandy bottoms and salt marsh creeks as nursery areas. Other species likely to use salt marsh creeks include anchovies, blue crabs, juveniles of migratory species, hard- and soft-shell clams, killifish, minnows, mummichogs, oysters, silversides, and weakfish. The shoreline along the York River may also provide habitat for federally threatened piping plovers (Baker, 2005b).

3.4.2 Site 32 Ecological Resources

The upland area of Site 32 in the vicinity of the former STP structures is currently an open field, which is periodically maintained and mowed by facility personnel. The remaining upland areas around the margins of the former structures and along the two impoundments are wooded. Small mammals and their predators, including raptors, would be expected to use the area. Canopy tree species include American sycamore, loblolly pine, sweet gum, and yellow poplar (CH2M HILL, 2008a). The downgradient wetland area is dominated by freshwater emergent wetland vegetation. Two herbaceous species, swamp lossestrife and mild water pepper, dominate the vegetation. Water levels in the main channel of Ballard Creek and the small, braided channels and pools are primarily regulated by rainfall and runoff from upgradient areas, and are typically 2 to 6 inches in depth. Water pennywort, American waterweed and duckweed are prevalent in these open areas and the more saturated areas of the wetland. A moderately elevated (approximately 1 foot) area is located within the central portion of the wetland, where soils are less saturated and support small shrub species. During the November 2005 field event, dead vegetation was encountered in the area near Impoundment No. 2, followed by the establishment of more salt-tolerant vegetation the following growing season from May 2006 to September 2006. Downgradient of Impoundment No. 2, tidal influences from the York River are present, and salt-tolerant vegetation is supported, including bulrush and saltmarsh cordgrass. Aquatic fauna observed and expected include various invertebrates, amphibians, and small fish, as well as beaver, raccoon, mink, ducks, geese, egrets, and great blue herons (CH2M HILL, 2008a).

A pair of breeding bald eagles was present in the area at the time of the aquatic BERA (CH2M HILL, 2008a). The pair was known to have nested over multiple years on the Colonial National Historic Park side of Ballard Creek. According to the Center for Conservation Biology's web site, the nest near Site 32 was active/occupied when last checked in 2011 (CCB, 2013). Although bald eagles nest in the area, it is unlikely that they hunt or forage within Site 32 either exclusively or primarily, given the amount and type of food eagles primarily consume. However, it is possible that the eagles use the wetlands as a drinking water source.

TABLE 3-1

Groundwater Elevations

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Well ID	TOC	May 17, 2012	
		DTW	Elevation
MW-01	33.63	25.18	8.45
MW-02	30.86	26.39	4.47
MW-03	26.53	21.38	5.15
MW-04	23.69	18.38	5.31
MW-05	24.86	18.96	5.90

Notes:
TOC = Top of Casing
DTW = Depth to Water

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 3-1 - RIVER TERRACES OF ATLANTIC COASTAL PLAIN.MXD CBOWMAN 9/25/2012 7:28:27 AM

Legend

- Interstate 64
- Camp Peary Scarp
- Approximate Boundary of Columbia Aquifer, February 3, 1997
- Roads and paved areas
- Shoreline and Water Bodies
- Watershed Boundaries
- Study Area Boundary
- Activity Boundaries
- County Boundary

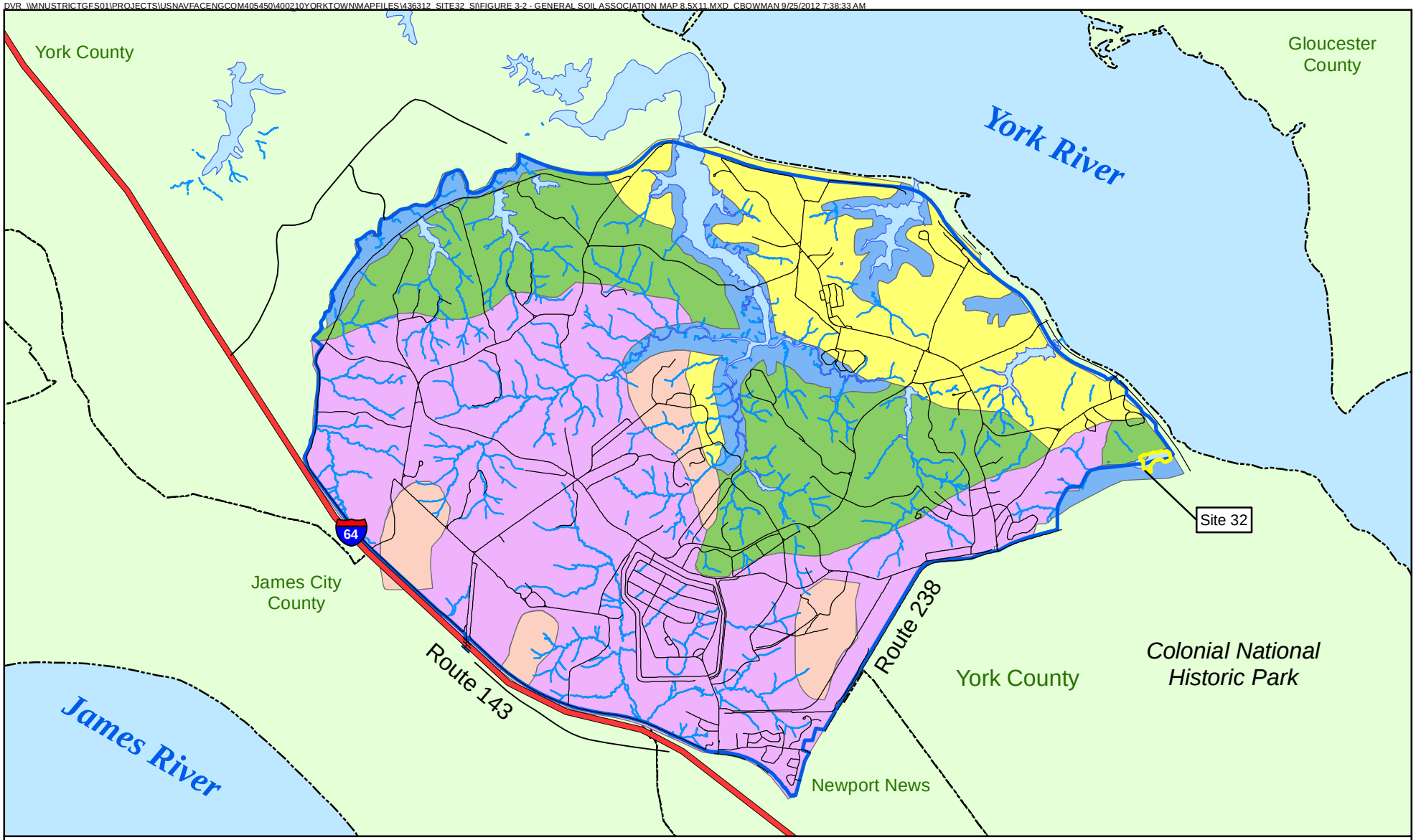
N
W E
S

0 4,000 8,000
Feet

Figure 3-1
River Terraces of the Atlantic Coastal Plain
SIte 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 3-2 - GENERAL SOIL ASSOCIATION MAP 8.5X11.MXD CBOWMAN 9/25/2012 7:38:33 AM



Legend

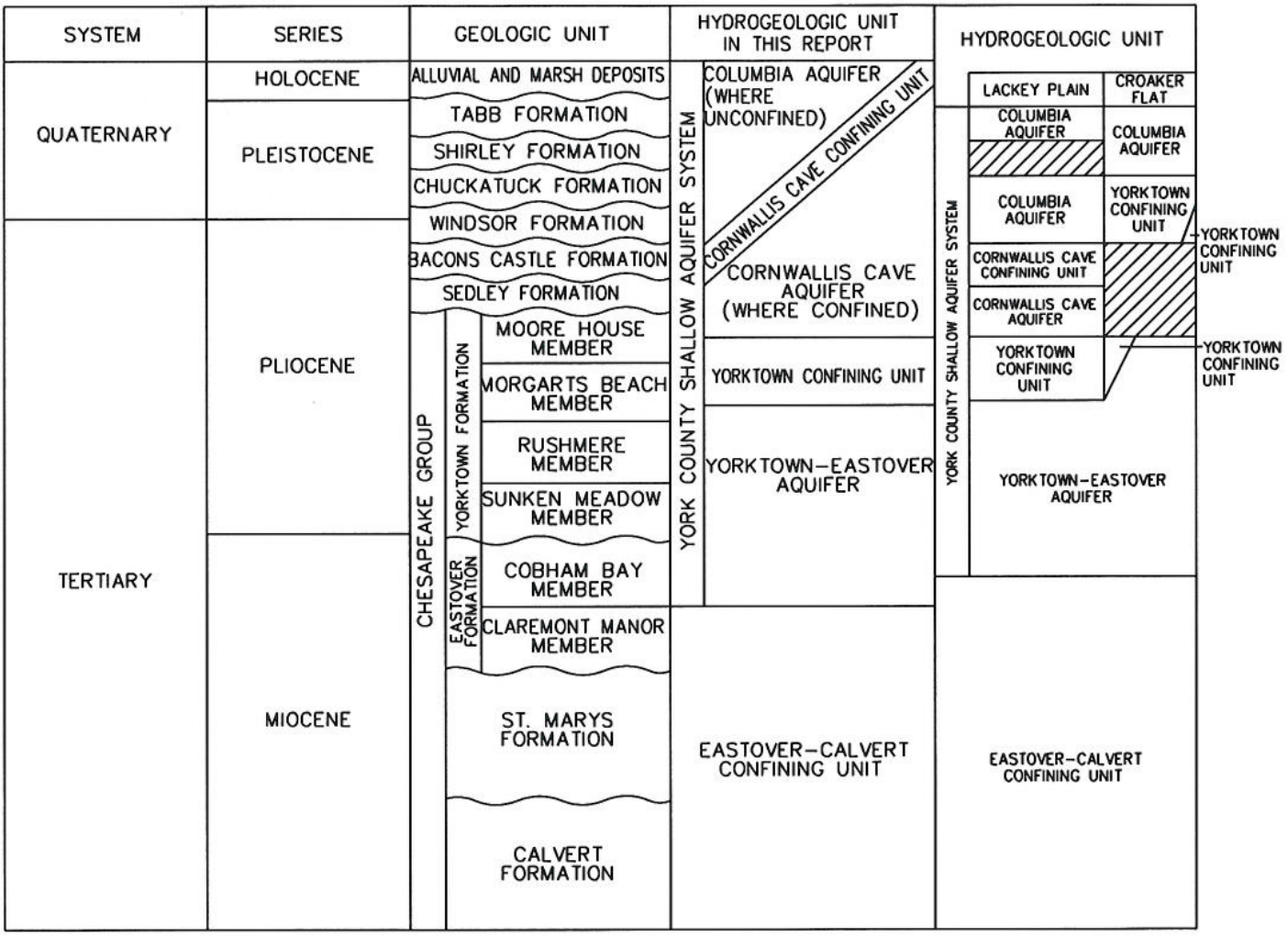
- Bohicket, Johnson, and Axis (1)
- Dogue, Pamunkey, and Uchee (2)
- Emporia, Kempsville, and Craven-Uchee Complex (3)
- Slagle, Emporia, and Emporia Complex (4)
- Slage, Berthera, and Craven-Uchee (5)
- Yorktown Naval Weapons Station Base Boundary
- Study Area Boundary

N
W E
S

0 2,500 5,000
Feet

Figure 3-2
WPNSTA Yorktown General Soil Association Map
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

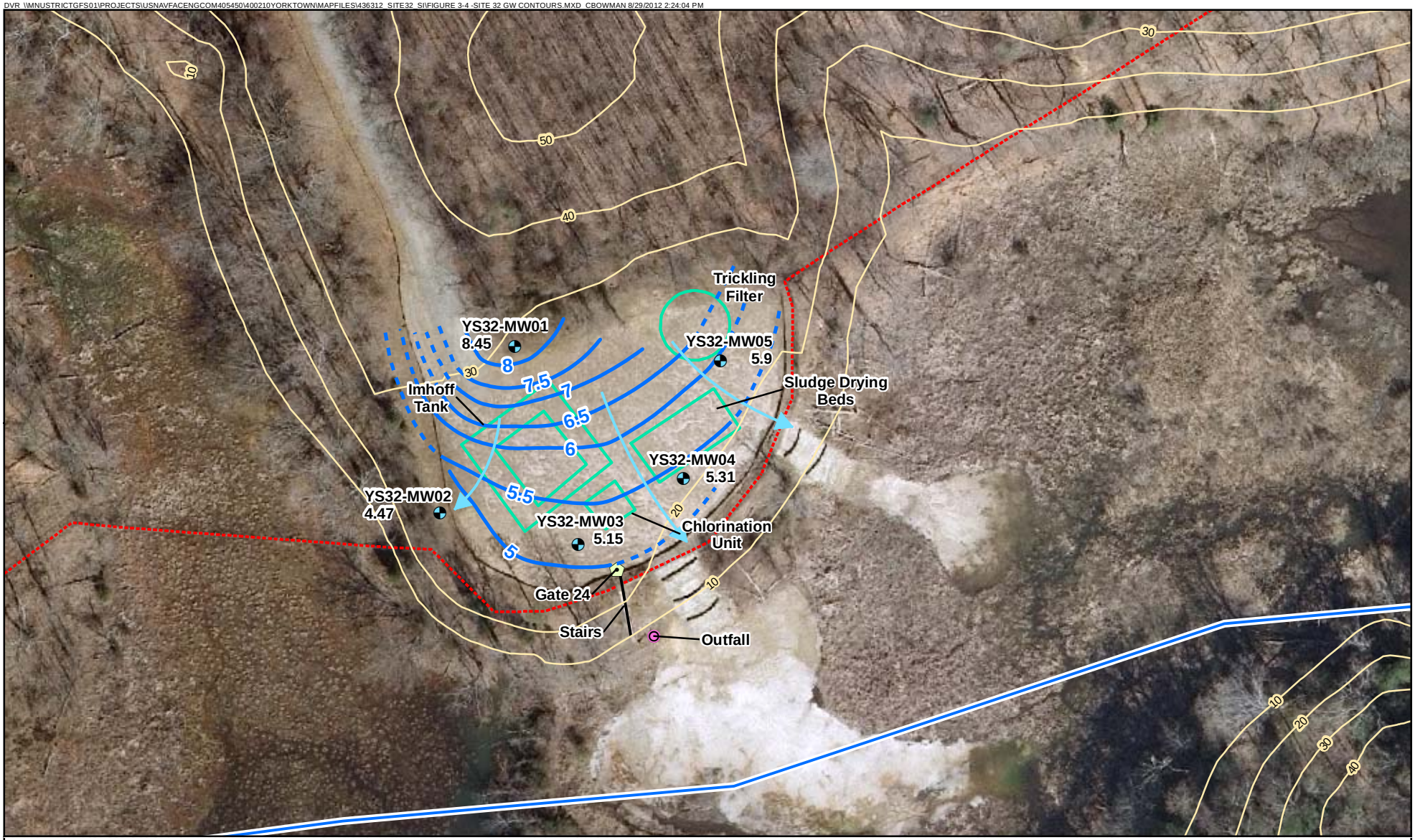
CH2MHILL



Source: Brockman, ET AL 1997 GEOHYDROLOGY OF THE SHALLOW AQUIFER SYSTEM, NAVAL WEAPONS STATION YORKTOWN, YORKTOWN, VIRGINIA

Figure 3-3
Geologic Units in York County
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 3-4 -SITE 32 GW CONTOURS.MXD CBOWMAN 8/29/2012 2:24:04 PM



Legend

- Monitoring Well Location at Groundwater Elevation (ft msl)
- Groundwater Contour
- Groundwater Contour (inferred)
- Groundwater Flow Direction
- Elevation Contour (10 ft interval)
- Fence
- Property Boundary Line
- Former Structures

Note:
Groundwater level measurements were collected on May 17, 2012.

N
W E
S

0 20 40 80
Feet

Figure 3-4
Site 32 Groundwater Contour Map
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

SECTION 4

Investigation Methodology

Section 4 describes the approach and methodology for the field investigation activities conducted in March and May 2012 as part of the SI at Site 32. Sampling was performed in accordance with the *Final Sampling and Analysis Plan, Site 32, Sewage Treatment Plant #2, Sludge Drying Bed Site Investigation* (CH2M HILL, 2012) and the *Master Project Plans, Naval Weapons Station Yorktown, Yorktown, Virginia and Cheatham Annex Williamsburg, Virginia* (Baker, 2005b). Field activities conducted in 2012 by CH2M HILL included surface and subsurface soil sampling, monitoring well installation, and groundwater monitoring and sampling.

Table 4-1 summarizes the environmental data collected to characterize the nature and extent of contamination, including the number of samples collected, sample nomenclature, the media sampled, and the analyses performed. **Figure 4-1** presents the locations of the samples collected during the SI in the various environmental media.

4.1 Pre-Investigation Activities

From June 2010 through September 2011 the Yorktown Partnering Team developed the goals and the investigative approach for the Site 32 SI. This process and the resulting sampling plan were documented in the UFP-SAP, which was finalized in November 2011. Prior to the 2012 SI field investigation activities, an on-base satellite accumulation area (Wright Circle) was selected to temporarily store the investigation derived waste (IDW) generated during the SI field investigation. In addition, an underground utility clearance was conducted at Site 32 by Accumark, Inc., of Chesapeake, Virginia.

4.2 Soil Sampling

Soil sampling was performed in March 2012. Colocated surface and subsurface soil samples were collected at the site upgradient, downgradient, and within the footprint of the former structures (**Figure 4-1**). The soil sampling activities were done in accordance with the standard operating procedures (SOPs) entitled *Shallow Soil Sampling* and *Soil Sampling* (CH2M HILL, 2012). After preparation and at the end of each day, samples were packed on ice and shipped overnight to the laboratory (Environmental Conservation Laboratories of Orlando, Florida) for analysis.

4.2.1 Discrete Surface and Subsurface Soil Sampling

Seven colocated discrete surface (0 to 6 inches bgs) and subsurface (6 to 24 inches bgs) soil samples and one additional colocated deep subsurface soil sample were collected using a hand auger and disposable plastic spoons. Locations were selected to evaluate soils in the footprints of the former trickling filter and Imhoff tank, downgradient of the former STP, and upgradient of the site (**Figure 4-1**). The deep subsurface soil sample was collected from the footprint of the former trickling filter (YS32-SB07), just above the water table during monitoring well installation, at 15 to 17 feet bgs. The sample from this location was intended to determine if site-related contaminants are present in subsurface soil in the native material beneath the clean fill in the former trickling filter location. All discrete soil samples were analyzed for cadmium, mercury, and silver, as outlined in the SAP (CH2M HILL, 2012).

4.2.2 Composite Surface and Subsurface Soil Sampling

Colocated surface (0 to 6 inches bgs) and subsurface (6 to 24 inches bgs) five-point composite soil samples were collected using a hand auger and disposable plastic spoons from the area of the former sludge drying bed (Y32-SO08 [**Figure 4-1**]). The samples were analyzed for TAL metals, TCL VOCs, TCL SVOCs, TCL pesticides, and PCBs. The composite samples were homogenized and composited in the field for all analytes prior to placement in the sample containers, except for samples analyzed for VOCs, which were placed directly in the sample containers and not homogenized in the field.

4.3 Groundwater Sampling

Groundwater monitoring wells were installed at locations selected to evaluate impacts from the former trickling filter, Imhoff tank, sludge drying bed, and chlorination unit, and to provide site-specific background (upgradient) conditions. One monitoring well was installed upgradient of the former STP #2 (YS32-GW01), and the remaining four monitoring wells (YS32-GW02 through YS32-GW05) were installed in downgradient locations (**Figure 4-1**). In accordance with the decision criteria outlined in the SAP (CH2M HILL, 2012), in April 2012, the Yorktown Partnering Team reviewed the March 2012 surface and subsurface soil raw analytical data and agreed to analyze the groundwater data only for total and dissolved cadmium, silver, and mercury (Appendix B). The analytical parameters were selected based on comparisons of the soil data to human health and ecological screening criteria, background concentrations, and soil leaching criteria. Sample depths were selected to be close to the top of the aquifer, where metals are most likely to be found because they are the most likely site-related contaminants.

4.3.1 Monitoring Well Installation

Five shallow monitoring wells (YS32-MW01 through YS32-MW05) were installed within the Cornwallis Cave aquifer to depths up to 31 feet bgs. Each monitoring well was installed in accordance with the SOP entitled *General Guidance for Monitoring Well Installation* (CH2M HILL, 2012). The monitoring well construction details are summarized in **Appendix A**.

Parratt-Wolff, Inc., of Hillsborough, North Carolina, provided hollow-stem auger (HSA) well drilling and installation services using a 4.25-inch-inside-diameter (ID) HSA and 2-foot-long acetate sleeves to provide lithologic descriptions. During soil logging, soil descriptions, including grain size, color, moisture content, relative density, consistency, soil structure, mineralogy, and other relevant information such as possible evidence of contamination, were recorded. Soil boring logs are included in **Appendix A**.

New monitoring wells were constructed with 2-inch-ID Schedule 40 polyvinyl chloride (PVC) casing and well screen (**Appendix A**). In accordance with the SOP entitled *Monitoring Well Installation* (CH2M HILL, 2012), the well screens were 10 feet long with 0.010-inch slot sizes. A silica sand filter pack was placed around the annular space of the well screen from the bottom of the boring and well screen to a depth of approximately 2 feet above the top of the screen. A bentonite layer (approximately 2 to 3 feet) was placed at the top of the sand pack. After the bentonite was hydrated for at least 24 hours, a cement-bentonite grout was placed in the remaining annular space to the surface. All monitoring wells were completed with steel stick-up casings and four protective bollards. A locking, watertight cap was placed on the top of each casing, and the well identification numbers were clearly marked on the well with etched well identification tags.

4.3.2 Monitoring Well Development

Prior to sampling, all monitoring wells were developed in order to restore the permeability of the aquifer material surrounding the well, which may have been reduced by the drilling operations, and to remove fine-grained materials that may have entered the well during installation. Monitoring well development was performed after the grout used to construct the new monitoring wells was allowed to adequately set (at least 24 hours or more) to prevent grout contamination of the screened interval. Monitoring wells were developed using a submersible pump and a combination of surging and pumping throughout the well screen.

Between 20 and 50 gallons of water were evacuated from each well, with a total of 155 gallons of water purged during the entire monitoring well development event. During monitoring well development, in accordance with the SOP entitled *Installation of Shallow Monitoring Wells* (CH2M HILL, 2012), water quality parameters (pH, oxidation-reduction potential [ORP], temperature, conductivity, turbidity, and dissolved oxygen [DO]) were recorded approximately every 5 minutes using a Horiba U-50 water quality meter (**Appendix A**). The Horiba U-50 instrument was calibrated daily, and calibration results were recorded in the field notebook.

Generally, development continued until at least three well volumes were removed and the water produced was free of turbidity, sand, and silt (to the maximum extent practicable). The Horiba U-50 meter was used to determine when the turbidity was low (preferably less than 20 nephelometric turbidity units). If turbidity

continued to decrease after the removal of three well volumes, monitoring was continued until turbidity readings stabilized (that is, until turbidity readings were within 10 percent for three consecutive readings). In addition, development typically ended once three successive measurements of pH, specific conductivity, and temperature were achieved (that is, until the readings for each measurement were within 10 percent of each other).

4.3.3 Groundwater Monitoring

A groundwater-level survey was conducted at all five monitoring wells prior to sampling. **Table 3-1** summarizes the groundwater-level measurements from each well. An electronic water-level meter was used to measure the depth to water from the marking on the top of casing to the nearest 0.01 foot.

4.3.4 Groundwater Sampling

Groundwater samples were collected from all monitoring wells, in accordance with the SOP entitled *Low-Flow Groundwater Sampling from Monitoring Wells* (CH2M HILL, 2012), in order to minimize drawdown and to obtain a sample representative of groundwater conditions in the surrounding geologic formation. Prior to groundwater sample preparation, monitoring wells were purged in order to remove any stagnant water that may have accumulated within the well. Groundwater samples were collected using a peristaltic pump and disposable tubing. Groundwater quality parameters comprising pH, conductivity, turbidity, DO, temperature, and ORP were collected during the purging of each well, using a Horiba U-22 water quality meter and a flow-through cell.

Purging continued until water quality readings collected 5 minutes apart stabilized to within 10 percent of one another (**Appendix A**). Following parameter stabilization, a CHEMet test was used to confirm DO readings measured by the Horiba U-50 (Model Numbers K-7501 for 0 to 1 part per million [ppm] and K-7512 for 1 to 12 parts per million [ppm]). Once DO confirmation was recorded, the flow-through cell was disconnected and samples were collected directly into laboratory-prepared, pre-preserved sample bottles. The final set of groundwater quality measurements recorded before sample collection for each monitoring well is presented in **Table 4-2**.

Groundwater for the total metals samples was pumped through the tubing directly into the appropriate laboratory-provided bottles. Groundwater collected for dissolved metals analyses was pumped through a 0.45-micron filter and then directly into the sample bottles. **Table 4-1** presents a summary of the monitoring wells sampled and the analyzed constituents.

4.4 Surveying Activities

During soil sampling, a Trimble Geo-XT Global Positioning System (GPS) was used to locate sample locations. Michael Surveying & Mapping, P.C., of Newport News, Virginia (a Virginia-licensed and registered surveyor), conducted a survey of the new monitoring wells. Each of the monitoring wells was surveyed for vertical and horizontal control to accuracies of ±0.01 foot and ±0.1 foot, respectively. Monitoring wells were surveyed at the top of the PVC casing (where marked) and at the ground surface. The vertical elevations were referenced to National Geodetic Vertical Datum 88 to remain consistent with the existing WPNSTA Yorktown vertical datum. Horizontal coordinates conformed to North American Datum 83 with ties to the Virginia State Plane Coordinate System. The survey is included as **Appendix C**.

4.5 Decontamination Procedures

All decontamination activities were conducted in accordance with the SOPs entitled *Decontamination of Drilling Rigs* and *Equipment* and *Decontamination of Personnel and Equipment*, as applicable (CH2M HILL, 2012). Disposable sampling equipment and personal protective equipment (PPE), such as Master flex tubing and nitrile gloves, were treated as non-hazardous solid waste. After use, equipment was placed in plastic contractor bags and disposed of in an onsite trash dumpster. Non-disposable sampling equipment, such as hand augers, was decontaminated prior to each use.

Reusable heavy equipment, such as drilling rods and augers, was decontaminated before and in between the collection of each sample using a high-pressure steam cleaner with potable-grade water. Pressure washing was conducted at the temporary decontamination pad, which had been constructed prior to the start of drilling activities. The decontamination pad consisted of a raised wood frame lined with a high-density polyethylene tarp, which acted as a basin to collect fluids. The fluids were then pumped into approved 55-gallon drums to await characterization and disposal. All heavy equipment decontamination procedures were conducted in accordance with the SOP entitled *Decontamination of Drilling Rigs and Equipment* (CH2M HILL, 2012).

Reusable sampling equipment, such as split-spoons, was decontaminated using the following procedure:

1. Rinse equipment with potable water.
2. Wash equipment with distilled water and 2.5-percent Liquinox solution, using a brush to remove any particulate matter or surface film.
3. Rinse equipment with potable water.
4. Rinse equipment with distilled or potable water and a 10 percent methanol solution.
5. Rinse equipment with distilled water and allow to air dry.
6. Wrap exposed areas with aluminum foil for transport and handling if not used immediately following decontamination.

Water generated during decontamination of sampling equipment was collected and transferred to an approved 55-gallon drum for characterization and disposal.

4.6 Investigation-Derived Waste Management

IDW generated during the SI included soil cuttings, well development groundwater, and groundwater sampling purge water, as well as decontamination rinse water from non-disposable sampling equipment and heavy equipment. IDW was containerized in approved 55-gallon drums that were properly labeled and stored within secondary containment at Wright Circle, the approved IDW staging location. Nnine drums of solid IDW, seven drums of aqueous IDW, and five drums of a mix of solid and aqueous IDW were generated during the 2012 SI field activities. The mixed drums contained flooded soil from the top 10 feet from each well location for treatment of fire ants.

Prior to disposal, CH2M HILL field staff collected one composite sample from all aqueous IDW drums and one composite sample from all solid and mixed IDW drums. Composite soil samples were collected prior to fire ant treatment. The IDW samples were analyzed for full Toxicity Characteristic Leaching Procedure (TCLP) analysis (VOCs, SVOCs, pesticides and PCBs, herbicides, and inorganic constituents), ignitability, reactive cyanide, reactive sulfide, and corrosivity. Based on the analytical results, all IDW was identified as non-hazardous and disposed of by Capital Environmental at the Soilex disposal facility located in Chesapeake, Virginia, within 90 days of generation.

All IDW management activities were conducted in accordance with the IDW Management Plan (Baker, 2005b) and the SOP for *Disposal of Waste Fluids and Solids in the Investigation Derived Waste Management Plans* (CH2M HILL, 2012). The analytical data, waste tracking logs, waste characterizations, and non-hazardous waste manifests for the IDW are included in **Appendix D.**

4.7 Quality Assurance and Quality Control

Samples collected for this field investigation were analyzed using SW 846 Program methods with Level IV quality assurance (QA)/quality control (QC).

Field QA/QC samples were collected during the sampling program for the following reasons:

- To ensure that disposable and reusable sampling equipment were free of contaminants
- To evaluate field methodology
- To establish ambient field background conditions
- To evaluate whether cross contamination occurred during sampling and/or shipping

The following types of field QA/QC samples were collected and analyzed in accordance with the Site 32 SAP (CH2M HILL, 2012) (**Table 4-1**):

- **Equipment Rinsate Blank:** Three equipment rinsate blank samples were collected (two soil and one groundwater). The samples were obtained by running laboratory-grade deionized water over and through sample collection equipment after the equipment was decontaminated (for reusable equipment) or prior to the equipment's use (for disposable equipment). The samples were used to determine if decontamination procedures for reusable equipment were adequate, and/or whether disposable, one-time-use equipment was contaminant-free prior to use.
- **Duplicate Sample:** Five duplicate samples (four soil and one groundwater) were collected at the same time and under identical conditions as their respective associated sample. The samples were collected to evaluate reproducibility of sample results. One duplicate sample was collected for every 10 environmental samples collected (or 10 percent) per media and sample type.
- **Trip Blank:** Two trip blank samples were collected (one soil and one IDW). Trip blanks were prepared at the laboratory, shipped with the sample containers, and stored onsite near the empty sample containers. Any time VOC samples were packed and shipped to the laboratory, a trip blank sample was included inside the shipping cooler. The trip blanks were analyzed for VOCs along with the other VOC samples. Trip blanks were used to evaluate whether or not cross-contamination of VOCs between sampling containers may have occurred during shipping.

In addition to samples collected to monitor field QC, the following samples were collected to monitor quality within the laboratory:

- **Matrix Spike (MS):** An aliquot of a matrix (either soil or water) was spiked with known quantities of specific compounds and subjected to the entire analytical procedure. By measuring recovery, the appropriateness of the method for the matrix was determined.
- **Matrix Spike Duplicate (MSD):** The samples were collected as second aliquots of the same matrix as the MS to determine the precision of the method.

One MS sample and one MSD sample were collected for every 20 environmental samples collected (or 5 percent of the samples collected) per medium and sample type. A total of five MS/MSD samples were collected.

4.8 Data Validation

The analytical data were reviewed and validated internally by CH2M HILL and were presented in a technical memorandum to the CH2M HILL project chemistry team. The laboratory analytical results are presented in **Appendix E**, and the results of the data validation are summarized as follows and included as **Appendix F**.

The data were evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents:

- SAP (Field Sampling Plan and QA Project Plan) Site 32, STP #2 Sludge Drying Bed SI, WPNSTA, Yorktown, Virginia (CH2M HILL, 2012)
- Region 3 Modifications for Organic Data Review (USEPA, 1994)
- Region 3 Modifications for Inorganic Data Review (USEPA, 1993)

Data were evaluated for completeness, technical holding times, instrument tuning, initial and continuing calibrations, blanks, internal standards, laboratory control samples, MS recoveries, field duplicates, serial dilution, identification and quantitation, and reporting limits. The data validation reports concluded that the sample delivery groups were complete and intact, and for all of the samples collected during this investigation, sample preparation analysis was performed within holding-time requirements, and the data are acceptable for use in the project decision-making process. The data validation report for all of the samples collected during this investigation is included in **Appendix F**.

TABLE 4-1

Sample Summary Table - CTO-WE50

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

	Station ID	Sample ID	Duplicate	MS/MSD	Soil					Aqueous				
					Analytical Group:	VOCs	SVOCs	Pest/PCBs	Metals	VOCs	SVOCs	Pest/PCBs	Metals	Dissolved Metals
					EPA Method:	SW-846 8260B	SW-846 8270D, 8270D-SIM	SW-846 8081B, SW-846 8082A	SW-846 6020A, SW-846 7471A	SW-846 8260B	SW-846 8270D, 8270D-SIM	SW-846 8081B, SW-846 8082A	SW-846 6020A, SW-846 7470A	SW-846 6020A, SW-846 7470A
All locations except sludge drying bed	**Surface Soil**													
	YS32-GW01	YS32-SS01-0312			SS				Cd, Hg, Ag only					
	YS32-GW02	YS32-SS02-0312			SS				Cd, Hg, Ag only					
	YS32-GW03	YS32-SS03-0312			SS				Cd, Hg, Ag only					
		YS32-SS03-0312-MS		X-SS	SS				Cd, Hg, Ag only					
		YS32-SS03-0312-SD			SS				Cd, Hg, Ag only					
	YS32-GW04	YS32-SS04-0312	X-SS		SS				Cd, Hg, Ag only					
		YS32-SS04P-0312			SS				Cd, Hg, Ag only					
	YS32-GW05	YS32-SS05-0312			SS				Cd, Hg, Ag only					
	YS32-SO06	YS32-SS06-0312			SS				Cd, Hg, Ag only					
	YS32-SO07	YS32-SS07-0312			SS				Cd, Hg, Ag only					
	Subsurface Soil													
	YS32-GW01	YS32-SB01-06-24-0312			SB				Cd, Hg, Ag only					
	YS32-GW02	YS32-SB02-06-24-0312			SB				Cd, Hg, Ag only					
	YS32-GW03	YS32-SB03-06-24-0312			SB				Cd, Hg, Ag only					
		YS32-SB03-06-24-0312-MS		X-SB	SB				Cd, Hg, Ag only					
		YS32-SB03-06-24-0312-SD			SB				Cd, Hg, Ag only					
	YS32-GW04	YS32-SB04-06-24-0312	X-SB		SB				Cd, Hg, Ag only					
		YS32-SB04P-06-24-0312			SB				Cd, Hg, Ag only					
	YS32-GW05	YS32-SB05-06-24-0312			SB				Cd, Hg, Ag only					
	YS32-SO06	YS32-SB06-06-24-0312			SB				Cd, Hg, Ag only					
	YS32-SO07	YS32-SB07-06-24-0312			SB				Cd, Hg, Ag only					
		YS32-SB07-15-17-0312			SB				Cd, Hg, Ag only					
Sludge drying bed	**Composite Soil**													
	YS32-SO08	YS32-SS08-0312	X-SS		SS	X	X	X	X					
		YS32-SS08P-0312			SS	X	X	X	X					
		YS32-SS08-0312-MS		X-SS	SS	X	X	X	X					
		YS32-SS08-0312-SD			SS	X	X	X	X					
		YS32-SB08-06-24-0312	X-SB		SB	X	X	X	X					
		YS32-SB08P-06-24-0312			SB	X	X	X	X					
		YS32-SB08-0312-MS		X-SB	SS	X	X	X	X					
		YS32-SB08-0312-SD			SS	X	X	X	X					
Monitoring Wells	**Groundwater**													
	YS32-GW01	YS32-GW01-0512			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
	YS32-GW02	YS32-GW02-0512			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
	YS32-GW03	YS32-GW03-0512			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
		YS32-GW03-0512-MS		X-GW	GW								Cd, Hg, Ag only	Cd, Hg, Ag only
		YS32-GW03-0512-SD			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
	YS32-GW04	YS32-GW04-0512	X-GW		GW								Cd, Hg, Ag only	Cd, Hg, Ag only
		YS32-GW04P-0512			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
	YS32-GW05	YS32-GW05-0512			GW								Cd, Hg, Ag only	Cd, Hg, Ag only
Blanks	**QA/QC Example Sample Nomenclature**													
	YS32-QC	YS32-TB03-030112			TB					X				
	YS32-QC	YS32-EB030112			EB					X	X	X	X	X
	YS32-QC	YS32-EB030612			EB					X			X	X
	YS32-QC	YS32-EB051712			EB								X	X

TABLE 4-2

Groundwater Field Parameter Results

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Station ID	YS32-MW01	YS32-MW02	YS32-MW03	YS32-MW04	YS32-MW05
Sample ID	YS32-GW01-0512	YS32-GW02-0512	YS32-GW03-0512	YS32-GW04-0512	YS32-GW05-0512
Sample Date	5/17/12	5/17/12	5/17/12	5/17/12	5/17/12
Field Parameter					
Dissolved Oxygen (mg/L)	1.41	1.4	0.4	1.01	3.29
Chemets Dissolved Oxygen (mg/L)	1.5	1.5	~1	1.5	3.5
Oxidation Reduction Potential (mV)	165	109	159	165	165
pH	6.74	6.7	6.77	6.68	6.76
Specific Conductivity (mS/cm)	0.858	0.859	0.811	0.845	0.837
Temperature (°C)	20.84	18.98	21.25	22.47	22.41
Turbidity (NTU)	14.7	0	2.5	1.2	0

Notes:
C - Degrees centigrade
mg/L - Milligrams per liter
mS/cm - Milliseimens per centimeter
mV - Millivolts
NTU - Nephelometric turbidity unit
pct - Percent
NA - Not analyzed

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 4-1 - SAMPLE LOCATIONS.MXD CBOWMAN 8/29/2012 2:49:17 PM

Legend

- Monitoring Well Location
- 5 Point Composite Surface and Subsurface Soil Sample Location
- Surface and Subsurface Soil Sample Location
- Elevation Contour (10 ft interval)
- Fence
- Property Boundary Line
- Former Structures
- Study Area Boundary

N
W E
S

0 20 40 80
Feet

Figure 4-1
Sample Locations
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

SECTION 5

Investigation Results

Section 5 presents an evaluation of the results from the SI performed at Site 32, including a summary of the analytical results and the findings of the human health risk screening (HHRS) and ecological risk assessment (ERA), and develops a conceptual site model (CSM) based on the results.

5.1 Data Results Summary

Data collected from the footprints and in the vicinity of the former STP structures in the upland portion of Site 32 during the 2012 SI field activities were evaluated as part of this SI report. **Tables 5-1**, **5-2**, and **5-3** summarize all constituents detected in Site 32 surface and subsurface soil samples collected during this investigation. There were no detections of constituents in groundwater. **Table 5-4** summarizes the groundwater data. Validated analytical data for groundwater and surface and subsurface soil collected during the 2012 SI field investigation are provided in **Appendix E**.

Data results were compared to the following screening criteria in accordance with the SAP (CH2M HILL, 2012):

- Surface and Subsurface Soil
  - WPNSTA Yorktown Background Dataset (CH2M HILL, 2011b)
  - USEPA Residential Soil Regional Screening Levels (RSLs) (USEPA, 2012), adjusted by dividing by 10 for non-carcinogenic endpoints
  - USEPA ecological screening values (ESVs) for plants and soil invertebrates (**Appendix G**)
  - USEPA "MCL-based" and "Risk-based" Soil Screening Levels (SSLs) to determine leaching potential (USEPA, 2012)
- Groundwater:
  - Maximum WPNSTA Yorktown Base-Wide Background Upper Tolerance Limits (UTLs) (CH2M HILL, 2011b)
  - Federal Maximum Contaminant Levels (MCLs)
  - USEPA Tap Water RSLs (Updated May 2012), adjusted by dividing by 10 for non-carcinogenic endpoints
  - USEPA Ambient Water Quality Criteria for the Protection of Aquatic Life

5.1.1 Discrete Surface and Subsurface Soil Samples

Seven colocated surface soil (0 to 6 inches) and subsurface soil (6 to 24 inches) samples (SS/SB01 through SS/SB07) were collected in locations upgradient and downgradient of the former STP structures and from within footprints of the former Imhoff tank, trickling filter, and sludge drying beds (**Figure 4-1**). In addition, one sample was collected from the footprint of the former trickling filter (YS32-SB07-15-17-0312), just above the water table (15 to 17 feet bgs), to ensure native material was evaluated, since the area within and in the vicinity of the former footprint of the trickling filter had previously been excavated and backfilled during the dismantling of STP #2. All of the samples were analyzed for cadmium, mercury, and silver. Results were compared to the previously listed screening criteria as outlined in the UFP-SAP (CH2M HILL, 2012). The results are presented in **Table 5-1** and **Figure 5-1** for surface soil and **Table 5-2** and **Figure 5-2** for subsurface soil, and are summarized as follows:

- **Discrete Surface Soil**
  - Cadmium exceeded the MCL-based SSL in one discrete surface soil sample (YS32-SS03).
  - Mercury concentrations exceeded the risk-based SSL in five locations (six samples including the YS32-SS04 duplicate), and also exceeded the MCL-based SSL, the ESV, and background in one sample location (YS32-SS03).

- Silver concentrations did not exceed any screening levels.
- No constituents exceeded the adjusted residential soil RSLs.

- **Discrete Subsurface Soil**
  - Cadmium exceeded the MCL-based SSL in four subsurface soil samples and the risk-based SSL in two subsurface soil samples, with a maximum concentration detected at YS32-SB05.
  - Mercury exceeded the risk-based SSL in five locations (six samples including the duplicate at YS32-SB04) and exceeded the MCL-based SSL, background, and ESV in two sample locations. The maximum concentration was detected at YS32-SB07.
  - Silver exceeded the risk-based SSL in three locations, and exceeded the background value YS32-SB04P.

5.1.2 Composite Surface and Subsurface Soil Samples

One five-point composite surface soil sample and one five-point composite subsurface soil sample were collected from within the footprint of the former sludge drying beds, and were analyzed for TCL VOCs, TCL SVOCs, pesticides and PCBs, and TAL metals. Results were compared to the previously-listed screening criteria as outlined in the SAP (CH2M HILL, 2012). The results were as follows:

- **Five-Point Composite Surface Soil (Tables 5-3)**
  - No VOCs were detected.
  - No SVOCs were detected.
  - Pesticides: 4,4'-dichlorodiphenyldichloroethylene (DDE) was detected above background but below all of the screening criteria.
  - PCBs: Aroclor-1268 was detected below the ecological screening value. There are no established SSL, RSL, or background values.
  - Fourteen metals were detected at concentrations that exceeded the SSL, RSL, and/or ecological screening criteria; however, only three (barium, iron, and lead) also exceeded background levels, as follows:
    - Barium exceeded the MCL-based SSL and background.
    - Iron exceeded the risk-based SSL, the residential soil RSL, and background.
    - Lead exceeded the MCL-based SSL and background.

- **Five-Point Composite Subsurface Soil (Table 5-3)**
  - No VOCs were detected.
  - Two SVOCs exceeded the risk-based SSL (benzo[a]anthracene and benzo[a]pyrene). No background concentrations were available for SVOCs in subsurface soil.
  - Pesticides: 4,4'-dichlorodiphenyldichloroethane (DDD) and 4,4'-dichlorodiphenyltrichloroethane (DDT) were detected above background but below the screening criteria; 4,4'-DDE exceeded the risk-based SSL and background.
  - PCB: Aroclor-1268 was detected above the ecological screening value. There are no established SSL, RSL, or background values.
  - Thirteen metals were detected at concentrations that exceeded the SSL, RSL, and/or ecological screening criteria; however, only lead was detected above a screening criterion (the MCL-based SSL) and background.

5.1.3 Groundwater Samples

Five groundwater samples were collected from monitoring wells across the upland area of Site 32 (**Figure 4-1**) and analyzed for cadmium, mercury, and silver. There were no detections of any of the constituents in any of the samples collected (**Table 5-4**). The reporting limit for cadmium was above the ESV. The reporting limit was established by the laboratory at the limit of detection (LOD) for the method. However, the data were evaluated to the detection limit (DL), which is below the LOD, and any detection above the DL would have been reported as detected and flagged with a "J" (estimated concentration). In the case of cadmium, the data were evaluated to cadmium's DL (0.11 microgram per liter [µg/L]), which was below all the screening values.

5.2 Human Health Risk Screening

An HHRS was performed to assess the potential for human health risks associated with exposure to soil and groundwater in the vicinity of former STP #2 at Site 32. The results of the HHRS provide an indication of potential risks from constituents of potential concern (COPCs) and are used to help determine whether the site requires further evaluation (such as a baseline risk assessment or additional data collection), or future unrestricted use (residential use, the most conservative site use, or any other potential future site use, including construction activities) of the site is acceptable based on human health risks.

5.2.1 Data Evaluation

Groundwater and soil samples were collected in the spring of 2012. Surface (0 to 6 inches bgs) and subsurface (6 to 24 inches bgs) composited soil data from the sludge drying bed and from the discrete sample locations in the vicinity of the former structures were evaluated in the HHRS. In the location of the trickling filter, an additional subsurface sample was collected just above the water table (from 15 to 17 feet bgs) to ensure that native material is evaluated (because this area was formerly backfilled). In accordance with the SAP this one deep soil sample was not evaluated in the HHRS due to the lack of a complete exposure pathway (CH2M HILL, 2012).

Groundwater samples were collected from five monitoring wells (one monitoring well installed at the upgradient soil sampling location and the remaining four installed at the four downgradient soil sampling locations) and analyzed for total and dissolved cadmium, mercury, and silver. Sample results did not detect the presence of the chemicals above the reported sample quantitation limits; therefore, groundwater was eliminated from future evaluation.

All the data included in the HHRS were validated and found to be reliable for use in the HHRS. The analytical data are presented in **Appendix E**. A review of the data identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as detected concentrations.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration.

5.2.2 Human Health Risk Screening

The maximum detected constituent concentrations in surface soil and subsurface soil were compared to USEPA residential soil RSLs (USEPA, 2012). RSLs based on noncarcinogenic effects were divided by 10 to account for exposure to multiple chemicals (that is, they were adjusted to a hazard quotient [HQ] of 0.1, from the HQ of 1.0 used on the USEPA RSL table). RSLs based on carcinogenic endpoints were used as presented in the RSL table, and are based on a carcinogenic risk of 1×10^{-6}.

If the maximum detected soil concentration exceeded the risk-based screening level (the adjusted RSL, as discussed in the preceding paragraph), the soil data were compared to the Cheatham Annex and Yorktown basewide background soil concentration; the 95 percent UTL from the Yorktown background soil database was used, if available, otherwise the Yorktown maximum detected background soil value was used, as presented in the *Background Study Report for Naval Weapons Station Yorktown, Yorktown, Virginia* (CH2M HILL, 2011a).

If the maximum detected concentration did not exceed the screening value or background concentration, no further evaluation or action is required.

As previously mentioned, none of the target analytes were detected in groundwater; therefore, no screening of the groundwater data was performed.

Table 5-5 presents the risk-based screening for surface soil. As shown in **Table 5-5**, the only analyte with a concentration above the residential RSL and background concentration is iron. Iron is an essential human nutrient. The concentration of iron detected in the surface soil (22,100 mg/kg) would result in an ingestion of iron for a child of 4.42 milligrams per day (mg/day), based on a soil ingestion rate of 200 milligrams of soil per day, which is below the recommended dietary allowance (RDA) for a 1- to 3-year-old child of 7 mg/day (NAS, 2001). The concentration of iron detected in the surface soil would result in an ingestion of iron for an adult of 2.21 mg/day, based on a soil ingestion rate of 100 mg/day—below the RDA for adults, which ranges from 8 to 27 mg/day (NAS, 2001). Therefore, it is not expected that exposure to surface soil at Site 32 would result in unacceptable risks to human receptors requiring additional action or remediation at the site.

Table 5-6 presents the risk-based screening for subsurface soil. As shown in **Table 5-6**, the only analyte with a concentration above the background concentration (where available) is Aroclor-1268. Aroclor-1268 is a relatively rare PCB that was generally used in rubbers, synthetic resins, wax extenders, neoprene (fire retardant and injection moldings), and as a plasticizer in caulking and roofing compounds. An RSL value for Aroclor-1268 is not available; therefore, the residential soil RSL for Aroclor-1260 was used as a surrogate. Base-wide background concentrations are not available for PCBs; therefore, a comparison to background was not possible for Aroclor-1268. The detected concentration of Aroclor-1268 exceeded the surrogate screening value by less than an order of magnitude. As Aroclor-1268 is the only constituent that exceeded the RSL, it would be reasonable to consider a screening level based on a cancer risk of 10^{-5} (which is still within USEPA's acceptable risk level of 10^{-6} to 10^{-4}). The Aroclor-1268 concentration is below 10 times the RSL (a screening level based on a 10^{-5} risk level). Therefore, exposure to subsurface soil associated with Site 32 would not result in any unacceptable human health risks.

5.2.3 Human Health Risk Screening Summary

None of the target analytes were detected above the reported sample quantitation limit for groundwater, and the reported sample quantitation limits were all below the tap water RSLs. Therefore, there are no unacceptable risks associated with potential exposure to groundwater.

Only one constituent detected in surface soil (iron) and one constituent detected in subsurface soil (Aroclor-1268) were detected at a concentration above the residential RSL. However, based on the rationale previously discussed in this report, there are no potential unacceptable human health risks associated with exposure to surface or subsurface soil. Therefore, based on the available sample data (one surface soil and one subsurface soil sample for the majority of the analytes), unrestricted use of the site would not result in any unacceptable human health risks.

5.3 Ecological Risk Assessment

In August 2012, the Yorktown Partnering Team met and reviewed the preliminary results of the SI investigation. They agreed at that time that an expanded ecological evaluation of the data beyond the planned screen was appropriate (Appendix B). A summary of the results of the screening level ecological risk assessment (SERA) and Step 3A of the BERA (referred to as the SERA + 3A) is provided in the following subsections. The full ERA is provided in **Appendix G**.

5.3.1 Data Evaluation

Surface (0 to 6 inches bgs) and subsurface (6 to 24 inches bgs) composited soil data from the sludge drying bed and from the discrete sample locations in the vicinity of the former structures were evaluated in the SERA + 3A. As outlined in the SAP (CH2M HILL, 2012), the deep subsurface sample in the vicinity of the trickling filter was not evaluated due to the lack of a complete exposure pathway.

Although ecological receptors do not typically have direct exposure to groundwater, groundwater data collected as part of this SI were also evaluated in this ERA. This was done to provide a conservative evaluation of the potential for significant contaminant transport from the upland areas of the site via groundwater to downgradient receiving water bodies and the subsequent potential exposure of ecological receptors in these water bodies. Potentially complete exposure pathways evaluated include direct contact with site-related chemicals in surface soil for lower-trophic-level receptors (such as plants and soil invertebrates) and potential ingestion of site-related chemicals via food webs by avian, mammalian, and reptilian terrestrial receptors. The technical approach and methods employed for this assessment are detailed in **Appendix G**.

5.3.2 Ecological Risk Evaluation

The risk evaluation integrates the various lines of evidence presented in the ERA in order to evaluate the potential for unacceptable risk.

5.3.2.1. Terrestrial Habitats

Nine assessment endpoints were developed for terrestrial habitats at Site 32. Lines of evidence for terrestrial habitats included the following:

- Comparison of surface soil and shallow subsurface soil concentrations with ESVs.
- Comparison of modeled dietary doses with ingestion toxicity reference values.
- Comparison of site surface and shallow subsurface soil concentrations with background concentrations.

In both surface and subsurface soils, only mercury had a 95 percent upper confidence limit (UCL)-based HQ that exceeded 1 and also exceeded the background UTL. Mercury exceeded ESVs and UTLs in a single surface (YS32-SS-03) and subsurface (YS32-SB-07) soil sample location (**Figures 5-1** and **5-2**). The magnitude of the 95 percent UCL HQs were relatively low (1.13 in surface and 1.33 in subsurface), and the mean HQs were less than 1 (0.63 in surface and 0.81 in subsurface). The maximum residual soil concentrations of mercury detected in Site 32 surface and subsurface soils (0.24 to 0.25 mg/kg) are consistent with the maximum concentration detected in background soils (0.24 mg/kg; CH2M HILL, 2011b). Given the habitat present on the site (periodically mowed grass), the potential exposures for mercury are considered to be within the acceptable risk range on a sitewide basis, especially when considering site concentrations in relation to the maximum background concentration and other ESVs from the literature (**Appendix G**).

The maximum surface soil concentration of mercury (0.244 mg/kg) is greater than the soil ESV (0.10 mg/kg), the 95 percent background UTL (0.111 mg/kg), and the maximum background value (0.24 mg/kg). Considering the relatively small size of the potentially impacted area (approximately 100 X 100 feet) and the early successional habitat present, plants and soil invertebrates are the most likely ecological receptors to be potentially affected. The potential effects for higher-trophic-level ecological receptors would be limited (based on the size of the site). Furthermore, the topography of the site is flat and contaminants in surface soil would not likely migrate to adjacent soils or the adjacent remediated wetland. Although unknown, the form of mercury at the site is expected to be in an inorganic form, which is less available to ecological receptors. Therefore, there is a low probability of ecological risk at this site, or to the adjacent wetland, from any residual mercury contamination in the soil of Site 32.

In surface soils, iron also exceeded the background UTL, and soil pH, on which its ESV is based, was not measured in site soils. The exceedance of the background UTL was of low magnitude (ratio of 1.11), and there were no background exceedances in subsurface soils (whose UTL was notably higher than the surface soil UTL [32,000 mg/kg versus 19,900 mg/kg]). It is unlikely that this slight exceedance of the surface soil background UTL is biologically significant.

No chemical had a Maximum Acceptable Toxicant Concentrations (MATC) HQ exceeding 1 based upon the 95 percent UCL exposure dose. Thus, risks from terrestrial food web exposures are considered acceptable.

5.3.2.2. Aquatic Habitats

No chemicals were identified as Step 3A COPCs for further risk evaluation in groundwater. Based upon the results of this evaluation, groundwater does not appear to be a significant transport medium for site-related constituents to the downgradient wetlands, and site-related constituents that might reach these water bodies via groundwater would not pose an unacceptable risk to aquatic biota.

5.3.3 Ecological Risk Summary

For terrestrial habitats, risks for lower-trophic-level receptors (plants and invertebrates) are acceptable on a sitewide basis. No chemical had a MATC HQ exceeding 1 based upon the 95 percent UCL exposure dose. Thus, risks from terrestrial food web exposures are acceptable. Groundwater does not appear to be a significant transport medium for site-related constituents to the downgradient wetlands, and site-related constituents in groundwater are unlikely to pose a significant risk to aquatic biota.

5.4 Conceptual Site Model

The CSM qualitatively combines and interprets the information presented in this section and earlier sections of the report, including the hydrogeologic CSM, contaminant sources, potential migration of the contaminants, and the potential exposure and receptor pathways. The CSM is used to support potential risk management decisions and aids in defining the effectiveness of remedial alternatives, if necessary.

The CSM relates potentially exposed receptor populations with potential source areas based upon physical site characteristics and complete exposure pathways. Important components of the CSM are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptors. Actual or potential exposures of receptors associated with a site are determined by identifying the most likely, and most important, mechanisms and pathways of contaminant release and transport. A complete exposure pathway has the following three components:

1. A source or sources of contamination that result in a release to the environment
2. A pathway and mechanism of chemical transport through an environmental medium
3. An exposure or contact point for a receptor

Potential transport pathways and potential current and future receptors identified for Site 32 are presented in the CSM (**Figure 5-3**).

Chemical groups detected in soils at Site 32 include SVOCs, pesticides, PCBs, and inorganic constituents. Complete potential exposure pathways are identified for human receptors via ingestion, dermal contact, and inhalation. Complete pathways were also identified for ecological receptors via direct contact exposures (plants and invertebrates) and food web exposures (birds, mammals, and reptiles). Constituents of interest identified in the HHRS and the ERA include iron, Aroclor-1268, and mercury in soils. However, there is no evidence linking Aroclor-1268 to a source at Site 32 and the magnitude of the background exceedances for iron and mercury are minimal. The results of the HHRS and ERA indicate that risks from all of these constituents are acceptable.

No constituents were detected in groundwater. Although percolation and infiltration into groundwater and groundwater discharge into the wetlands and Ballard Creek were identified as potentially complete pathways, the pathways were not identified as sources or transport mechanisms of contamination. Concentrations of the SVOCs benzo(a)anthracene and benzo(a)pyrene, the pesticide 4,4'-DDE, and the metals barium, iron, and lead in soils exceeded SSLs and background concentrations (where available). However, there is no indication that these constituents are linked to a site source. There were no detections in groundwater for the three metals identified as being potentially site-related (cadmium, mercury, and silver). Soil, therefore, is not likely acting as a source of contamination to groundwater at Site 32, and groundwater is not acting as a source of contamination to the wetlands and Ballard Creek.

5.5 Project Quality Objectives

In order to accomplish the objectives of this investigation, nine project quality objectives (PQOs) were evaluated using the results of the soil and groundwater sampling from March and May 2012. The questions were developed and documented in the SAP (CH2M HILL, 2012), and a summary of the results are provided as follows:

1. **PQO:** If concentrations of any contaminants in the sludge drying bed composite samples exceed RSLs, ecological screening criteria, or SSLs, and additionally exceed both site-specific and basewide background, the Team will meet to evaluate the data and decide on the contaminants to be analyzed in groundwater (other than cadmium, mercury, or silver, which will be evaluated in groundwater regardless of soil results).

   Result: Concentrations of one pesticide and 14 metals in surface soil, and two SVOCs, three pesticides, and 13 metals in subsurface soil exceeded one or more screening criteria and/or background levels in soil samples. The Yorktown Partnering Team met and discussed the soil sample results in May 2012 and agreed to analyze groundwater samples for cadmium, mercury, and silver only.

2. **PQO:** If concentrations of any contaminants are present in surface soil, subsurface soil, or total groundwater at levels posing potentially unacceptable risk to human or ecological receptors based on a risk screening, concentrations will be compared to base-wide and site-specific upgradient background levels.

   Result: There were no detections of constituents in groundwater samples, and no potential human health or ecological risks associated with groundwater at Site 32 were identified.

   The HHRS determined that iron was the only constituent identified above background levels and human health residential RSLs in surface soil. Aroclor-1268 was identified above the human health residential RSL for subsurface soil. No background value was available.

   The ERA determined that only mercury had a 95 percent UCL-based HQ that exceeded 1 and also exceeded the background UTL but soil concentrations of mercury were consistent with the maximum background value. Iron in surface soil also exceeded the background UTL, and soil pH, on which its ESV is based, was not measured in site soils. The exceedance of the background UTL was of low magnitude (ratio of 1.11), and there were no background exceedances in subsurface soils. Potential ecological risks from mercury and iron were determined to be acceptable.

3. **PQO:** If concentrations of any contaminants are present in total groundwater at levels exceeding MCLs, concentrations will be compared to base-wide and site-specific upgradient background levels. If review of the groundwater data indicates that the dissolved and total recoverable metals data are dissimilar, then the dissolved data will be considered in accordance with the 1992 USEPA Region 3 Guidance on the Selection of Metal Results from Monitoring Well Samples for Use in the Quantitative Assessment of Risk.

   Result: There were no detections of constituents in groundwater samples.

4. **PQO:** If concentrations of contaminants above background in total groundwater are present at levels above MCLs or potentially posing unacceptable risk, the Team will review the total and dissolved data to determine if there is a significant difference between the two datasets. If the elevated concentrations could be a result of suspended sediment based on the two data sets, the Team will discuss possible used of the dissolved data for decision making.

   Result: There were no detections of constituents in groundwater samples.

5. **PQO:** If concentrations of contaminants potentially posing unacceptable risk are present at concentrations greater than background, the risk will be considered site-related.

   Results: Though iron, mercury, and Aroclor-1268 were detected at concentrations above screening values and background (no background was available for Aroclor-1268), the risk of exposure to these constituents for both human and ecological receptors was determined to be acceptable. In addition, there is no evidence linking Aroclor-1268 to a source or historic use at Site 32 and exceedances of the background values for iron and mercury were of low magnitude.

6. **PQO:** If a potentially unacceptable site-related risk is identified in soil and the Team agrees that the nature and extent of contamination has been sufficiently defined to support a removal, an NTCRA will be considered.

   Result: No potentially unacceptable human health or ecological risks were identified for surface soil, subsurface soil, or groundwater at Site 32.

7. **PQO:** If potentially unacceptable site-related risk is identified in either soil or groundwater (or if groundwater concentrations are greater than background and MCLs) and the Team agrees that additional investigation is necessary to define the nature and extent of contamination, a remedial investigation will be completed.

   Result: No potentially unacceptable human health or ecological risks were identified for surface soil, subsurface soil, or groundwater at Site 32.

8. **PQO:** If unacceptable site-related risks are identified for soil but not for groundwater, wells will be abandoned following a second round of groundwater sampling for which the same conclusion is drawn. If unacceptable risk is identified for groundwater but not for soils, and/or if concentrations greater than background and MCLs are found in groundwater in the absence of unacceptable risk, an evaluation of groundwater monitoring alternatives will be considered.

   Result: No potentially unacceptable risks were identified for surface soil, subsurface soil, or groundwater at Site 32; therefore, a second round of groundwater sampling is not required, groundwater monitoring alternatives do not need to be considered, and these monitoring wells can be abandoned.

9. **PQO:** If no unacceptable risks or MCL exceedances are identified for groundwater or soil that are attributable to the site, no further investigation or action will be warranted and monitoring wells will be abandoned upon finalization of the SI report.

   Result: No potentially unacceptable human health or ecological risks were identified for surface soil, subsurface soil, or groundwater at Site 32; therefore, no further investigation or action is warranted, and NFA is recommended for Site 32. Upon finalization of this SI report, the monitoring wells will be abandoned.

TABLE 5-1

Surface Soil Exceedance Results - Discrete Samples

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Station ID	MCL-Based SSLs	Residential Soil RSLs (Adjusted)	Risk-Based SSLs	Background*	Ecological Screening Value	YS32-GW01	YS32-GW02	YS32-GW03	YS32-GW04		YS32-GW05	YS32-SO06	YS32-SO07
Sample ID						YS32-SS01-0312	YS32-SS02-0312	YS32-SS03-0312	YS32-SS04-0312	YS32-SS04P-0312	YS32-SS05-0312	YS32-SS06-0312	YS32-SS07-0312
Sample Date						03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name													
Total Metals (mg/kg)													
Cadmium	0.38	7	0.52	1.33	32	**0.372 J**	7.34 U	**0.393 J**	**0.245 J**	**0.161 J**	**0.319 J**	6.95 U	**0.272 J**
Mercury	0.1	2.3	0.033	0.111	0.1	**0.026**	**0.0227**	0.244	**0.0393**	**0.0425**	**0.0534**	**0.0335**	**0.0441**
Silver	--	39	0.6	1.09	560	0.156 U	**0.0979 J**	**0.185 J**	0.155 U	0.155 U	0.198 J	0.151 U	0.156 U

Notes:

Exceeds MCL-based SSLs

Exceeds Residential Soil RSL

Exceeds Risk-based SSLs

Bold box indicates exceedance of Background

Exceeds both MCL-based SSLs Risk-based SSLs

Exceeds MCL-based SSLs, Risk-based SSLs and the Ecological screening value

Bold text indicates detections

* Background values are the 95% UTL. When no UTL value exists the CLEAN YKTWN ALL MAX BKG value is used.

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

mg/kg - Milligrams per kilogram

TABLE 5-2

Subsurface Soil Exceedance Results - Discrete Samples

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Station ID	MCL-Based SSLs	Residential Soil RSLs (Adjusted)	Risk-Based SSLs	Background*	Ecological Screening Value	YS32-GW01	YS32-GW02	YS32-GW03	YS32-GW04		YS32-GW05	YS32-SO06	YS32-SO07	
Sample ID						YS32-SB01-06-24-0312	YS32-SB02-06-24-0312	YS32-SB03-06-24-0312	YS32-SB04-06-24-0312	YS32-SB04P-06-24-0312	YS32-SB05-06-24-0312	YS32-SB06-06-24-0312	YS32-SB07-06-24-0312	YS32-SB07-15-17-0312
Sample Date						03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/06/12
Chemical Name														
Total Metals (mg/kg)														
Cadmium	0.38	7	0.52	--	32	**0.595 J**	**0.189 J**	6.84 U	**0.445 J**	**0.284 J**	**0.746 J**	6.49 U	**0.447 J**	**0.332 J**
Mercury	0.1	2.3	0.033	0.104	0.1	**0.0328**	**0.05**	**0.0347**	**0.0953**	**0.0946**	**0.125**	**0.0128 J**	**0.251**	0.00729 U
Silver	--	39	0.6	1.1	560	0.168 U	**0.0727 J**	0.148 U	**0.951**	**1.15**	**0.834**	0.141 U	**0.601**	0.166 U

Notes:

Exceeds MCL-based SSLs

Exceeds Residential Soil RSL

Exceeds Risk-based SSLs

Bold box indicates exceedance of Background

Exceeds both MCL-based SSLs Risk-based SSLs

Exceeds MCL-based SSLs, Risk-based SSLs and the Ecological screening value

* Background values are the 95% UTL. When no UTL value exists the CLEAN YKTWN ALL MAX BKG value is used.

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

mg/kg - Milligrams per kilogram

TABLE 5-3

Surface and Subsurface Soil Exceedance Results - Composite Samples

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Station ID	MCL-Based SSLs	Residential Soil RSLs (Adjusted)	Risk-Based SSLs	Yorktown 95% UTL Background Subsurface Soil*	Yorktown 95% UTL Background Surface Soil*	Ecological Screening Value	YS32-SO08			
Sample ID							YS32-SS08-0312	YS32-SS08P-0312	YS32-SB08-06-24-0312	YS32-SB08P-06-24-0312
Sample Date							03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name										
Volatile Organic Compounds (µg/kg)										
No Detections										
Semivolatile Organic Compounds (µg/kg)										
Benzo(a)anthracene	--	150	10	--	220	2000	29 U	30 U	**27 J**	**28 J**
Benzo(a)pyrene	240	15	3.5	--	340	2000	29 U	30 U	**11 J**	**13 J**
Benzo(b)fluoranthene	--	150	35	--	650	2000	29 U	30 U	**21 J**	**24 J**
Chrysene	--	15,000	1,100	--	480	2000	29 U	30 U	**14 J**	**17 J**
Fluoranthene	--	230,000	70,000	--	270	3625	29 U	30 U	**33 J**	**36 J**
Pyrene	--	170,000	9,500	--	330	2000	29 U	30 U	**29 J**	**38**
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	--	2,000	66	12	3.1	583	**0.77 J**	**1.2 J**	**8.6 J**	**44 J**
4,4'-DDE	--	1,400	46	23	3.9	114	**6.2 J**	**11 J**	**51 J**	**63 J**
4,4'-DDT	--	1,700	67	10	--	100	**2.3 J**	**2.8 J**	**15 J**	**36 J**
Aroclor-1268	--	--	--	--	--	8000	23 U	**12 J**	**920 J**	**270 J**
Total Metals (mg/kg)										
Aluminum	--	7,700	23,000	13,000	12,200	--	**6,290 J**	**10,300 J**	**5,840**	**5,660**
Arsenic	0.29	0.39	0.0013	5.54	6.36	18	**2.61 J**	**3.8 J**	**2.5 J**	**3.22 J**
Barium	82	1,500	120	84.5	52.9	330	**43.5 J**	**86.8 J**	**28.1**	**28.7**
Beryllium	3.2	16	13	0.505	0.587	40	**0.416 J**	**0.83 J**	**0.549 J**	**0.415 J**
Cadmium	0.38	7	0.52	--	1.33	32	**0.35 J**	**0.321 J**	**0.292 J**	**0.154 J**
Calcium	--	--	--	2,380	2,290	--	**2,140**	**2,010**	**5,440 J**	**8,740 J**
Chromium	180,000	0.29	5.90E-04	33.7	18.2	64	**10.1 J**	**16**	**21.8 J**	**9.87 J**
Cobalt	--	2.3	0.21	5.18	9.93	13	**2.66 J**	**6.59 J**	**4.11**	**3.07**
Copper	46	310	22	3.17	4.25	70	**4.88 J**	**11.4 J**	**5.8**	**7.41**
Iron	--	5,500	270	32,000	19,900	--	**10,100 J**	**22,100 J**	**15,500**	**13,600**
Lead	14	400	--	8.79	17.4	120	**18.4**	**16.1**	**14.5**	**18.5**
Magnesium	--	--	--	1,120	1,070	--	**751 J**	**1,040 J**	**1,670 J**	**557 J**
Manganese	--	180	21	176	324	220	**82.6 J**	**187 J**	**125 J**	**79.5 J**
Mercury	0.1	2.3	0.033	0.104	0.111	0.1	**0.0392**	**0.0318**	**0.0424**	**0.0449**
Nickel	--	150	20	17.6	9.52	38	**4.31 J**	**8.51 J**	**7.77 J**	**4.38 J**
Potassium	--	--	--	901	708	--	**452 J**	**622 J**	**583 J**	**466 J**
Silver	--	39	0.6	1.1	1.09	560	**0.0442 J**	**0.0917 J**	**0.0654 J**	**0.384 J**
Sodium	--	--	--	811	521	--	210 U	213 U	**62.1 J**	**75.2 J**
Thallium	0.14	0.078	0.011	--	--	1	**0.0755 J**	**0.157 J**	**0.0529 J**	**0.0607 J**
Vanadium	--	39	78	48.3	27.9	130	**15.2 J**	**29.6 J**	**17.5**	**14.6**
Zinc	--	2,300	290	28	26.5	120	**23.4 J**	**40.4 J**	**39**	**29.2**

Notes:

Exceeds MCL-based SSLs

Exceeds Residential Soil RSL

Exceeds Risk-based SSLs

Bold box indicates exceedance in Background

Exceeds both MCL-based SSLs Risk-based SSLs

Exceeds MCL-based SSLs, Risk-based SSLs and the Ecological screening value

Exceeds MCL-based SSLs, Risk-based SSLs, and Residential Soil RSL

Exceeds both Residential Soil RSL and Risk-based SSL

Bold text indicates detections

* Background values are the 95% UTL. When no UTL value exists the maximum background value is used.

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 5-4

Groundwater Results

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Sample ID	Background*	Tapwater RSLs (Adjusted)	MCL	Ecological Screening Value	YS32-GW01-0512	YS32-GW02-0512	YS32-GW03-0512	YS32-GW04-0512	YS32-GW04P-0512	YS32-GW05-0512
Sample Date					5/17/12	5/17/12	5/17/12	5/17/12	5/17/12	5/17/12
Chemical Name										
Total Metals (UG/L)										
Cadmium	0.605	0.69	5	0.27	4 U	4 U	4 U	4 U	4 U	4 U
Mercury	0.081	0.43	2	0.91	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Silver	NC	7.1	NC	0.36	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Dissolved Metals (UG/L)										
Cadmium	0.177			0.25	4 U	4 U	4 U	4 U	4 U	4 U
Mercury	0.1			0.77	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Silver	NC			0.36	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U

Notes:

* Background values are the 95% UTL. When no UTL value exists the maximum background value is used.

NS - Not sampled

U - The material was analyzed for, but not detected

liter

TABLE 5-5

Human Health Risk Screening for Surface Soil

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Exceeds STV?	Exceeds Background
Surface Soil	72-54-8	4,4'-DDD	1.2E-03 J	1.2E-03 J	MG/KG	YS32-SS08P-0312	1/1	0.002 - 0.002	1.2E-03	3.1E-03	2.0E+00 C	6.6E-02	SSL	NO	
	72-55-9	4,4'-DDE	1.1E-02 J	1.1E-02 J	MG/KG	YS32-SS08P-0312	1/1	0.002 - 0.002	1.1E-02	3.9E-03	1.4E+00 C	4.6E-02	SSL	NO	
	50-29-3	4,4'-DDT	2.8E-03 J	2.8E-03 J	MG/KG	YS32-SS08P-0312	1/1	0.002 - 0.002	2.8E-03	N/A	1.7E+00 C	6.7E-02	SSL	NO	
	11100-14-4	Aroclor-1268	1.2E-02 J	1.2E-02 J	MG/KG	YS32-SS08P-0312	1/1	0.047 - 0.047	1.2E-02	N/A	2.2E-01 C	2.4E-02	SSL	NO	
	7429-90-5	Aluminum	1.0E+04 J	1.0E+04 J	MG/KG	YS32-SS08P-0312	1/1	468 - 1180	1.0E+04	1.2E+04	7.7E+03 N	2.3E+04	SSL	YES	NO
	7440-38-2	Arsenic	3.8E+00 J	3.8E+00 J	MG/KG	YS32-SS08P-0312	1/1	23.4 - 23.7	3.8E+00	6.4E+00	3.9E-01 C	1.3E-03	SSL	YES	NO
	7440-39-3	Barium	8.7E+01 J	8.7E+01 J	MG/KG	YS32-SS08P-0312	1/1	11.7 - 11.8	8.7E+01	5.3E+01	1.5E+03 N	1.2E+02	SSL	NO	
	7440-41-7	Beryllium	8.3E-01 J	8.3E-01 J	MG/KG	YS32-SS08P-0312	1/1	2.34 - 2.37	8.3E-01	5.9E-01	1.6E+01 N	1.3E+01	SSL	NO	
	7440-43-9	Cadmium	2.5E-01 J	3.9E-01 J	MG/KG	YS32-SS03-0312	6/8	13.7 - 14.7	3.9E-01	N/A	7.0E+00 N	5.2E-01	SSL	NO	
	7440-70-2	Calcium	2.1E+03	2.1E+03	MG/KG	YS32-SS08-0312	1/1	1400 - 1420	2.1E+03	2.3E+03	N/A	N/A		NUT	
	7440-47-3	Chromium	1.6E+01	1.6E+01	MG/KG	YS32-SS08P-0312	1/1	11.7 - 11.8	1.6E+01	1.8E+01	2.9E-01 C	5.9E-04		YES	NO
	7440-48-4	Cobalt	6.6E+00 J	6.6E+00 J	MG/KG	YS32-SS08P-0312	1/1	1.17 - 1.18	6.6E+00	9.9E+00	2.3E+00 N	2.1E-01	SSL	YES	NO
	7440-50-8	Copper	1.1E+01 J	1.1E+01 J	MG/KG	YS32-SS08P-0312	1/1	1.17 - 1.18	1.1E+01	4.3E+00	3.1E+02 N	2.2E+01	SSL	NO	
	7439-89-6	**Iron**	**2.2E+04 J**	**2.2E+04 J**	**MG/KG**	**YS32-SS08P-0312**	**1/1**	**164 - 415**	**2.2E+04**	**2.0E+04**	**5.5E+03 N**	**2.7E+02**	**SSL**	**YES**	**YES**
	7439-92-1	Lead	1.8E+01	1.8E+01	MG/KG	YS32-SS08-0312	1/1	5.85 - 5.92	1.8E+01	1.7E+01	4.0E+02 NL	N/A		NO	
	7439-95-4	Magnesium	1.0E+03 J	1.0E+03 J	MG/KG	YS32-SS08P-0312	1/1	262 - 265	1.0E+03	1.1E+03	N/A	N/A		NUT	
	7439-96-5	Manganese	1.9E+02 J	1.9E+02 J	MG/KG	YS32-SS08P-0312	1/1	2.57 - 65.2	1.9E+02	3.2E+02	1.8E+02 N	2.1E+01	SSL	YES	NO
	7439-97-6	Mercury	2.3E-02	2.4E-01	MG/KG	YS32-SS03-0312	8/8	0.0161 - 0.0198	2.4E-01	1.1E-01	2.3E+00 N	3.3E-02	SSL	NO	
	7440-02-0	Nickel	8.5E+00 J	8.5E+00 J	MG/KG	YS32-SS08P-0312	1/1	1.17 - 1.18	8.5E+00	9.5E+00	1.5E+02 N	2.0E+01	SSL	NO	
	7440-09-7	Potassium	6.2E+02 J	6.2E+02 J	MG/KG	YS32-SS08P-0312	1/1	4090 - 4150	6.2E+02	7.1E+02	N/A	N/A		NUT	
	7440-22-4	Silver	9.2E-02 J	2.0E-01 J	MG/KG	YS32-SS05-0312	4/8	0.571 - 0.611	2.0E-01	N/A	3.9E+01 N	6.0E-01	SSL	NO	
	7440-28-0	Thallium	1.6E-01 J	1.6E-01 J	MG/KG	YS32-SS08P-0312	1/1	1.17 - 1.18	1.6E-01	N/A	7.8E-02 N	1.1E-02	SSL	YES	NO
	7440-62-2	Vanadium	3.0E+01 J	3.0E+01 J	MG/KG	YS32-SS08P-0312	1/1	2.34 - 2.37	3.0E+01	2.8E+01	3.9E+01 N	7.8E+01	SSL	NO	
	7440-66-6	Zinc	4.0E+01 J	4.0E+01 J	MG/KG	YS32-SS08P-0312	1/1	11.7 - 11.8	4.0E+01	2.7E+01	2.3E+03 N	2.9E+02	SSL	NO	

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are 95% UTL from Cheatham Annex/Yorktown background surface soil samples if available. Otherwise values from Yorktown All Maximum background dataset.

[4] Oak Ridge National Laboratory (ORNL). May 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Available: http://epa-prgs.ornl.gov/chemicals/index.shtml. Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) residential soil RSLs.
RSL value for Aroclor-1260 used as surrogate for Aroclor-1268.
RSL value for chromium(VI) used as surrogate for chromium.
RSL value for manganese (non-diet) used as surrogate for manganese.
RSL value for mercuric chloride used as surrogate for mercury.

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

SSL = Soil Screening Levels from RSL table (not adjusted for noncarcinogenic constituents)

TABLE 5-6

Human Health Risk Screening for Subsurface Soil

Site 32 Site Investigation Report

Naval Weapons Station Yorktown

Yorktown, Virginia

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Exceeds STV?	Exceeds Background Deletion or Selection
Subsurface Soil	56-55-3	Benzo(a)anthracene	2.8E-02 J	2.8E-02 J	MG/KG	YS32-SB08P-06-24-0312	1.0E+00	0.037 - 0.038	2.8E-02	N/A	1.5E-01 C	1.0E-02	SSL	NO	
	50-32-8	Benzo(a)pyrene	1.3E-02 J	1.3E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.037 - 0.038	1.3E-02	N/A	1.5E-02 C	3.5E-03	SSL	NO	
	205-99-2	Benzo(b)fluoranthene	2.4E-02 J	2.4E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.037 - 0.038	2.4E-02	N/A	1.5E-01 C	3.5E-02	SSL	NO	
	218-01-9	Chrysene	1.7E-02 J	1.7E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.037 - 0.038	1.7E-02	N/A	1.5E+01 C	1.1E+00	SSL	NO	
	206-44-0	Fluoranthene	3.6E-02 J	3.6E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.037 - 0.038	3.6E-02	N/A	2.3E+02 N	7.0E+01	SSL	NO	
	129-00-0	Pyrene	3.8E-02	3.8E-02	MG/KG	YS32-SB08P-06-24-0312	1/1	0.037 - 0.038	3.8E-02	N/A	1.7E+02 N	9.5E+00	SSL	NO	
	72-54-8	4,4'-DDD	4.4E-02 J	4.4E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.0019 - 0.002	4.4E-02	1.2E-02	2.0E+00 C	6.6E-02	SSL	NO	
	72-55-9	4,4'-DDE	6.3E-02 J	6.3E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.0019 - 0.002	6.3E-02	2.3E-02	1.4E+00 C	4.6E-02	SSL	NO	
	50-29-3	4,4'-DDT	3.6E-02 J	3.6E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	0.0019 - 0.002	3.6E-02	1.0E-02	1.7E+00 C	6.7E-02	SSL	NO	
	11100-14-4	**Aroclor-1268**	**9.2E-01 J**	**9.2E-01 J**	**MG/KG**	**YS32-SB08-06-24-0312**	**1/1**	**0.045 - 0.046**	**9.2E-01**	**N/A**	**2.2E-01 C**	**2.4E-02**	**SSL**	**YES**	
	7429-90-5	Aluminum	5.8E+03	5.8E+03	MG/KG	YS32-SB08-06-24-0312	1/1	673 - 1150	5.8E+03	1.3E+04	7.7E+03 N	2.3E+04	SSL	NO	
	7440-38-2	Arsenic	3.2E+00 J	3.2E+00 J	MG/KG	YS32-SB08P-06-24-0312	1/1	22.4 - 23.1	3.2E+00	5.5E+00	3.9E-01 C	1.3E-03	SSL	YES	NO
	7440-39-3	Barium	2.9E+01	2.9E+01	MG/KG	YS32-SB08P-06-24-0312	1/1	11.2 - 11.5	2.9E+01	8.5E+01	1.5E+03 N	1.2E+02	SSL	NO	
	7440-41-7	Beryllium	5.5E-01 J	5.5E-01 J	MG/KG	YS32-SB08-06-24-0312	1/1	2.24 - 2.31	5.5E-01	N/A	1.6E+01 N	1.3E+01	SSL	NO	
	7440-43-9	Cadmium	1.9E-01 J	7.5E-01 J	MG/KG	YS32-SB05-06-24-0312	6/8	13 - 15.5	7.5E-01	N/A	7.0E+00 N	5.2E-01	SSL	NO	
	7440-70-2	Calcium	8.7E+03 J	8.7E+03 J	MG/KG	YS32-SB08P-06-24-0312	1/1	1350 - 1380	8.7E+03	2.4E+03	N/A	N/A		NUT	
	7440-47-3	Chromium	2.2E+01 J	2.2E+01 J	MG/KG	YS32-SB08-06-24-0312	1/1	11.2 - 11.5	2.2E+01	3.4E+01	2.9E-01 C	5.9E-04	SSL	YES	NO
	7440-48-4	Cobalt	4.1E+00	4.1E+00	MG/KG	YS32-SB08-06-24-0312	1/1	1.12 - 1.15	4.1E+00	5.2E+00	2.3E+00 N	2.1E-01	SSL	YES	NO
	7440-50-8	Copper	7.4E+00	7.4E+00	MG/KG	YS32-SB08P-06-24-0312	1/1	1.12 - 1.15	7.4E+00	3.2E+00	3.1E+02 N	2.2E+01	SSL	NO	
	7439-89-6	Iron	1.6E+04	1.6E+04	MG/KG	YS32-SB08-06-24-0312	1/1	236 - 404	1.6E+04	3.2E+04	5.5E+03 N	2.7E+02	SSL	YES	NO
	7439-92-1	Lead	1.9E+01	1.9E+01	MG/KG	YS32-SB08P-06-24-0312	1/1	5.61 - 5.76	1.9E+01	8.8E+00	4.0E+02 NL	N/A		NO	
	7439-95-4	Magnesium	1.7E+03 J	1.7E+03 J	MG/KG	YS32-SB08-06-24-0312	1/1	251 - 258	1.7E+03	1.1E+03	N/A	N/A		NUT	
	7439-96-5	Manganese	1.3E+02 J	1.3E+02 J	MG/KG	YS32-SB08-06-24-0312	1/1	2.54 - 37	1.3E+02	1.8E+02	1.8E+02 N	2.1E+01	SSL	NO	
	7439-97-6	Mercury	1.3E-02 J	2.5E-01	MG/KG	YS32-SB07-06-24-0312	8/8	0.0155 - 0.021	2.5E-01	N/A	2.3E+00 N	3.3E-02	SSL	NO	
	7440-02-0	Nickel	7.8E+00 J	7.8E+00 J	MG/KG	YS32-SB08-06-24-0312	1/1	1.12 - 1.15	7.8E+00	1.8E+01	1.5E+02 N	2.0E+01	SSL	NO	
	7440-09-7	Potassium	5.8E+02 J	5.8E+02 J	MG/KG	YS32-SB08-06-24-0312	1/1	3930 - 4040	5.8E+02	9.0E+02	N/A	N/A		NUT	
	7440-22-4	Silver	7.3E-02 J	1.2E+00	MG/KG	YS32-SB04P-06-24-0312	5/8	0.541 - 0.647	1.2E+00	N/A	3.9E+01 N	6.0E-01	SSL	NO	
	7440-23-5	Sodium	7.5E+01 J	7.5E+01 J	MG/KG	YS32-SB08P-06-24-0312	1/1	404 - 415	7.5E+01	8.1E+02	N/A	N/A		NUT	
	7440-28-0	Thallium	6.1E-02 J	6.1E-02 J	MG/KG	YS32-SB08P-06-24-0312	1/1	1.12 - 1.15	6.1E-02	N/A	7.8E-02 N	1.1E-02	SSL	NO	
	7440-62-2	Vanadium	1.8E+01	1.8E+01	MG/KG	YS32-SB08-06-24-0312	1/1	2.24 - 2.31	1.8E+01	4.8E+01	3.9E+01 N	7.8E+01	SSL	NO	
	7440-66-6	Zinc	3.9E+01	3.9E+01	MG/KG	YS32-SB08-06-24-0312	1/1	11.2 - 11.5	3.9E+01	2.8E+01	2.3E+03 N	2.9E+02	SSL	NO	

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are 95% UTL from Cheatham Annex/Yorktown background subsurface soil samples.
Yorktown All Maximum background dataset.

[4] Oak Ridge National Laboratory (ORNL). May 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Available: http://epa-prgs.ornl.gov/chemicals/index.shtml. Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) residential soil RSLs.
RSL value for Aroclor-1260 used as surrogate for Aroclor-1268.
RSL value for Chromium(VI) used as surrogate for chromium.
RSL value for Mercury (inorganic salts) used as surrogate for mercury.

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.
SSL = Soil Screening Levels from RSL table (not adjusted for noncarcinogenic constituents)

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 5-1 - SURFACE SOIL EXCEEDANCES.MXD CBOWMAN 9/25/2012 7:42:28 AM

	Screening Criteria				
	MCL-Based SSL	Residential Soil RSL (Adjusted)	Risk-Based SSL	95% UTL Background	Ecological Screening Value
Pesticide/Polychlorinated Biphenyls (µg/kg)					
4,4'-DDE	--	1,400	46	3.9	114
Total Metals (mg/kg)					
Aluminum	--	7,700	23,000	12,200	--
Arsenic	0.29	0.39	0.0013	6.36	18
Barium	82	1,500	120	52.9	330
Beryllium	3.2	16	13	0.587	40
Cadmium	0.38	7	0.52	1.33	32
Chromium	180,000	0.29	5.90E-04	18.2	64
Cobalt	--	2.3	0.21	9.93	13
Copper	46	310	22	4.25	70
Iron	--	5,500	270	19,900	--
Lead	14	400	--	17.4	120
Manganese	--	180	21	324	220
Mercury	0.1	2.3	0.033	0.111	0.1
Silver	--	39	0.6	1.09	560
Thallium	0.14	0.078	0.011	--	1
Vanadium	--	39	78	27.9	130
Zinc	--	2,300	290	26.5	120

Station ID: YS32-SO07	
Sample ID: YS32-SS07-0312	3/1/2012
Mercury	**0.0441**

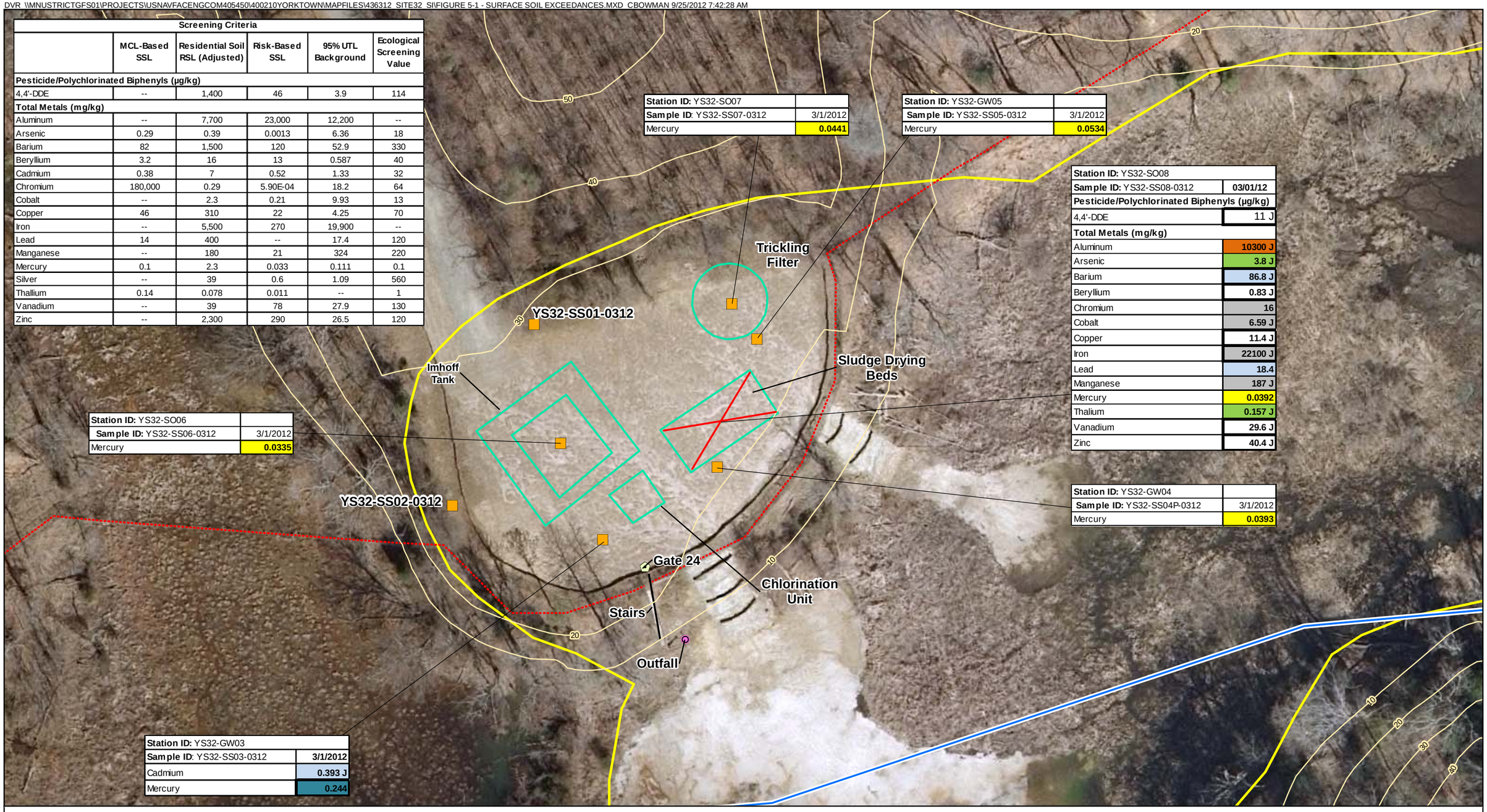
Station ID: YS32-GW05	
Sample ID: YS32-SS05-0312	3/1/2012
Mercury	**0.0534**

Station ID: YS32-SO08	
Sample ID: YS32-SS08-0312	**03/01/12**
Pesticide/Polychlorinated Biphenyls (µg/kg)	
4,4'-DDE	11 J
Total Metals (mg/kg)	
Aluminum	**10300 J**
Arsenic	**3.8 J**
Barium	**86.8 J**
Beryllium	**0.83 J**
Chromium	**16**
Cobalt	**6.59 J**
Copper	**11.4 J**
Iron	**22100 J**
Lead	**18.4**
Manganese	**187 J**
Mercury	**0.0392**
Thalium	**0.157 J**
Vanadium	**29.6 J**
Zinc	**40.4 J**

Station ID: YS32-SO06	
Sample ID: YS32-SS06-0312	3/1/2012
Mercury	**0.0335**

Station ID: YS32-GW04	
Sample ID: YS32-SS04P-0312	3/1/2012
Mercury	**0.0393**

Station ID: YS32-GW03	
Sample ID: YS32-SS03-0312	**3/1/2012**
Cadmium	**0.393 J**
Mercury	**0.244**



Legend
- Surface and Subsurface Soil Sample Location
- Elevation Contour (10 ft interval)
- Fence
- Property Boundary Line
- Former Structures
- 5 Point Composite Surface and Subsurface Soil Sample Location
- Study Area Boundary

Notes:
- Exceeds MCL-Based SSL
- Exceeds Residential Soil RSL (Adjusted)
- Exceeds CLEAN RSLs Risk-Based SSLs 0512
- Bold box indicates exceedance of Background
- Exceeds both MCL-Based SSL and Risk-Based SSL
- Exceeds MCL-Based SSL, Risk-Based SSL and Ecological Screening Value
- Exceeds MCL-Based SSL, Risk-Based SSL and Residential Soil RSL (Adjusted)
- Exceeds both Residential Soil RSL (Adjusted) and Risk-Based SSL

* Background values are the 95% UTL. When no UTL value exists the maximum background value is used.
J - Analyte present, value may or may not be accurate or precise
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N W E S

0 50 100 Feet

Figure 5-1
Surface Soil Exceedances
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\400210YORKTOWN\MAPFILES\436312_SITE32_SI\FIGURE 5-2 - SUBSURFACE SOIL EXCEEDANCES.MXD CBOWMAN 9/25/2012 7:40:50 AM

	Screening Criteria				
	MCL-Based SSL	Residential Soil RSL (Adjusted)	Risk-Based SSL	95% UTL Background	Ecological Screening Value
Semivolatile Organic Compounds (µg/kg)					
Benzo(a)anthracene	--	150	10	--	2000
Benzo(a)pyrene	240	15	3.5	--	2000
Pesticide/Polychlorinated Biphenyls (µg/kg)					
4,4'-DDD	--	2,000	66	12	583
4,4'-DDE	--	1,400	46	23	114
4,4'-DDT	--	1,700	67	10	100
Total Metals (mg/kg)					
Arsenic	0.29	0.39	0.0013	5.54	18
Cadmium	0.38	7	0.52	--	32
Calcium	--	--	--	2,380	--
Chromium	180,000	0.29	5.90E-04	33.7	64
Cobalt	--	2.3	0.21	5.18	13
Copper	46	310	22	3.17	70
Iron	--	5,500	270	32,000	--
Lead	14	400	--	8.79	120
Magnesium	--	--	--	1,120	--
Manganese	--	180	21	176	220
Mercury	0.1	2.3	0.033	0.104	0.1
Silver	--	39	0.6	1.1	560
Thallium	0.14	0.078	0.011	--	1
Zinc	--	2,300	290	28	120

Station ID: YS32-GW01	
Sample ID: YS32-SB01-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Cadmium	**0.595 J**

Station ID: YS32-SO07	
Sample ID: YS32-SB07-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Cadmium	**0.447 J**
Mercury	**0.251**
Silver	**0.601**

Station ID: YS32-GW05	
Sample ID: YS32-SB05-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Cadmium	**0.746 J**
Mercury	**0.125**
Silver	**0.834**

Station ID: YS32-SO08	
Sample ID: YS32-SB08P-06-24-0312	**03/01/12**
Semivolatile Organic Compounds (µg/kg)	
Benzo(a)anthracene	**28 J**
Benzo(a)pyrene	**13 J**
Pesticide/Polychlorinated Biphenyls (µg/kg)	
4,4'-DDD	**44 J**
4,4'-DDE	**63 J**
4,4'-DDT	**36 J**
Total Metals (mg/kg)	
Arsenic	**3.22 J**
Beryllium	**0.549 J**
Calcium	**8740 J**
Chromium	**21.8 J**
Cobalt	**4.11**
Copper	**7.41**
Iron	**15,500**
Lead	**18.5**
Magnesium	**1670 J**
Manganese	**125 J**
Mercury	**0.0449**
Thallium	**0.0607 J**
Zinc	**39.0**

Station ID: YS32-GW02	
Sample ID: YS32-SB02-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Mercury	**0.05**

Station ID: YS32-GW04	
Sample ID: YS32-SB04-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Cadmium	**0.445 J**
Mercury	**0.0953**
Silver	**1.15**

Station ID: YS32-GW03	
Sample ID: YS32-SB03-06-24-0312	3/1/2012
Total Metals (mg/kg)	
Mercury	**0.0347**

Trickling Filter
Imhoff Tank
Sludge Drying Beds
YS32-SB06-06-24-0312
Chlorination Unit
Gate 24
Stairs
Outfall
10
20
30
40

Legend
- Surface and Subsurface Soil Sample Location
- Elevation Contour (10 ft interval)
- Fence
- Property Boundary Line
- Former Structures
- 5 Point Composite Surface and Subsurface Soil Sample Location
- Study Area Boundary

Notes:
- Exceeds MCL-Based SSL
- Exceeds Residential Soil RSL (Adjusted)
- Exceeds CLEAN RSLs Risk-Based SSLs 0512
- Bold box indicates exceedance of Background
- Exceeds both MCL-Based SSL and Risk-Based SSL
- Exceeds MCL-Based SSL, Risk-Based SSL and Ecological Screening Value
- Exceeds MCL-Based SSL, Risk-Based SSL and Residential Soil RSL (Adjusted)
- Exceeds both Residential Soil RSL (Adjusted) and Risk-Based SSL

* Background values are the 95% UTL. When no UTL value exists the maximum background value is used.
J - Analyte present, value may or may not be accurate or precise
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N W E S

0 50 100 Feet

Figure 5-2
Subsurface Soil Exceedances
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

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Potential Future Resident: (adult, child) Incidental ingestion of and dermal contact with surface and subsurface soil, and inhalation of particulate emissions from surface and subsurface soil, ingestion and dermal contact with groundwater, and inhalation of volatile emissions from groundwater

Potential Pathway: Percolation and infiltration of soil contaminants into groundwater

Former Imhoff Tank

Former Trickling Filter

Potential Future Construction Worker: Incidental ingestion of and dermal contact with surface and subsurface soil, inhalation of particulate emissions from surface and subsurface soil, dermal contact with groundwater and inhalation of volatile emissions from groundwater

Former Sludge Drying Beds

Potential Ecological Receptors:
- Terrestrial plants and soil invertebrates exposure via direct contact with surface soil
- Terrestrial upper trophic level receptors (birds, mammals, reptiles) exposure via food webs

YS32-MW01

YS32-MW02

YS32-MW03

YS32-MW04

YS32-MW05

Wetlands Downgradient of Beaver Pond

40 - 60 ft

Cornwallis Cave Aquifer

Yorktown Confining Unit

Sediment Removal Areas

Outfall

Former Chlorination Unit

Potential Current/Future Trespasser: (adult, adolescent) Incidental ingestion of and dermal contact with, and inhalation of particulate emissions from, surface and subsurface soil

Potential Pathway: Groundwater discharge to the wetland and creek

Potential Current/Future Maintenance Worker: Incidental ingestion of, dermal contact with, and inhalation of particulate emissions from, surface and subsurface soil

LEGEND
- Study Area Boundary
- Groundwater Table Elevation
- Surface Water Flow Direction
- Groundwater Flow Direction
- Former Structures
- Monitoring Wells
- Approximate Property Boundary Line
- Groundwater Contour Line
- Approximate Wetlands Boundary

Current exposure to potential human receptors is for surface soil, and future exposure to potential human receptors is for surface and subsurface soil
Not to scale.

FIGURE 5.3
Conceptual Site Model
Site 32 Site Investigation
Naval Weapons Station Yorktown
Yorktown, Virginia

SECTION 6

Conclusions and Recommendations

The purpose of the SI is to determine if a release of hazardous constituents has occurred at Site 32 as a result of past CERCLA-regulated activities, and if contamination is present at levels posing potentially unacceptable human health or ecological risk in soil and groundwater at Site 32 that warrants further investigation. In order to accomplish the objectives of the investigation, five main environmental questions were evaluated. The results are outlined below.

- **Has there been a release of contaminants to soils due to historical activities associated with STP #2?**
  - A release from the trickling filter of STP #2 to Site 32 soils was historically reported but not documented or quantified. The SI identified three constituents of interest from Site 32 soil detected in concentrations greater than background and conservative screening values. Evaluation of additional lines of evidence determined that concentrations were consistent with background (mercury and iron) and/or were not attributable to STP historical practices (Aroclor-1268), indicating no current or residual source release to Site 32 media.
- **Has there been a release of contaminants to groundwater due to leaching from soil at the site?**
  - There were no detections of constituents analyzed in groundwater samples.
- **Do site-related soil and groundwater contaminant concentrations (if present) pose a potentially unacceptable human health or ecological risk?**
  - No unacceptable human health or ecological risks were identified.
- **What are the likely contaminant transport pathways at the site?**
  - A historical release occurred directly from the trickling filter to wetlands through the discharge pipe. The pathway is no longer complete, and no other complete pathways have been identified.
- **Is further investigation (i.e., further data collection and evaluation) warranted at the site based on the results of this study?**
  - No site-related releases posing potentially unacceptable risks to human health or the environment requiring further investigation have been identified.

6.1 Recommendations

NFA is recommended for Site 32 based on the results of the data collected during the 2012 investigation activities, including the HHRS and ERA. Following finalization of this report, the NFA decision will be documented in the 2014-2015 SMP, and the monitoring wells at Site 32 will be abandoned.

SECTION 7

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Appendix A
Field Investigation Logs and Data

CH2MHILL

PROJECT NUMBER	BORING NUMBER
408244.FI.FS	MW-01

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR: Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersoll Rand A300 truck mounted rig

ATD WATER LEVEL : 25.18 Start: 3/5/2012 END : 3/6/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
	0-4	48	1	NA	**0-0.2':** TOPSOIL, black 7.5YR2.5/1, loose **0.2-4'**: lean CLAY (CL), strong brown 7.5YR4/6, medium density, high plasticity, trace organics	CL	0
4	4-8	48	2	NA	lean CLAY (CL) strong brown 7.5YR4/6, medium density, medium plasticity, trace organics	CL	
8	8-12	24	3	NA	lean CLAY (CL) strong brown 7.5YR4/6, medium density, medium plasticity, trace organics	CL	
12	12-16	16	4	NA	lean CLAY (CL) strong brown 7.5YR4/6, soft, medium plasticity, trace organics	CL	
16	16-20	20	5	NA	clayey SAND (SC), strong brown 7.5YR4/6, moist, dense, fine to medium sand, cemented white shells throughout clay	SC	DC: Soft at ~19-19.5'
20	20-24	48	6	NA	clayey SAND (SC), strong brown 7.5YR4/6, moist, dense, fine to medium sand, cemented white shells throughout clay	SC	DC: Stiff around 23'
24	24-28	48	7	NA	clayey SAND (SC), strong brown 7.5YR4/6, moist, dense, fine to medium sand, cemented white shells throughout clay	SC	
28							

CH2MHILL

PROJECT NUMBER	BORING NUMBER
408244.FI.FS	MW-01

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR: Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : 25.18 3/5/2012 END : 3/6/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS
							PID Readings: Breathing Zone: Above Hole:
	28-32	48	8	NA	clayey poorly sorted SAND (SC-SP), light olive brown 2.5Y5/4, low plasticity, ~10-15% shells	SC-SP	
32							
	32-36	48	9	NA	clayey SAND (SC), yellowish brown 10YR5/4, medium to coarse sand, ~90% shells throughout core	SC	
36							
	36-40	48	10	NA	clayey SAND (SC), dark greenish gray 4/5GY, medium to coarse sand, ~90% shells throughout core	SC	Max PID: 0.0ppm
40							
44							

CH2MHILL

PROJECT NUMBER 408244.FI.FS

BORING NUMBER MW-02

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR: Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : 26.39 Start: 3/7/2012 END : 3/7/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
4	0-4	37	1	NA	**0-0.3'**: TOPSOIL **0.3-0.4':** lean CLAY with sand (CL), medium plasticity **2-2.5':** well-graded silty SAND (SW-SM), olive brown 2.5YR4/4, no plasticity **2.5-8':** clayey SAND with silt (SC-SM), dark yellowish brown 10YR4/6, shell hash layers	CL SW-SM SC-SM	0.0ppm
8	4-8	44	2	NA		CL	
12	8-12	23	3	NA	clayey SAND (SC), white, shell cemented with clay 10-15'	SC	
16	12-16	24	4	NA	sandy SILT (ML), yellowish brown 10YR5/4, very stiff	ML	
20	16-20	31	5	NA	sandy SILT (ML), yellowish brown 10YR5/4, very stiff	ML	
24	20-24	31	6	NA	sandy SILT (ML), yellowish brown 10YR5/4, very stiff	ML	wet at 23'
28	24-28	NM	7	NA	**24.4-24.8':** silty SAND (SM), yellowish brown 10YR5/4, very stiff **24.8-28':** silty SAND (SM), yellowish brown 10YR5/4, very stiff, hash layer cemented with silt	SM	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
408244.FI.FS	MW-03

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : 21.38 Start: 3/7/2012 END : 3/7/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION	USCS	COMMENTS
					SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:
	0-4	48	1	NA	**0-0.3':** SILT (ML), light olive brown 2.5Y5/3, dry, medium stiffness **0.3-11':** sandy lean CLAY (CL), strong brown 7.5YR5/6, high plasticity, few layers of 1" max gray sand throughout	ML	0.0ppm
4	4-8	27	2	NA		CL	
8	8-12	23	3	NA		SC	
12	12-16	32	4	NA	**11'-19.5':** clayey SAND (SC), dark grayish olive 10Y5GY4/2, stiff, medium sand, shell hash cemented with lean clay	SC	
16	16-20	31	5	NA		SC	water at 18'2" w/water level meter
20	20-24	48	6	NA	**19.5-28':** clayey SAND (SC), light yellowish brown 2.5Y6/4, soft, medium sand, shell hash cemented with clay	SC	wet at 23'
24	24-28	48	7	NA		SC	Max PID: 0.0ppm
28							

CH2MHILL

PROJECT NUMBER	BORING NUMBER
408244.FI.FS	MW-04

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR: Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : 18.38 Start: 3/6/2012 END : 3/7/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
4	0-4	44	1	NA	**0.2-0.8':** TOPSOIL, black 7.5YR2.5/1 **0.8-2':** poorly graded SAND (SP), black 7.5YR2.5/1, very stiff, ~5-10% gravel **2-5':** clayey SAND (SC), light yellowish brown 2.5Y6/4, medium plasticity, shell layer cemented with clay, >90% shells	SP SC	0.0ppm
8	4-8	20	2	NA	**5-16':** clayey SAND (SC), light yellowish brown 2.5Y6/4, shell hash layer in clayey sand >90% shells	SC	
12	8-12	21	3	NA	clayey SAND (SC), light yellowish brown 2.5Y6/4, shell hash layer in clayey sand >90% shells	SC	0.00 ppm
16	12-16	20	4	NA	clayey SAND (SC), light yellowish brown 2.5Y6/4, shell hash layer in clayey sand >90% shells	SC	
20	16-20	48	5	NA	clayey SAND (SC), light yellowish brown 2.5Y 6/4, wet, soft, low to medium plasticity, >90% shells	SC	water at ~19.5'
24	20-24	48	6	NA	clayey SAND (SC), light yellowish brown 2.5Y 6/4, wet, soft, low to medium plasticity, >90% shells	SC	
28	24-28	48	7	NA	clayey SAND (SC), light yellowish brown 2.5Y 6/4, wet, soft, low to medium plasticity, >90% shells	SC	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
408244.FI.FS	MW-05

SOIL BORING LOG

PROJECT : Site 32 MW Installation LOCATION : NWS Yorktown

ELEVATION : NM DRILLING CONTRACTOR Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : 18.96 Start: 3/6/2012 END : 3/6/2012 LOGGER : K.Coke

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
0	0-4	48	1	NA	**0-1.5':** clayey SAND (SC), very dark grayish brown 10YR3/2 to dark yellowish brown 10YR3/4, medium stiffness, high plasticity, shell hash cemented with clay **1.5'-4':** clayey SAND (SC), dark yellowish brown 10YR3/4, very stiff, medium plasticity, shell hash layer as above with ~50-90% shells	SC	0.0ppm
4	4-8	27	2	NA	clayey SAND (SC), dark yellowish brown 10YR3/4, very stiff, medium plasticity, shell hash layer as above with ~90% shells	SC	
8	8-12	30	3	NA	clayey SAND (SC), dark yellowish brown 10YR3/4, very stiff, medium plasticity, shell hash layer as above with ~90% shells	SC	0.00 ppm
12	12-16	30	4	NA	clayey SAND (SC), dark yellowish brown 10YR3/4, very stiff, medium plasticity, shell hash layer as above with ~90% shells	SC	>90% shell
16	16-20	48	5	NA	**16-18':** clayey SAND (SC), dark yellowish brown 10YR3/4, very stiff, medium plasticity, shell hash layer as above with ~90% shells **18-21':** sandy SILT (ML), wet, soft, no to low plasticity, ~25% shells	SC ML	water at ~19'
20	20-24	48	6	NA	silty SAND (SM), dark yellowish brown 10YR3/4, wet, soft, no to low plasticity, a few inches of >90% shells and intermittent layers of >90% shells and ~25% shells to depth	ML	0.00 ppm
24	24-28	48	7	NA		SM	At 28' In the nose of the core bitsoil transitioned to GLEY 1 4/N dark gray
28							

PROJECT NUMBER	WELL NUMBER		
408244.FI.FS	MW-01	SHEET 1	OF 1

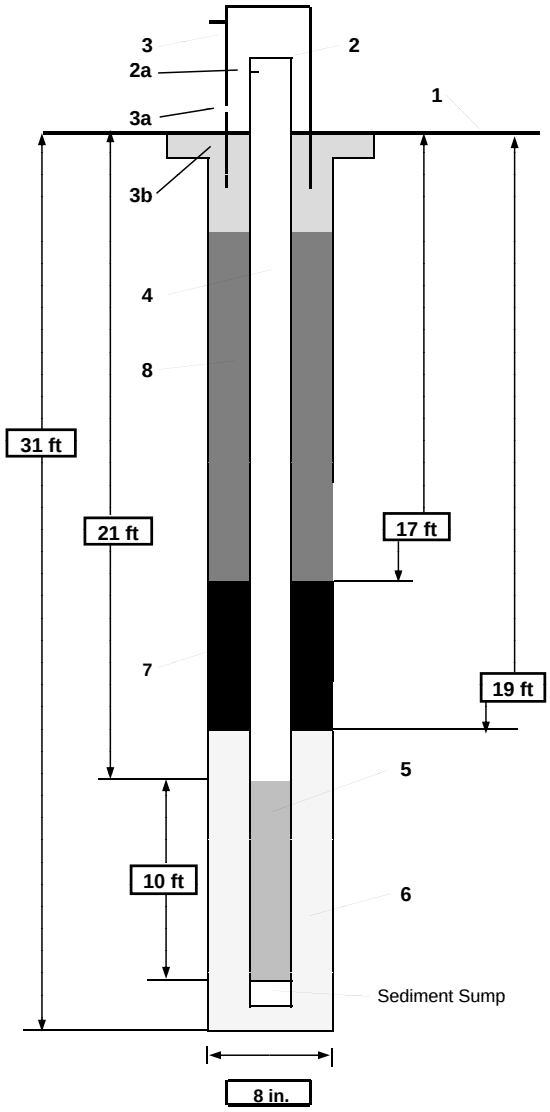
WELL COMPLETION DIAGRAM

PROJECT : Yorktown Site 32 - Well Installation LOCATION : Site 32, Yorktown, VA

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersol Rand A300 Rig - Truck Mounted

WATER LEVELS : 25.18' START : ########## END : March 6, 2012 LOGGER : Kimberley Coke



1- Ground elevation at well: NM ft.

2- Top of casing elevation: NM ft.
a) vent hole?: Yes

3- Wellhead protection cover type: Metal Locking Protective Casing
a) weep hole?: No
b) concrete pad dimensions: 2 ft diameter

4- Diameter/type of well casing: 2-inch PVC

5- Type/slot size of screen: 0.010 slot PVC

6- Type screen filter: DSI#1 sand
a) Quantity used: 6 bags

7- Type of seal: 3/8" Bentonite Plug
a) Quantity used: 1 bags

8- Grout
a) Grout mix used: 1/2-94 lb bag Portland Cement, 1 cup Bentonite Powder (estimated), 4 gal water.
b) Method of placement: Tremie Method
c) Vol. of well casing grout: 35 gallons

Development method: Surge (whale pump) and pump

Development time: 2 hour

Estimated purge volume: 40 gallons

Comments

Total Well Depth (BTOC) = 31.19 ft.

Final Well Development Field Parameters:

pH = 6.93 , Conductivity = 0.847 µs/cm, T = 18.88 ^{Oc}

ORP 167 mV, Turb 29.8 NTU, DO 4.51 mg/L

NOTE: Diagram is not to scale.

PROJECT NUMBER	WELL NUMBER		
408244.FI.FS	MW-02	SHEET 1	OF 1

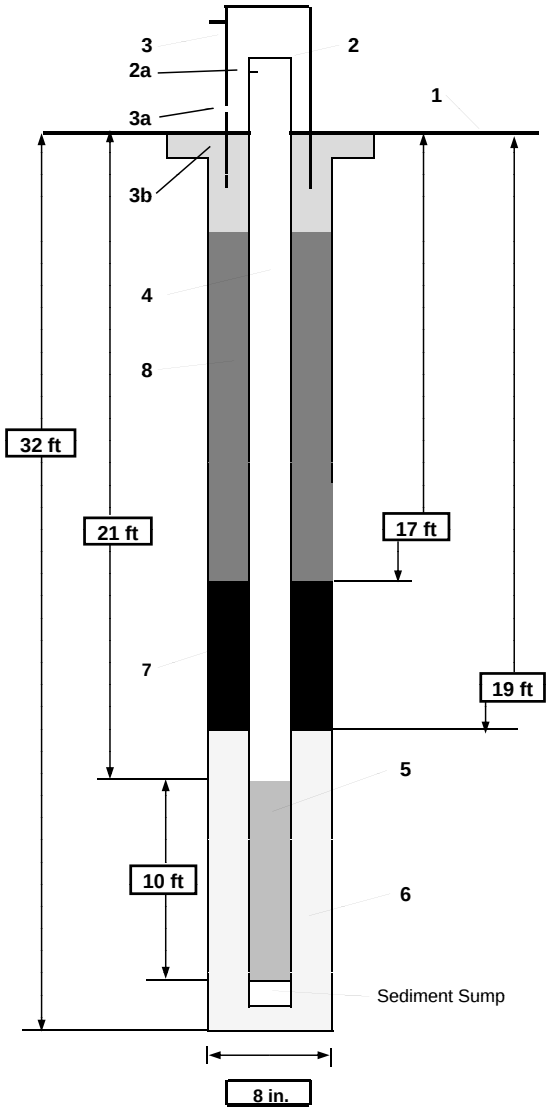
WELL COMPLETION DIAGRAM

PROJECT : Yorktown Site 32 - Well Installation LOCATION : Site 32, Yorktown, VA

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersol Rand A300 Rig - Truck Mounted

WATER LEVELS : 26.39' START : ########## END : March 7, 2012 LOGGER : Kimberley Coke



1- Ground elevation at well: NM ft.

2- Top of casing elevation: NM ft.
a) vent hole?: Yes

3- Wellhead protection cover type: Metal Locking Protective Casing
a) weep hole?: No
b) concrete pad dimensions: 2 ft diameter

4- Diameter/type of well casing: 2-inch PVC

5- Type/slot size of screen: 0.010 slot PVC

6- Type screen filter: DSI#1 sand
a) Quantity used: 6 bags

7- Type of seal: 3/8" Bentonite Plug
a) Quantity used: 1 bags

8- Grout
a) Grout mix used: 1/2-94 lb bag Portland Cement, 1 cup Bentonite Powder (estimated), 4 gal water.
b) Method of placement: Tremie Method
c) Vol. of well casing grout: 38 gallons

Development method: Surge (whale pump) and pump

Development time: 1 hour

Estimated purge volume: 20 gallons

Comments

Total Well Depth (BTOC) = 32.27 ft.

Final Well Development Field Parameters:

pH = 6.82 , Conductivity = 0.852 µs/cm, T = 19.16 ^{Oc}

ORP 263 mV, Turb 38.1 NTU, DO 4.78 mg/L

NOTE: Diagram is not to scale.

PROJECT NUMBER	WELL NUMBER		
408244.FI.FS	MW-03	SHEET 1	OF 1

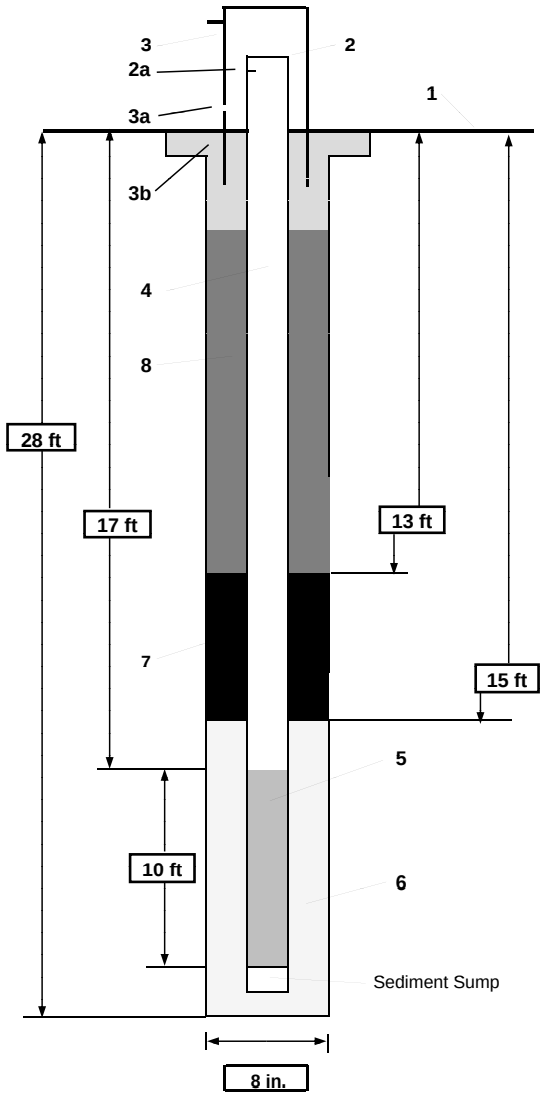
WELL COMPLETION DIAGRAM

PROJECT : Yorktown Site 32 - Well Installation LOCATION : Site 32, Yorktown, VA

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersol Rand A300 Rig - Truck Mounted

WATER LEVELS : 21.38' START : ########## END : March 7, 2012 LOGGER : Kimberley Coke



NOTE: Diagram is not to scale.

1- Ground elevation at well: NM ft.

2- Top of casing elevation: NM ft.
a) vent hole? Yes

3- Wellhead protection cover type: Metal Locking Protective Casing
a) weep hole? No
b) concrete pad dimensions: 2 ft diameter

4- Diameter/type of well casing: 2-inch PVC

5- Type/slot size of screen: 0.010 slot PVC

6- Type screen filter: DSI#1 sand
a) Quantity used: 6 bags

7- Type of seal: 3/8" Bentonite Plug
a) Quantity used: 1 bags

8- Grout
a) Grout mix used: 1/2-94 lb bag Portland Cement, 1 cup Bentonite Powder (estimated), 4 gal water.
b) Method of placement: Tremie Method
c) Vol. of well casing grout: 28 gallons

Development method: Surge (whale pump) and pump

Development time: ### hour

Estimated purge volume: 46 gallons

Comments

Total Well Depth (BTOC) = 28.11 ft.

Final Well Development Field Parameters:
pH = 6.70 , Conductivity = 0.841 µs/cm, T = 18.32 Oc
ORP 217 mV, Turb 8.8 NTU, DO 2.09 mg/L

PROJECT NUMBER	WELL NUMBER		
408244.FI.FS	MW-04	SHEET 1	OF 1

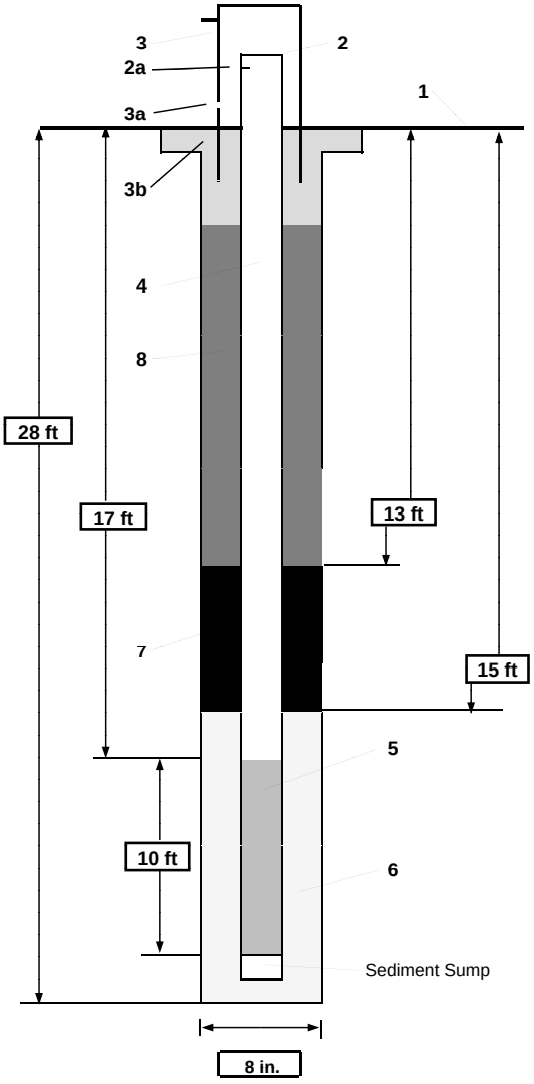
WELL COMPLETION DIAGRAM

PROJECT : Yorktown Site 32 - Well Installation LOCATION : Site 32, Yorktown, VA

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersol Rand A300 Rig - Truck Mounted

WATER LEVELS : 18.38' START : ########### END : March 6, 2012 LOGGER : Kimberley Coke



1- Ground elevation at well: NM ft.

2- Top of casing elevation: NM ft.
a) vent hole? Yes

3- Wellhead protection cover type: Metal Locking Protective Casing
a) weep hole? No
b) concrete pad dimensions: 2 ft diameter

4- Diameter/type of well casing: 2-inch PVC

5- Type/slot size of screen: 0.010 slot PVC

6- Type screen filter: DSI#1 sand
a) Quantity used: 6 bags

7- Type of seal: 3/8" Bentonite Plug
a) Quantity used: 1 bags

8- Grout
a) Grout mix used: 1/2-94 lb bag Portland Cement, 1 cup Bentonite Powder (estimated), 4 gal water.
b) Method of placement: Tremie Method
c) Vol. of well casing grout: 28 gallons

Development method: Surge (whale pump) and pump

Development time: ### hour

Estimated purge volume: 30 gallons

Comments

Total Well Depth (BTOC) = 27.73 ft.

Final Well Development Field Parameters:

pH = 6.89 , Conductivity = 0.881 µs/cm, T = 19.27 ^{Oc}

ORP 261 mV, Turb 16.7 NTU, DO 6.23 mg/L

NOTE: Diagram is not to scale.

PROJECT NUMBER	WELL NUMBER	
408244.FI.FS	MW-05	SHEET 1 OF 1

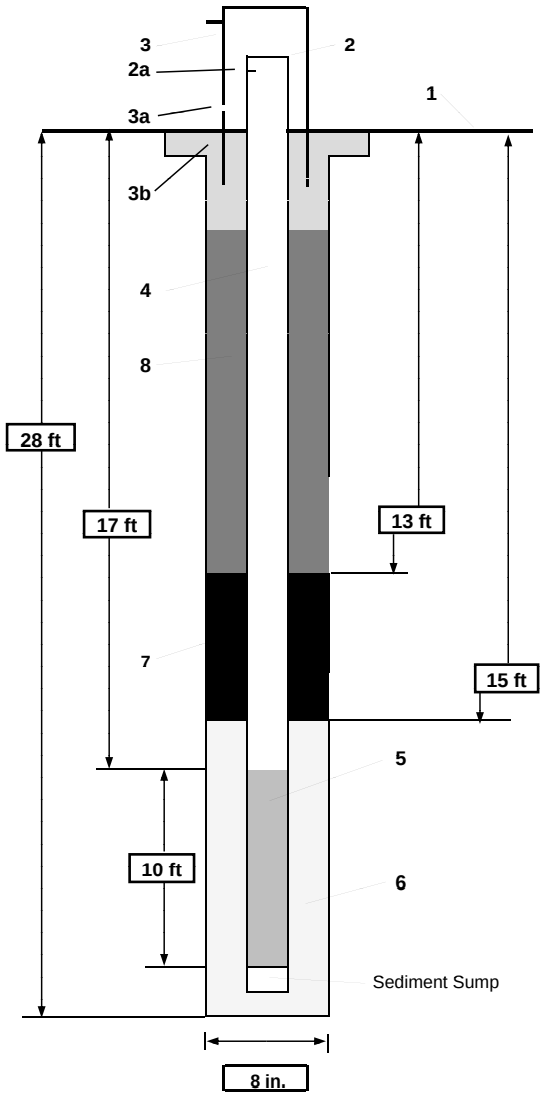
WELL COMPLETION DIAGRAM

PROJECT : Yorktown Site 32 - Well Installation LOCATION : Site 32, Yorktown, VA

DRILLING CONTRACTOR : Parratt Wolff

DRILLING METHOD AND EQUIPMENT USED : Ingersol Rand A300 Rig - Truck Mounted

WATER LEVELS : 18.96' START : ########## END : March 6, 2012 LOGGER : Kimberley Coke



NOTE: Diagram is not to scale.

1- Ground elevation at well	NM	ft.
2- Top of casing elevation	NM	ft.
a) vent hole?	Yes	
3- Wellhead protection cover type	Metal Locking Protective Casing	
a) weep hole?	No	
b) concrete pad dimensions	2 ft diameter	
4- Diameter/type of well casing	2-inch	
	PVC	
5- Type/slot size of screen	0.010 slot	
	PVC	
6- Type screen filter	DSI#1 sand	
a) Quantity used	6 bags	
7- Type of seal	3/8" Bentonite Plug	
a) Quantity used	1 bags	
8- Grout		
a) Grout mix used	1/2-94 lb bag Portland Cement, 1 cup Bentonite Powder (estimated), 4 gal water.	
b) Method of placement	Tremie Method	
c) Vol. of well casing grout	28 gallons	
Development method	Surge (whale pump) and pump	
Development time	2 hour	
Estimated purge volume	17 gallons	

Comments

Total Well Depth (BTOC) = 28.15 ft.

Final Well Development Field Parameters:

pH = 6.90 , Conductivity = 0.863 µs/cm, T = 19.85 ^{Oc}

ORP 133 mV, Turb 12.3 NTU, DO 7.46 mg/L

Appendix B
Team Agreements

From: Moshood Oduwole
To: Gravette, James CIV NAVFAC MIDLANT, IPTNE
Cc: Forshey, Adam/VBO; nvrouse@gmail.com; Friedmann, William/VBO; wmsmith@deq.virginia.gov
Subject: RE: Site 32 Unvalidated Soil data. official EPA response to Navy"s Proposal to
Date: Thursday, May 03, 2012 11:08:01 AM

Jim:

Yes,.

Moshood Oduwole
Remedial Project Manager
US EPA Region III
Hazardous Site Cleanup Division
NPL/BRAC Federal Facilities Branch (3HS11)
Tel: (215) 814-3362
Fax: (215) 814-5518
oduwole.moshood@epa.gov

From: "Gravette, James CIV NAVFAC MIDLANT, IPTNE" <james.gravette@navy.mil>
To: Moshood Oduwole/R3/USEPA/US@EPA, <wmsmith@deq.virginia.gov>
Cc: <William.Friedmann@CH2M.com>, <Adam.Forshey@CH2M.com>, <nvrouse@gmail.com>
Date: 05/03/2012 10:58 AM
Subject: RE: Site 32 Unvalidated Soil data. official EPA response to Navy's Proposal to

---

Moshood - Thanks. To clarify - since it not specifically indicated in your email below...you are saying that based on a review of the soil data - EPA is ok with us only sampling groundwater for the three sediment COCs (i.e., mercury, cadmium, and silver) - right?

Wade - please confirm you are also ok with this approach. Thanks.

Jim

-----Original Message-----
From: Moshood Oduwole [mailto:Oduwole.Moshood@epamail.epa.gov]
Sent: Thursday, May 03, 2012 10:46
To: William.Friedmann@CH2M.com; wmsmith@deq.virginia.gov; Gravette, James CIV NAVFAC MIDLANT, IPTNE; Adam.Forshey@CH2M.com; nvrouse@gmail.com
Subject: Site 32 Unvalidated Soil data. official EPA response to Navy's Proposal to

All,

After further consultation, EPA is concurring with the Navy's proposal with regarding groundwater sampling at Site 32 as described in 4/20 email.. While it is recognized that additional compounds were detected at concentrations above background, and/or groundwater SSLs, there is no reason to believe that these concentrations are high enough to be a continual source of groundwater contamination.

I recommend that in the future, the team should consider incorporating contingency plans into planing documents, this way information can be readily available that immediately inform subsequent decisions in the field, thereby avoiding such complications.

All appropriate internal support folks have been made aware of this decision. Please accept this as an official EPA response.

Regards,
Moshood Oduwole
Remedial Project Manager
US EPA Region III
Hazardous Site Cleanup Division
NPL/BRAC Federal Facilities Branch (3HS11)
Tel: (215) 814-3362
Fax: (215) 814-5518
oduwole.moshood@epa.gov

From:	Smith, Wade (DEQ)
To:	james.gravette@navy.mil
Cc:	Friedmann, William/VBO; Forshey, Adam/VBO; Oduwole.Moshood@epamail.epa.gov; nvrouse@gmail.com
Subject:	NWSY: Site 32 Groundwater Sampling Approach - DEQ Concurrence
Date:	Thursday, May 03, 2012 3:46:11 PM

The DEQ concurs with the proposed groundwater sampling approach, specifically sampling for Cd, Ag, and Hg in groundwater.
Please let me know if you have any questions.
Thanks,
wade

From: William.Friedmann@CH2M.com [mailto:William.Friedmann@CH2M.com]
Sent: Friday, April 20, 2012 12:18 PM
To: Oduwole.Moshood@epamail.epa.gov; Smith, Wade (DEQ); james.gravette@navy.mil; Adam.Forshey@CH2M.com; nvrouse@gmail.com
Subject: Site 32 Unvalidated Soil Results - Input and Discussion Needed
Importance: High

Moshood and Wade,
Attached and discussed are the soil results from the Site 32 investigation. It is important to note that this data is unvalidated, though we do not anticipate any changes in the value, possibly only qualifiers. I have attached the four soil tables (surface, subsurface, composite-surface, and composite-subsurface) and a map of sample locations.

The tables have the screening values which were specified in the UFP-SAP; residential RSLs, groundwater leaching levels (SSLs), the Yorktown 95% UTL, and the ECO-SSLs.

As a quick review on our path for the site, the team has agreed that cadmium, mercury, and silver would be collected from all wells. These soil results would be used to determine if any additional samples would need to be included into the round of groundwater sampling. Rather than walk through all compounds with detections, please note the following trends and generalities in your review.

- Even with detections and exceedences of Cd, Ag, and Hg in the non-sludge drying bed sample locations, the detected concentrations are low
- Within the sludge drying beds, several inorganics that exceed screening and background are not considered site related due to their concentrations when compared to regional values (iron, calcium, manganese).
- Data from the composite samples within the sludge drying beds had no detections of VOCs.
- Of those SVOCs detected within the sludge drying bed, only two exceeded the groundwater SSL; none posed an unacceptable risk to human health or eco

Please review the tables and figures. Based on the screening tables, the

Navy is currently considering adding thallium to the list of compounds to be sampled in groundwater. Though the UFP-SAP would require that thallium be sampled in all groundwater samples, it is believed that thallium, though a human health RSL exceedence, but with no UTL, is not site related. We would like your input by e-mail and then to arrange a call with the team to discuss those compounds which will be analyzed for groundwater. We would like to have this call this coming Thursday (April 26th) either before 10AM or after 1PM. Please advise to each of your availability to attend.
Thanks,
Bill

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FINAL MEETING MINUTES FOR THE 14th AND 15th OF AUGUST 2012 MEETING (No. 113) OF THE NAVAL WEAPONS STATION YORKTOWN PARTNERING TEAM

LOCATION: CH2M HILL PHL
1717 Arch St. Suite 4400
Philadelphia, PA 19103
215-563-4220

MEETING MANAGER: Mr. Wade Smith
MEETING HOST: Mr. Moshood Oduwole
TIMEKEEPER: Mr. Jim Gravette
FACILITATOR: Ms. Nancy Rouse
TIER II: Mr. Bruce Beach
RECORDER: Mr. Adam Forshey
GUESTS: Mr. Bill Friedmann

INTRODUCTION

The WPNSTA Yorktown Partnering Team held a partnering meeting on August 14th and 15th, 2012. The Final Agenda for this meeting is included on pages 12 & 13 of these minutes.

MEETING ATTENDANCE
The following people also participated in the meeting:

Donna Caldwell/Navy (phone), Herminio Concepcion/USEPA, Steve Hirsh/USEPA, Frank Fritz/USEPA, Kyle Newman/VDEQ, Katherine Will/Navy (phone), Peter Knight/USEPA, Bruce Beach/USEPA, Dawn Ioven/USEPA (phone)

CONFERENCE CALLS:
October 17th, 2012 (Agenda Call): 1000 – 1100 Eastern

Chorus Call: 866-203-7023
Pass Code: 9226075075

UPCOMING EVENTS:

FUTURE PARTNERING MEETING: November 7th and 8th, 2012 (No. 114)
LOCATION: Virginia Beach, VA
AGENDA CALL: October 16th, 2012; 1000 – 1100 Eastern

MEETING MANAGER: TBD
MEETING HOST: TBD
FACILITATOR: Nancy Rouse
TIMEKEEPER: TBD
RECORDER: Adam Forshey

Guests: TBD

NEXT RAB MEETING: Thursday, November 15th, 2012
TIME: 1 to 3 PM
LOCATION: York County Library – Yorktown

FUTURE PARTNERING MEETING: TBD (115)
LOCATION: TBD
AGENDA CALL: TBD

MEETING MANAGER: TBD
MEETING HOST: TBD
FACILITATOR: Nancy Rouse
TIMEKEEPER: TBD
RECORDER: Adam Forshey

TUESDAY AUGUST 14th 2012 DISCUSSION

Agenda Item: Partnering Team Exercise

Discussion Leader: Nancy Rouse/The Management Edge

Document/Prep Work: None

Desired Outcome: Standard Meeting Format/Team Building

Additional Conference Call Participants: None

Discussion: Nancy led a discussion on effective communication and building trust in communication skills.

Wrap-Up/Action Item: None

Agenda Item: LUC RD Update (Sites 1, 6, 7, 12, and 19)

Discussion Leader: Jim Gravette/Navy

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Conference Call Participants: None

Discussion: Jim provided a review and summary of the status of each of the LUC RDs.

- Site 1 – Projecting a draft to the Team in June 2013, because we are holding onto it until after the additional investigation (per Team Agreement)
- Site 6 – Two LUC RDs; one for the impoundment (which can happen now) and one for the excavated area (which will not happen until after we investigate the two possible excavated areas)
- Site 7 – We are moving forwarding with preparing this one. Should be to the Team in September
- Site 12 – This one has gone to the Team we are responding to some EPA comments.
- Site 19 – The LUC RD will be done after the additional investigation. We are developing the ESD to explain that the Navy believes the floor exceedance may have been removed. However, additional sampling will be necessary to confirm this in the upcoming investigation (to be discussed during the Site 9 & 19 discussion). Based on additional discussion (see Site 9 & 19 UFP SAP discussion section below), the ESD will be put on hold until after the additional investigation.
- Site 22 – Draft to team no later than 90 days after the ROD.

Wrap-Up/Action Item: CH2M HILL will develop Gantt chart for all the SMP schedules and submit it to NIRIS for discussion at the next partnering meeting (**Action Item #1**).

Agenda Item: Site 31 Update

Discussion Leader: Bill Friedmann/CH2M HILL & Jim Gravette/Navy

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: Jim provided the current standing of the vapor intrusion sampling. The "seasonal variation" round of sampling is currently being completed (for the summer sampling event). Jim outlined what buildings are now empty and where people from the evacuated buildings have been moved. Shed 3 is planned to be used for deep storage. VDEQ asked if the Navy would be calculating acceptable durations for workers going into the building for deep storage. Bill indicated that the Navy's public health professionals could do such a calculation for entering the building.

Jim discussed the SAP approach. Up to 20 MIP samples will be advanced to delineate the soil source area. There will also be select soil samples collected to support the MIP data. Three wells will be installed to support the groundwater plume delineation. Jim discussed the proposed surface water and sediment samples as well. Two additional sediment and surface water samples will be collected during the next phase of investigation to confirm contamination is not leaving the base boundary.

Wrap-Up/Action Item: Jim reviewed the proposed schedule with the Team.

Agenda Item: Site 6 Groundwater Discussion

Discussion Leader: Bill Friedmann/CH2M HILL & Jim Gravette/Navy

Document/Prep Work: Review Handouts

Desired Outcome: Informational

Additional Participants: Herminio Concepcion

Discussion: Jim provided a summary of Site 6 and the history of contamination. The aerial view of the plume was provided. Jim also reviewed the groundwater cross sections that will be presented in the SAP. Herminio asked if permanent wells or DPT data are currently planned for the investigation? Jim and Bill discussed that the permanent wells are proposed, as installation logistics and costs would be increased by doing DPT then installing permanent wells.

The proposed well locations were discussed. Moshood asked if there is a real need for all the wells currently proposed (to make everyone comfortable with the plume delineation). Jim walked through an explanation of each well, but discussed areas where some wells may not be necessary. Herminio agrees with the approach, but he would like to see it combined with a little bit of screening tools to select well locations. Jim stated that the approach presented in the SAP will be the best proposal from the Navy, but we will need to evaluate costs to determine if some wells need to be consolidated or do a phased approach, etc. Bill presented that the current well installation locations were identified to help with moving the site toward the remedy phase. Moshood emphasized that the Team should be smart with how monitoring well locations are selected, but he agrees that the focus of well placement should be to move from an RI to a remedy. Bill discussed that implementation of the technology to install the wells will be new and challenging. We will need to do a vendor site visit and discuss installation options. It may be challenging by it can be done.

Jim outlined that groundwater and source soils will be collected first phase. Then sediment and surface water will be collected in a second phase. Maybe at that point additional wells could be installed.

Wrap-Up/Action Item: Jim noted that the SAP will be written in a way that will allow for installation of a couple more wells, if it's determined to be necessary based on Regulator input. Herminio indicated that he likes the approach but he will wait to see the SAP for all of the details.

Agenda Item: Site 8 Soil

Discussion Leader: Bill Friedmann/CH2M HILL

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: Bill discussed the Site 8 history of contamination. The original site was just the discharge area. However, similar to a lot of Yorktown sites (Site 7), other media are being considered to ensure all data gaps that may be associated with site buildings are filled. A removal action was completed in the discharge area. For upgradient soil, some data was collected but it is limited. Bill reviewed the site layout and the existing soil data, including soil samples and DPT data. Based on the existing data, there is a slight concern for PAHs but the risks are within the acceptable risk range. There was also no risk for soil from an ecological perspective. The demolition contractors have indicated that decontamination will be necessary for the building to remove explosive residue. However, the building is contained with wash out trenches and does not appear to have drains.

Based on current data, it appears we really don't have a soil problem. However, there is uncertainty from the contribution from upgradient buildings due to minimal sample data. Jim and Bill discussed that the recommended approach would be to finish up the internal draft FS and then put it on hold while soil is evaluated. If soil is not a problem, then complete the FS. If it is a problem, then add soils to the existing FS. Then move everything into one ROD. Otherwise we would move forward with the groundwater FS, then have it held up for a ROD until after soils are evaluated. If soils are a concern, then another FS would be necessary and there would be more delays to the site schedule.

Groundwater is going to sit for a little bit. The next thing the regulators will see is a SAP for soil characterization to confirm the soils are not an issue. The Navy will contact the decontamination contractor at Site 8 to confirm that there are no floor drains in Building 456 (**Action Item #2**).

Wrap-Up/Action Item: The schedule for Site 8 will need to be evaluated and updated based on holding off on the FS to complete this soil investigation. The goal will be to provide the Team with a draft UFP-SAP by the end of the calendar year.

Agenda Item: Site 9 & 19 UFP-SAP

Discussion Leader: Bill Friedmann/CH2M HILL

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: The presentation outlined the new investigation approach for Site 9 & 19. The following are key changes since the last time Sites 9 & 19 were discussed.

- Site 9 & 19 will be investigated separately from Site 33
  - A UFP-SAP will be submitted addressing only Site 9 & 19
- Site 9 and 19 investigation areas have been expanded and combined, and now include the former site buildings. The boundary has been expanded to include a "TNT Building" to the north east of the previous site boundary as well.

Bill recapped the sampling summary and reasoning for the proposed sample locations (for all media). Bill asked that the regulators listen to see if there is any input from BTAG about the depth of surface/subsurface soil samples (e.g. what depths are surface and what depths are subsurface? What depths are the eco horizons?). Bill reviewed that soil samples will be collected from beneath the old conveyor belt to support the ESD logic that contamination from the floor (the one floor exceedance) was likely removed.

The Team discussed that in the conveyor belt area, it is unclear why an ESD would be necessary if the Navy now believes that the floor exceedance was removed. The Navy now proposes to complete this sampling event to determine if the contaminant concentrations were removed or not. Based on the findings of the samples during the investigation, either an ESD will be needed to document that RGs were not met and the additional LUCs are necessary (assuming contamination remains) or that the sample results confirm that the exceedances were removed and a LUC RD will be necessary for residential restrictions only (no ESD). Jim will summarize the Site 19 approach for the additional sampling, need for an ESD (or not) and the LUC RD and provide it to the Team (**Action Item #3**). Jim will discuss with Katherine Will the reason that it is believed an ESD is no longer necessary for Site 19 (**Action Item #4**). Jim reviewed the other soil sample locations throughout the former plant location. Wade noted that we need to confirm that one soil sample is adequate at the loading area around the TNT Building. The Navy and CH2M HILL will need to look at building drawings to determine if there are loading points along that stretch of railroad track.

Jim also reviewed the sediment and surface water samples. One thing to point out is that there are no samples going into Lee Pond. This is because the area leading into Lee Pond has been investigated. So upgradient sediment and surface water samples will be collected to confirm noting else was added to the downgradient area. This will all be included in the SAP.

Wrap-Up/Action Item: CH2M HILL will provide the technical approach for Site 9 and 19 to Moshood (**Action Item #5**). Moshood will provide the Site 9 and 19 technical approach to BTAG and set up discussion with the Team (**Action Item #6**).

Agenda Item: Site 22 ROD Update

Discussion Leader: Team

Document/Prep Work: None

Desired Outcome: Discuss any comments/status update

Additional Participants: Frank Fritz/USEPA, Donna Caldwell/Navy, Katherine Will/Navy, Steve Hirsh/USEPA, Stephanie Sawyer/CH2M HILL

Discussion: Moshood outlined that USEPA has two or three points on what they feel should be in the ROD to make it something that they could agree to and sign. The Team reviewed the portions of the ROD that are of concern. One of the main concerns that the EPA still has about the ROD is the TCE. The Navy currently defers the TCE plume until after the RDX contamination is treated.

EPA indicated that they are fine with the RDX part; their concern is with the MNA part. The EPA believes that the TCE should be able to be treated before the RDX contamination. So, the TCE should be treated sooner rather than later. What they wanted to see in the ROD is something that says TCE will be looked at in the pre-design. The Navy summarized that the intent is to do the performance monitoring in the pre-design phase. Jim summarized that the new language that was sent on Wednesday of last week should help to summarize this.

Steve's concern is, "what if the VOC numbers go up and MNA is not working?" The well that has only been sampled once, is the deepest well, with the highest concentration, and most down gradient. Essentially, this well has been in MNA for seven-years. EPA agrees that it is likely that MNA will work; but believes the Navy is selecting a remedy on a dataset that is smaller than what is normally worked with. In this case, EPA thinks we can live with it but we need to include language in the ROD stating that the Navy will confirm MNA is working. Katherine added that she feels this would be attempting to write something to address a situation that does not yet exist. It seems we should defer making that decision once the problem is defined. EPA feels that the language in the ROD should say that if the MNA data is not functioning as intended the remedy will need to be reevaluated. Frank indicated that the revised language that Navy submitted is about 75% of the way there. He suggested that the piece that is missing here is what to do if during predesign investigation, MNA is determined not to be working. It was pointed out that, if any part of the remedy isn't working the remedy would be reevaluated. Kathrine suggested that we make the last sentence in the first paragraph of the "Performance Monitoring and Long-term Monitoring" should be parallel to the first sentence of the same paragraph. EPA Legal worked though edits of the language in the ROD. Moshood asked about the schedule for the pre-design work plan and if the schedule needs to be in the ROD. Steve indicated that he is ok with the current language because "following the pre-design" gives him a timeframe for sometime shortly after the pre-design.

Frank reviewed some proposed language for the ROD that he developed. The Team agreed that the measurement of success for MNA can be included in the Pre-design work plan but should not be included in the ROD.

Section 2.5.2 regarding TCE and VC, Frank indicated that the first draft of the ROD expressed a clear certainty that MNA is working. So now, the revision indicates that EPA has concerns that MNA isn't working. To resolve this, the Navy and EPA worked through language in the ROD.

Frank looked through most of the other changes and indicated that in Section 2.5.2, in the second and third paragraphs there are still some sentences which may be difficult to understand by the public. He suggested to simplify the language or use terms that are easier to understand. Frank said he will provide his comments to Moshood to give to the Navy.

Wrap-Up/Action Item: The edits will be made to the ROD and the document will be resubmitted to the USEPA. Bill is sending both pieces of the ROD to Katherine and Frank right now. Frank and Katherine will make sure they are both good with the language. We will incorporate everything and accept the changes and send it to Moshood. The Team should have comments back from EPA (one set of comments) by the end of next week.

WEDNESDAY AUGUST 15th 2012 DISCUSSION

Agenda Item: Tier II Update

Discussion Leader: Bruce Beach/Tier II

Document/Prep Work: None

Desired Outcome: Informational

Additional Participants: None

Discussion: Bruce discussed that a couple years ago, Tier II had mentioned documenting sites closed as AOCs/SSAs in pre-ROD decisions in a follow-up ROD. There is no real legal standing for having to tell the public such in a ROD. Based on that, Tier II will be issuing a short document to provide specific information on the "mega" ROD not being a requirement. Secondly, the process for visiting past decisions or documents was discussed. Ultimately, this should be a Partnering process/exercise. If the Team does not agree to reopening a document, then a dispute would be issued for resolution. Jim reviewed that the FFA outlines the process for re-

opening documents. 1) There needs to be new data, 2) the issue needs to be "significant," and 3) the agency with the issue needs to submit the problem in writing to the Team. Finally, Bruce reminded the Team to develop the success stories.

Jim presented a couple of Team items for Bruce to discuss with Tier II. The first item was manpower for all agencies. The second item is review timeframes and possible concerns with that process. Finally, Bill mentioned the need for EPA to update their NIRIS certificates and provide funds for renewal.

Wrap-Up/Action Item: None.

Agenda Item: Site 24 RI RTC Update

Discussion Leader: Bill Friedmann/CH2M HILL

Document/Prep Work: Review Presentation

Desired Outcome: Comment Resolution

Additional Participants: Donna Caldwell/NAVFAC, Bill Kappleman/CH2M HILL, Kyle Newman/VDEQ, Peter Knight/BTAG, Bruce Beach/USEPA

Discussion: Jim discussed that the RTCs were submitted on July 27th and reviewed the schedule that the Navy has for the Site. The Team reviewed the individual specifics of the remaining comments of concern. On Comment 3, Peter noted that the response outlines that, based upon the evaluation contained in the ERA, additional groundwater investigation is not warranted for ecological receptors. Moshood asked how Peter feels about the case that is stated above supporting the response. Peter indicated that these are all assumptions. He is concerned with use of mean concentrations vs. max concentrations. Moshood summarized that it seems EPA has an opinion on what should be used and Navy has a different opinion on what should be used. If the Navy is not using the mean, does that mean they are wrong? Peter stated that, in his opinion, this would lead to a data gap. Peter stated that, other than being able to write a general sentence in the report that groundwater discharges to the York River, all other decisions will be based on assumptions.

Jim added that Site 24 is not considered a big groundwater site. We don't see the contamination in the wells right next to the pits, so why would we step out to the York River. The response to Comment 3 details this. Kyle asked if the max concentrations in groundwater are actually driving an ecological risk. How bad are the groundwater detections that are driving the concern? Bill Kappleman outlined that, in most cases, if you use the maximums and the most conservative assumptions you are going to fail something. That is why there is a stepwise process that goes from the absolute worst case down to more realistic assumptions. Bill Kappleman also indicated that he thought EPA went away from maximum exposure to "reasonable" maximum exposure. Peter stated that he is unaware of the "reasonable" discussion, but he knows that he's made this comment a number of times. Peter noted that because the groundwater discharges to the York River hasn't been sampled and the Navy is not proposing to sample it, there must be a resolution. Bill Kappleman noted that we have identified that the groundwater discharges to the York River, but what is not identified is a contaminant significant enough to leave the site. If there were high levels of contaminants in the groundwater, additional investigation identifying the discharge points would be necessary. Without a contaminant problem at the site, there is no need to evaluate the discharge. Peter stated that he has not had a chance to go back to the data in the original report. At the moment, Peter does not have a problem with assuming max concentrations and using a dilution factor (the strategy presented by Kyle). If that information supports the information that was made from using the mean data, then Peter feels we can remove groundwater as a problem. If the reverse happens, the groundwater issue is not solved.

If you use the most conservative measure, then you are better situated to make risk management decisions. Peter will complete review of the RTCs and take the time to respond. We as a Team can then have a technical call discuss any remaining issues. The Team summarized that they would like to have another call or discussion to complete the discussion of Peter's comments and concerns that remain.

Summary of remaining concerns from Peter:
Comment 3

- Mean/Max issue
- Second Paragraph in comment 3 refers to caches that cannot be identified. How much certainty is there that you know where the caches are? He recalls a photograph over 10 years ago showing the locations. How many soil samples were taken and

how many caches were there. Some language in the text indicates they were in the northeast corner of the site. The uncertainty about the locations needs to be addressed.

Comment 5

- There's a sentence that discusses 7.5.6 that identifies "spatially limited areas." Other people would call these hot spots. Will these areas be included in the remediation action for the site? That was addressed in the redline. There is a conclusion about not adding amphibians. The logic used to support that is questionable.

Comment 4

- The question was about making risk management decisions. Who makes the risk management decisions, particularly if they involve ecological issues? Peter is not convinced the correct decisions will be made. Multiple comments/redlines were referenced during the discussion of this comment (not captured by the minutes). These comments will be summarized in the response provided by EPA.

Wrap-Up/Action Item: The next steps will be to get some information on the comments in writing and then a conference call will be set up.

Agenda Item: Site 1 Summary

Discussion Leader: Jim Gravette/Navy

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: Herminio Concepcion/USEPA, Peter Knight/BTAG, Kyle Newman/VDEQ, Bill Kappleman/CH2M HILL, Bruce Pluta/USEPA, Dawn Ioven/USEPA

Discussion: Jim presented that the purpose of this meeting is a scoping session to let the Team know what they will be seeing soon. Jim summarized the history of the site and contamination. There are some data gaps with the site. Documentation is needed for the extent of the waste and the thickness/extent of the cover over the waste. Based on the groundwater data from the previous investigations there are some data gaps and issues. Additional groundwater data is necessary. Jim reviewed the initial proposal for the additional groundwater investigation. Five new wells are currently proposed. A deep well (GW24A) will be installed to see if any contaminants are going under the water body. Herminio stated that he feels what we are proposing addresses his concerns. Peter asked why we are only looking at VOCs in porewater? VOCs and metals are being evaluated in surface water and sediment, why are metals not included in sediment porewater? This needs to be considered when we are preparing the SAP and if not, it needs to be explained why metals are not included. Bill Kappleman summarized that VOCs are the primary groundwater contaminant, so that's all that was proposed in porewater. Peter reiterated that metals should be considered, if warranted. Kyle also added that it may save the Team from going back out for additional sampling in the future. The sample locations were presented for surface water, sediment, and porewater. The sample locations and time of sampling will need to be coordinated with the Team.

Wrap-Up/Action Item: Jim reviewed the schedule. The Navy will work to get the draft out to the Team around October.

Agenda Item: Site 32 SI Update

Discussion Leader: Bill Friedmann/CH2M HILL

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: Bill Kappleman/CH2M HILL, Kyle Newman/VDEQ, Peter Knight/BTAG, Bruce Beach/USEPA, Dawn Ioven/USEPA, Herminio Concepcion/USEPA

Discussion: Bill presented the Site 32 SI approach to the Team and support staff. The site history and previous investigations/actions were reviewed. The sampling approach presented in the SAP included grab samples beneath most of the former buildings and a composite beneath the sludge drying bed. Groundwater wells were also installed and sampled based on the soil data. The

groundwater samples were evaluated for silver, cadmium, and mercury. The soil samples were collected in March. The groundwater was collected in May.

Peter stated that when he looks at the site layout figure he sees one sample at each individual building. He stated that one of the hills that we will have to climb is to justify why we only did one sample. Moshood discussed that Navy, BTAG, EPA all agreed to the sampling approach. The Human Health risk screening for surface soil shows that there are no human health risks. Kyle asked if we have soil pH. That will be the data gap that might be necessary for toxicity of the iron. This may need to be discussed in the report. Aroclor-1268 was detected. There is no residential soil RSL for Aroclor-1268, so Aroclor-1260 was used. Aroclor-1268 is within acceptable risk ranges and below ten times the RSL, so Risks are considered acceptable. Dawn indicated that the approach sounded reasonable to her.

Bill reviewed the ecological risk evaluation. The surface and subsurface soils were evaluated for maximum detected concentrations. Ecological risks considered acceptable. However, because there were a couple of compounds that were of concern, if a Step 3a investigation were done, all risks would be acceptable for ecological receptors.

The SI questions and answers included in the presentation were reviewed. There is no risk when evaluated beyond the most conservative screening. However, additional evaluation and the need for NFA would need to be justified in the SI. How does the Team (and technical support staff) feel about including these extra steps in the SI? Peter stated that, he does not have a problem with what is put in an SI. What he would like is for all the decisions and conclusions that are made provide justifications and all uncertainties without using statements like "the Team decided this". If you use that statement, include "because of a, b, c, d, etc." Moshood added that he agrees, but there should be a balance between what is included without covering all the discussion from a two day partnering meetings. Be brief and specific. Peter provided the following example, on the first page of the eco discussion slide. BTAG interpretation of HQs are that if it meets or exceeds 1, it's a risk. If we are stating it is not a risk, it must be justified and any uncertainty should be outlined. Peter also indicated that if there are high concentrations of mercury on the site, if he were a public member he would want to know why additional action isn't being done if there are high concentrations of mercury that remain. Kyle added that given the size of the site he feels like the number of samples are more than a standard SI. So he is ok with the additional step, just call it something other than a Step 3a.

Peter asked questions about where Shaw's samples were collected. He indicated that he was unaware of additional samples being collected under the drying areas for Shaw. That information should be included in the SI (possibly as an appendix).

Wrap-Up/Action Item: Jim clarified, does anyone have an issue with us including the Step 3a risk assessment into the SI? Peter and Kyle indicated they agree with including the additional step. Kyle suggested calling it something other than a Step 3a. Jim summarized that the SI will be beefed up a little bit to support decisions and uncertainty and we'll include the Step 3a (but call it something else). Moshood will talk with BTAG coordinator to confirm if it is ok to finish Site 32 in the SI with an expanded risk screening evaluation (**Action Item #7**). Moshood and Wade will send a link to their technical support for the public website Admin Record (**Action Item #8**).

Agenda Item: Five Year Review

Discussion Leader: Adam Forshey/CH2M HILL

Document/Prep Work: Review RTCs/Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: The Team reviewed the schedule. EPA comments are expected by late August or early September. Wade will ask his ARARs person to review the ARARs. CH2M HILL and the Navy will look at the schedule for the Five-Year Review in detail and provide a copy to the Team for presenting to their reviewers/supervisors (**Action Item #9**).

Wrap-Up/Action Item: While Frank was in the meeting, he indicated that he will try to get to the FYR by August. Jim noted that would be good. However, Jim asked if the document cannot be signed by November, what is the requirement for signature and who defines it. Steve indicated that there is flexibility within EPA, but their goal is the EPA date. Jim noted that there have been fines

before. Steve noted that the process for the first review is the most thorough. EPA cannot change their date in CERCLIS, for whatever reason. If necessary, Steve indicated that EPA can send something (a letter) to the Navy stating why the FYR will not be signed by the Navy signature date (November 2012) which the Navy can provide to their management.

Agenda Item: Site 3 Soils

Discussion Leader: Jim Gravette/Navy

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: Jim presented information on the Site 3 soils to the Team. There is a ROD and an ESD for UU/UE of soils. The TPH in the soils are present but not at levels that pose a risk. Moshood's concern is how much will be enough for making sure the soil issue is covered. It was discussed that the issue is presented in the RI, a couple of soils samples were collected in the RI for the soil, it is not at levels of risk, and the RI recommends how to consider the TPH in the remedy. EPA stated that as long as it is documented as such in the RI, the do not have a problem with addressing it in the groundwater FS.

Wrap-Up/Action Item: Continue development of the Site 3 FS and submit draft to the Team in September. Moshood will identify who reviews FS' (is legal review required for the ARARs) (**Action Item #10**).

Agenda Item: UXO-3 PA Update

Discussion Leader: Adam Forshey/CH2M HILL

Document/Prep Work: Review Presentation

Desired Outcome: Informational

Additional Participants: None

Discussion: Adam provided the Team with a review of the documents that were collected as part of the desktop review and the path forward for development and submittal of the PA Report.

Wrap-Up/Action Item: None.

Agenda Item: SASR/Action Items/Team Goals

Discussion Leader: Bill Friedmann/CH2M HILL and Adam Forshey/CH2M HILL

Document/Prep Work: Review SASR, Goals and Action Items

Desired Outcome: Standard Meeting Format

Additional Participants: None

Discussion: Adam reviewed the dates in the SASR and the following comments were made on the documents

Site 1& 3 RI comes off the schedule
Site 3 FS – trying to get the RAA to the Navy in August and the FS to team in September to October
Site 6 & 7 Tech Memos to suspend the LTM are with the Navy and will be provided to the team by September
Site 6 & 7 LUC RDs – September to the Team
Site 6 Pre-FS UFP-SAP to the Navy by end of August; to team in September

Site 7 UFP-SAP – preparing final UFP-SAP; sampling anticipated in October. Clearance of some vegetation will be needed.
Site 8 FS – based on discussions during the partnering meeting, the FS will be placed on hold until the soils are evaluated.
Site 9 & 19 UFP-SAP – now that broken out from Site 33, will go to Navy in September and then Team in October
Site 19 ESD – on hold based August 14 discussion until following the investigation; LUC RD to follow the ESD. Adam will send an e-mail to the team stating that the SMP will change the order and schedule of
Site 33 UFP-SAP – August to Navy and September to Team in keeping with original schedule
Site 12 ESD – comments received by VDEQ and EPA. Two minor comments from EPA will be addressed and then ready for signature.
Site 12 LUC RD – draft to the Team by early September
Site 12 LTM UFP-SAP – to Jim by the end August and September to the Partnering Team (Tier II format)
Site 16/SSA 16 – sampling of two wells August 15 & 16th
Site 22 ROD – being reviewed by EPA and Navy
Site 23, 25, & 26 draft UFP-SAP – September to the Navy and October to the Partnering Team
Site 24 RI – waiting for EPA response to the RTC which should be submitted to the Team by August 24th
Site 31 UFP-SAP – received by Team on July 26th and looking for expedited comments to the Navy by August 24th.
Site 34 UFP-SAP – end of August to Navy and to the Team in the Navy; Site 34 FS will be on hold until
UXO-3 PA to team in September
FY13-FY14 SMP – revised document to the Team at the end of August (One copy each for VDEQ and EPA)
FYR – anticipating EPA comments by end of August.

Moshood will check with EPA tech support on review of the Site 31 UFP-SAP which the Navy is requesting to have by August 24th (**Action Item #11**).

CH2M HILL will verify whether a soil sample will be collected underneath Building 537 at Site 34 (**Action Item #12**).

Goals – updated goals are provided in the partnering package. How does the team use the goals? Navy takes the goals and distills them down for the Navy Tier II contact. They should remain tracking for Tier II to identify any trends in delays, if they exist. The team will continue to utilize the SASR to understand the details of any delays.

Action Items – Rollover action regarding using the mean or maximum concentrations in identifying the COPCs.

CH2M HILL will ask Bill K. to develop a paragraph discussing the disagreement regarding the use of mean or max concentrations to determine the COPCs (**Action Item #13**).

Wrap-Up/Action Item: None.

Agenda Item: Agenda Building/Roundtable

Next Partnering Meeting: November 7th & 8th, 2012 – Virginia Beach, VA
Agenda call: October 17th, 2012 – 10:00 am EST

Possible Agenda Topics for November meeting:
1. TBD

Following Partnering Meeting: TBD
Agenda Call: TBD

Following Partnering Meeting: TBD
Agenda Call: TBD

Plus	Delta
Right technical support staff participated	Make sure most up to date information and documents are ready and provided to technical support
Location great	Not checking in with recorder and team

Better time management	Working lunches for both days
Good team advocacy and building trust	Phone check-ins could improve during discussions
Opening discussion set positive tone for the meeting	Continue improving active listening
Good to have placeholder at the end of the day for wrap up	
Stayed focused for two days	
Good job asking clarifying questions	
Discussions were balanced with check-ins and support by all members	

Parking Lot Items

1. Clean up documents on NIRIS

Listing of Action Items

1. CH2M HILL will develop Gantt chart for SMP schedules and submit it to NIRIS for discussion at the next partnering meeting
2. The Navy will contact the decon contractor at Site 8 to confirm that there are no floor drains in Building 456
3. Jim will summarize the Site 19 approach for the additional sampling, need for an ESD (or not) and the LUC RD and provide it to the Team
4. Jim will discuss with Katherine Will the reason that we no longer believe an ESD is necessary for Site 19
5. CH2M HILL will provide the technical approach for Site 9 and 19 to Moshood
6. Moshood will provide the Site 9 and 19 technical approach to BTAG and set up discussion with the Team
7. Moshood will talk confirm with BTAG coordinator if it is ok to finish Site 32 in the SI with an expanded risk screening evaluation
8. Moshood and Wade will send a link to their technical support for the public website Admin Record
9. CH2M HILL and the Navy will look at the schedule for the Five-Year Review in detail and provide a copy to the Team for presenting to their reviewers/supervisors
10. Continue development of the Site 3 FS and submit draft to the Team in September. Moshood will identify who reviews FS' (is legal review required for the ARARs)
11. Moshood will check with EPA tech support on review of the Site 31 UFP-SAP which the Navy is requesting to have by August 24th
12. CH2M HILL will verify whether a soil sample will be collected underneath Building 537 at Site 34
13. CH2M HILL will ask Bill K. to develop a paragraph discussing the disagreement regarding the use of mean or max concentrations to determine the COPCs

PARTNERING LOCATION: **CH2M HILL Philadelphia Office**
1717 Arch St., Suite 400
Philadelphia, PA 19103
215-563-4220
CALL IN: (866) 203-7023
Passcode: 9226075075

Next Partnering Meeting
November 2012
Newport News, VA (CH2M HILL office)

MEETING MANAGER: **Mr. Wade Smith/VDEQ**
TIMEKEEPER: **Mr. Jim Gravette/Navy**
RECORDER: **Mr. Adam Forshey/ CH2M HILL**
MEETING HOST: **Mr. Moshood Oduwole/USEPA**
FACILITATOR: **Ms. Nancy Rouse/ Management Edge**
TIER II Link: **Mr. Bruce Beach/USEPA**

GUESTS: **Bill Friedmann/CH2M HILL, Donna Caldwell/Navy, Herminio Concepcion/USEPA, Steve Hirsh/USEPA, Frank Frisch/USEPA, Kyle Newman/VDEQ, Katherine Will/Navy**

WPNSTA YORKTOWN PARTNERING MEETING
FINAL AGENDA
Tuesday August 14th, 2012

Start Time	Agenda Item	Leader	Support	Prep Work	Desired Outcome	Duration
0830	Welcome & Check-in	Team	None	None	Standard Meeting Format	30 min
0900	Partnering Team Exercise	Nancy	None	None	Standard Meeting Format	1 hour
1000	**Break**					10 min
1010	LUC RD Update (Sites 1, 6, 7, 12, 19)	Jim	None	Review Presentation	Informational	60 min
1110	Site 31 Update (VI and UFP-SAP)	Jim/Bill	None	Review Presentation	Informational	30 min
1140	**Lunch (Site 6 GW Discussion)**	Jim/Bill	Herminio	Review Handouts	Informational	1 hour
1240	Site 8 Soil Update (tie in GW and CERCLA process)	Bill	None	Review Presentation	Informational	45 min
1325	Site 9 and 19 UFP-SAP	Bill	None	Review Presentation	Informational	45 min
1410	**Break**					10 min
1420	Site 22 ROD Update	Team	Frank F., Donna C., Katherine W., Steve H.	None	Discuss any comments/status update	60 min
1520	Site 33 UFP-SAP	Bill	None	Review Presentation	Informational	30 min
1550	**Break**					10 min
1600	Wrap Up and Check-in on Partnering Team Exercise	Team	None	Review and Actions	No spill over to next day	60 min
1700	Conclude First Day					

WPNSTA YORKTOWN PARTNERING MEETING FINAL AGENDA Wednesday August 15th, 2012						
Start Time	**Agenda Item**	**Leader**	**Support**	**Prep Work**	**Desired Outcome**	**Duration**
0830	Welcome & Check-in	Team	None	None	Standard Meeting Format	30 min
0900	Tier II Update	Bruce Beach	None	None	Standard Meeting Format	30 min
0930	Site 24 RI Update	Bill	Donna, Stephanie Bill K. and BTAG	Review Presentation	Comment Resolution	60 min
1030	**Break**					10 min
1040	Site 1 Summary	Bill	Herminio, BTAG, Kyle	Review Presentation	Informational	30 min
1110	Site 32 SI Update	Bill	BTAG, Kyle, Bill K.	Review Presentation	Informational	30 min
1140	**Lunch**					1 hour
1240	FYR	Adam	None	Review RTCs	Informational	30 min
1310	Site 3 Soils	Jim	None	Review Presentation	Informational	45 min
1355	UXO-3 PA Update	Adam	None	Review Presentation	Informational	30 min
1425	**Break**					10 min
1435	Review Outstanding Actions, SASR and Team Goals Update	Team	None	Review Action Items and SASR	Standard Meeting Format	1 hr
1535	**Break**					10 min
1545	Roundtable/Agenda Building/Next Meetings	Team	None	None	Next Meeting	45 min
1630	Facilitator Feedback/ Plus-Delta	Nancy	None	None	Standard Meeting Format	30 min
1700	Conclude Second Day					

From:	Moshood Oduwole
To:	Friedmann, William/VBO; wmsmith@deq.virginia.gov; james.gravette@navy.mil; Forshey, Adam/VBO; nvrouse@gmail.com
Subject:	Action item - Site 32 SI
Date:	Thursday, August 16, 2012 2:57:47 PM

All,

I confirmed with Bruce Pluta, BTAG. Coordinator. He doesn't have a problem with including a Step 3a in the SI Report for Site 32.

Moshood Oduwole
Remedial Project Manager
US EPA Region III
Hazardous Site Cleanup Division
NPL/BRAC Federal Facilities Branch (3HS11)
Tel: (215) 814-3362
Fax: (215) 814-5518
oduwole.moshood@epa.gov

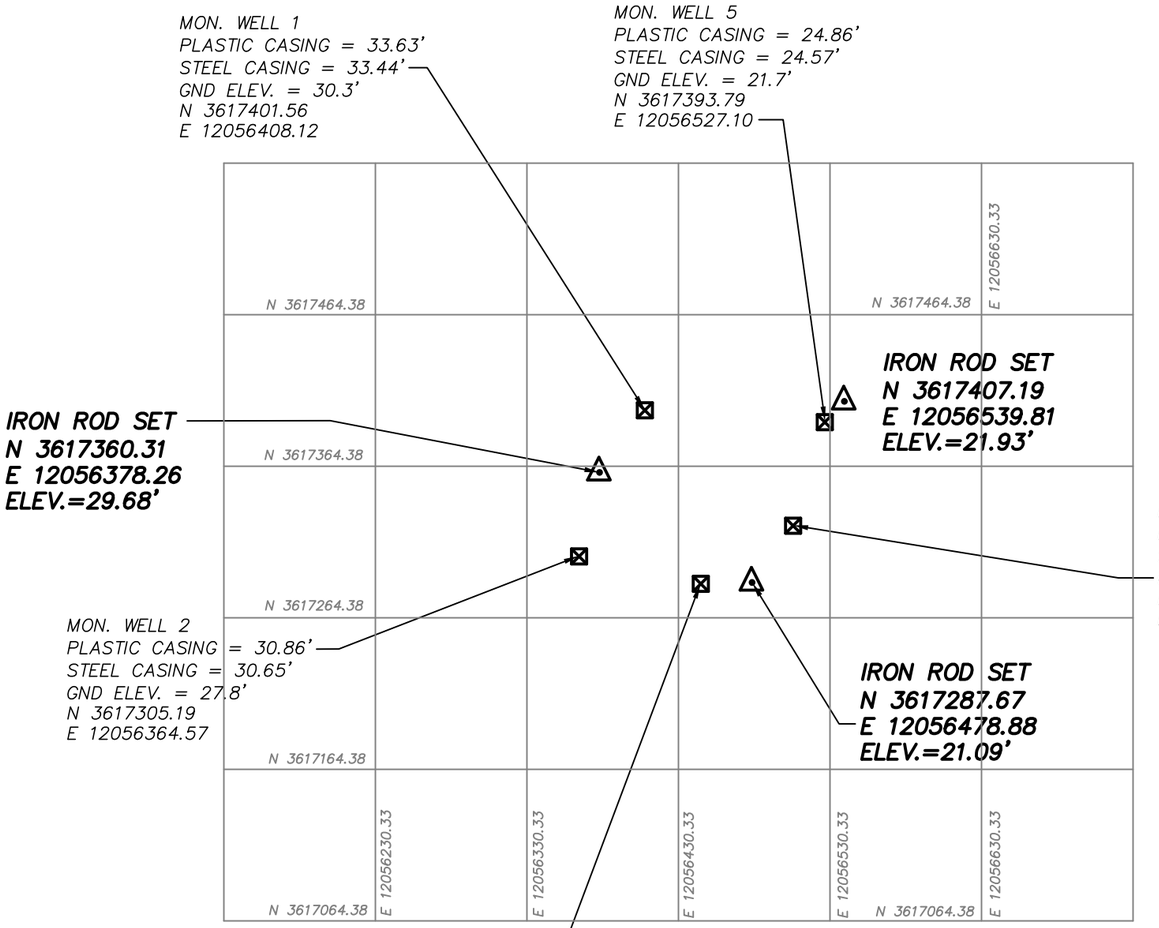
Appendix C
Survey Report

LOCATION OF NEW
MONITORING WELLS
AT SITE 32
NAVAL WEAPONS STATION YORKTOWN
FOR: CH2MHILL
PROJ. #12-103
SCALE: 1"=100' – DATE: JUNE 13, 2012

MICHAEL SURVEYING & MAPPING, P.C.
41 OLD OYSTER POINT ROAD
SUITE B
NEWPORT NEWS, VA. 23602
TEL 757.873.1762
FAX 757.873.1772

COMMONWEALTH OF VIRGINIA
6/13/12
PAUL W. MICHAEL, JR.
Lic NO. 002438
LAND SURVEYOR

SEE NOTE 1



△ DENOTES TRAVERSE CONTROL POINT

⊠ DENOTES MON. WELL

NOTES:

1. HORIZONTAL COORDINATES ARE REFERRED TO VIRGINIA STATE PLANE COORDINATE SYSTEM SOUTH ZONE NAD 83. ELEVATIONS REFER TO NAVD 88 DATUM. UNITS ARE IN U.S. SURVEY FEET.

2. THIS TOPOGRAPHIC SURVEY WAS COMPLETED UNDER THE DIRECT AND RESPONSIBLE CHARGE OF, PAUL W. MICHAEL, JR. FROM AND ACTUAL [X] GROUND OR AIRBORNE SURVEY MADE UNDER MY SUPERVISION; THAT THE IMAGERY AND/OR ORIGINAL DATA WAS OBTAINED IN JUNE, 2012 ; AND THAT THIS PLAT, MAP, OR DIGITAL GEOSPATIAL DATA INCLUDING METADATA MEETS MINIMUM ACCURACY STANDARDS UNLESS OTHERWISE NOTED.

Appendix D
Investigation-Derived Waste Data and Manifests

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
N/A	1	800-774-5562	

GENERATOR

5. Generator's Name and Mailing Address

NAVFAC Mid Atlantic/NWS Yorktown
Bldg N-26, Rm 3208, 9742 Maryland Ave., Norfolk, VA 23511
Generator's Phone: 757 341-0477 Attn: Jim Gravette

Generator's Site Address (if different than mailing address)

Naval Weapons Station Yorktown
Site 32
Yorktown, VA 23691

6. Transporter 1 Company Name: LCM Corp. — U.S. EPA ID Number: N/A

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

MMG Clearfield
416 Dominion Blvd. North
Facility's Phone: 757 549-8448 Chesapeake, VA 23320-6900 — N/A

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	RCRA, Nonhazardous, Non DOT regulated soil	9	DM	Est 4500	P	None
2.	RCRA, Nonhazardous, Non DOT regulated water	7	DM	Est 350	G	None
3.	RCRA, Nonhazardous, Non DOT regulated soil and water	5	DM	Est 250	P	None
4.						

13. Special Handling Instructions and Additional Information

1. soil Site 32
2. water Site 32
3. soil and water Site 32

CESI Job# ROAN-TFORT-2985-20888

14. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name — Signature — Month — Day — Year

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: J Scott Wood — Signature — Month: 05 — Day: 27 — Year: 2011

Transporter 2 Printed/Typed Name — Signature — Month — Day — Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month — Day — Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name — Signature — Month — Day — Year

169-BLS-C 6 10497 (Rev. 8/06)

COPY

SOILEX

Material Characterization Form

Applicant Information

Company Name: Capitol Environmental Services, Inc
Address: 200 Biddle Ave., Suite 205
City / State / Zip: Newark, DE 19702
Contact: Terri Fort
Phone: 540-777-6547
Fax: 540-904-4788
e-mail: terri.fort@capitol-environmental.com

Generator Information

Company Name: NAVFAC MidAtlantic/NWS Yorktown
Address: Bldg N-26, Rm 3208, 9742 Maryland Ave
City / State / Zip: Norfolk, VA 23511
Contact: Jim Gravette
Phone: 757-341-0477
Fax:
e-mail: james.gravette@navy.mil

Project Description

Site Name: Naval Weapons Station Yorktown (Site 32)
Site Address: Yorktown, VA 23691
Source of Contamination: unknown source, passed TCLP with no detections
Waste Generating Activity: subsurface investigation to determine if soil is contaminated with metals.VOAs,SVOA

Waste Description

Applicant must complete the following information and attach all laboratory analyses utilized to characterize the material as non-hazardous and acceptable for receipt by Soilex Corporation.

General Description: soil

Matrix *(Check one)*: ☑ Soil ☐ Sludge ☐ Other (Please Describe)

Petroleum Type: *(Check all that apply)* ☐ Non-Virgin ☐ Gasoline ☐ Used Oil ☐ Diesel / Heating Oil ☐ Other (Please Describe) N/A

Estimated Volume: 9 ☐ Tons ☐ Cubic Yards ☑ Drums ☐ Gallons

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed M*aterial Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

James V. Gravette 5/8/12
Generator Signature / Date

James Gravette
Generator Printed Name

For Facility Use Only

Approved By:
Approval Code:
Approval Date:
Comments:

SOILEX

Material Characterization Form

Applicant Information

Company Name: Capitol Environmental Services, Inc
Address: 200 Biddle Ave., Suite 205
City / State / Zip: Newark, DE 19702
Contact: Terri Fort
Phone: 540-777-6547
Fax: 540-904-4788
e-mail: terri.fort@capitol-environmental.com

Generator Information

Company Name: NAVFAC MidAtlantic/NWS Yorktown
Address: Bldg N-26, Rm 3208, 9742 Maryland Ave
City / State / Zip: Norfolk, VA 23511
Contact: James Gravette
Phone: 757-341-0477
Fax:
e-mail: james.gravette@navy.mil

Project Description

Site Name: Naval Weapons Station Yorktown (Site 32)
Site Address: Yorktown, VA 23691
Source of Contamination: unknown source, passed TCLP with no detections
Waste Generating Activity: subsurface investigation to determine if water is contaminated with metals.VOAs,SVOA

Waste Description

Applicant must complete the following information and attach all laboratory analyses utilized to characterize the material as non-hazardous and acceptable for receipt by Soilex Corporation.

General Description: water

Matrix *(Check one)*: ☐ Soil ☐ Sludge ☑ Other (Please Describe) Water

Petroleum Type: ☐ Non-Virgin ☐ Gasoline ☐ Used Oil ☐ Diesel / Heating Oil
(Check all that apply)
☐ Other (Please Describe) N/A

Estimated Volume: 7 ☐ Tons ☐ Cubic Yards ☑ Drums ☐ Gallons

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed *Material Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

Jan V. Gravette 5/8/12
Generator Signature / Date

James Gravette
Generator Printed Name

For Facility Use Only

Approved By: _____ Approval Code: _____
Approval Date: _____ Comments: _____

SOILEX

Material Characterization Form

Applicant Information

Company Name: Capitol Environmental Services, Inc
Address: 200 Biddle Ave., Suite 205
City / State / Zip: Newark, DE 19702
Contact: Terri Fort
Phone: 540-777-6547
Fax: 540-904-4788
e-mail: terri.fort@capitol-environmental.com

Generator Information

Company Name: NAVFAC MidAtlantic/NWS Yorktown
Address: Bldg N-26, Rm 3208, 9742 Maryland Ave
City / State / Zip: Norfolk, VA 23511
Contact: Jim Gravette
Phone: 757-341-0477
Fax:
e-mail: james.gravette@navy.mil

Project Description

Site Name: Naval Weapons Station Yorktown (Site 32)
Site Address: Yorktown, VA 23691
Source of Contamination: unknown source, passed TCLP with no detections
Waste Generating Activity: subsurface investigation to determine if soil is contaminated with metals.VOAs,SVOA

Waste Description

Applicant must complete the following information and attach all laboratory analyses utilized to characterize the material as non-hazardous and acceptable for receipt by Soilex Corporation.

General Description: soil with water added to flood fire ants

Matrix *(Check one)*: ☐ Soil ☐ Sludge ☑ Other (Please Describe) Soil and water

Petroleum Type: *(Check all that apply)* ☐ Non-Virgin ☐ Gasoline ☐ Used Oil ☐ Diesel / Heating Oil ☐ Other (Please Describe) N/A

Estimated Volume: 5 ☐ Tons ☐ Cubic Yards ☑ Drums ☐ Gallons

Generator Certification

I hereby certify, based upon my diligent inquiry into the activities and processes generating the waste described on this form, that these materials are not classified as listed or characteristic hazardous waste as regulated by the Commonwealth of Virginia or the state of origin of this waste; that the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's); that the analytical results, completed *Material Characterization Form* and attached documentation are a representative, true, and accurate description of these materials; that no deliberate or willful omissions have been made in the preparation of this form; and that all known or suspect hazards have been disclosed herein. I further acknowledge that I am aware it is the duty of all persons to dispose of their solid waste in a legal manner (Va.Code ' 10.1-1418.1.A).

Jan N. Gravette 5/8/12
Generator Signature / Date

James Gravette
Generator Printed Name

For Facility Use Only

Approved By: _____ Approval Code: _____
Approval Date: _____ Comments: _____

CTO-WE29
Yorktown - Site 32
Unvalidated Aqueous IDW Detected Analytical Results
March 2012

Sample ID	YS32-IW030812
Sample Date	3/8/12
Chemical Name	
TCLP Volatile Organic Compounds (MG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (MG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (MG/L)	
No Detections	
TCLP Herbicides (MG/L)	
No Detections	
TCLP Metals (MG/L)	
No Detections	
Wet Chemistry (PH)	
pH	7.6
Ignitability (DEG/F)	
No Detections	

\\ariadne\Proj\CLEANII\BASES\Yorktown\Site 32 (SSA 25)\SI report\pre-draft\Appendix\Appendix C - IDW\[CTO-WE29_Site32_AQ-IDW_UnVAL_TBL.xlsx], Troy Horn, 04/25/2012

Notes:

D - Dilution result
DEG/F - Degrees Fahrenheit
MG/L - Milligrams per liter
NS - Not sampled
PH - pH units
U - The material was analyzed for, but not detected
UG/L - Micrograms per liter
UJ - Analyte not detected, quantitation limit may be inaccurate
Shading indicates detection

CTO-WE29
Yorktown - Site 32
Unvalidated Solid IDW Detected Analytical Results
March 2012

Sample ID	YS32-IS030812
Sample Date	3/8/12
Chemical Name	
TCLP Volatile Organic Compounds (MG/L)	
No Detections	
TCLP Semivolatile Organic Compounds (MG/L)	
No Detections	
TCLP Pesticides/Polychlorinated Biphenyls (MG/L)	
No Detections	
TCLP Herbicides (MG/L)	
No Detections	
TCLP Metals (MG/L)	
No Detections	
Wet Chemistry (PH)	
pH	7.6
Ignitability (UNKNOWN)	
No Detections	

\\ariadne\Proj\CLEANII\BASES\Yorktown\Site 32 (SSA 25)\SI report\pre-draft\Appendix\Appendix C - IDW\[CTO-WE29_Site32_SolidIDW_UnVAL_TBL.xlsx], Troy Horn, 04/25/2012

Notes:

D - Dilution result
MG/KG - Milligrams per kilogram
MG/L - Milligrams per liter
PH - pH units
U - The material was analyzed for, but not detected
UG/KG - Micrograms per kilogram
UJ - Analyte not detected, quantitation limit may be inaccurate
UNKNOWN - Unknown units
Shading indicates detection

Transportation and Disposal Log

Location NWS YORKTOWN
Site 32

Task Description
Staging Location(s)

Project Number

(Sub)Contractor Parratt Wolff

Container ID													
Boring/Well Number	MW-01 top 10'	MW-01	decon pad water	MW-03 top 10'	90% MW-03 10% MW-04	MW-04 top 10'	MW04	25% MW-01 75% MW-05	MW05	SB07 & MW05 top 10'	MW02 top 10'	MW02/ MW03	MW-02
Container Type	1- 55 gall drum	2- 55 gall drums	4- 55 gall drums	1- 55 gall drum	1- 55 gall drum	1- 55 gall drum	1- 55 gall drum	1-55 gall drum	1-55 gall drum	1-55 gall drum	1-55 gall drum	1-55 gall drum	2- 55 gall drum
Waste Profile No													
Accumulation Start Date	3/5/12	3/5/12	3/6/12(2) 3/7/12(2)	3/7/12	3/7/12	3/6/12	3/6/12	3/6/12	3/6/12	3/6/12	3/7/12	3/7/12	3/7/12
Date Transported to Staging Location WRIGHT CIRCLE	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12	3/8/12
Comments/Notes	flooded for fire ants		3/6/12 drums shed decon H2O for MW02, MW05 & MW04	flooded for fire ants		flooded for fire ants				flooded for fire ants. Soil sample at SB07 to ~16' included	flooded for fire ants		

Kimberly Site all drums picked up and Waste @ 13:00 on 5/23/12

Note: All waste should be included on the Waste Tracking Log from the moment of generation.

Transportation and Disposal Log

Location NWS Yorktown
Site 32
Task Description MW Inistallation
Staging Location(s) Wright Circle

Project Number

(Sub)Contractor Parratt Wolff

Container ID				
Boring/Well Number	**MW-01**	**MW-05, MW-04, MW-03 & all MW purge water from GW Sampling on 5/17/12**	**MW-03, MW02**	
Container Type	55 gallon drum	55 gallon drum	55 gallon drum	
Waste Profile No				
Accumulation Start Date	3/8/2012	3/8/2012	3/8/2012	
Date Transported to Staging Location	3/8/2012	3/8/2012	3/8/2012	
Comments/Notes				

all drums removed from NWS
5/23/12 @ 1300
Kimberly Clark

Note: All waste should be included on the Waste Tracking Log from the moment of generation.

Appendix E
Laboratory Analytical Results

CTO WE29

Yorktown Site 32

Validated Surface Soil Analytical Results

Station ID	YS32-GW01	YS32-GW02	YS32-GW03	YS32-GW04		YS32-GW05	YS32-SO06	YS32-SO07
Sample ID	YS32-SS01-0312	YS32-SS02-0312	YS32-SS03-0312	YS32-SS04-0312	YS32-SS04P-0312	YS32-SS05-0312	YS32-SS06-0312	YS32-SS07-0312
Sample Date	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name								
Total Metals (mg/kg)								
Cadmium	0.372 J	7.34 U	0.393 J	0.245 J	0.161 J	0.319 J	6.95 U	0.272 J
Mercury	0.026	0.0227	0.244	0.0393	0.0425	0.0534	0.0335	0.0441
Silver	0.156 U	0.0979 J	0.185 J	0.155 U	0.155 U	0.198 J	0.151 U	0.156 U

\\ariadne\Proj\CLEANII\BASES\Yorktown\Site 32 (SSA 25)\SI report\pre-draft\Appendix\Appendix D - Analytical Data\[Validated surface soil data.xlsx], Hillary Ott, 07/24/2012

Notes:

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

mg/kg - Milligrams per kilogram

CTO WE29
Yorktown Site 32
Validated Subsurface Soil Analytical Results

Station ID	YS32-GW01	YS32-GW02	YS32-GW03	YS32-GW04		YS32-GW05	YS32-SO06	YS32-SO07	
Sample ID	YS32-SB01-06-24-0312	YS32-SB02-06-24-0312	YS32-SB03-06-24-0312	YS32-SB04-06-24-0312	YS32-SB04P-06-24-0312	YS32-SB05-06-24-0312	YS32-SB06-06-24-0312	YS32-SB07-06-24-0312	YS32-SB07-15-17-0312
Sample Date	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/01/12	03/06/12
Chemical Name									
Total Metals (mg/kg)									
Cadmium	0.595 J	0.189 J	6.84 U	0.445 J	0.284 J	0.746 J	6.49 U	0.447 J	0.332 J
Mercury	0.0328	0.05	0.0347	0.0953	0.0946	0.125	0.0128 J	0.251	0.00729 U
Silver	0.168 U	0.0727 J	0.148 U	0.951	1.15	0.834	0.141 U	0.601	0.166 U

\\ariadne\Proj\CLEANII\BASES\Yorktown\Site 32 (SSA 25)\SI report\pre-draft\Appendix\Appendix D - Analytical Data\[Validated subsurface soil data.xlsx], Hillary Ott, 07/24/2012

Notes:

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

mg/kg - Milligrams per kilogram

CTO WE29
Yorktown Site 32
Validated Composite Surface and Subsurface Soil Analytical Results

Station ID	YS32-SO08			
Sample ID	YS32-SS08-0312	YS32-SS08P-0312	YS32-SB08-06-24-0312	YS32-SB08P-06-24-0312
Sample Date	03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name				
Volatile Organic Compounds (µg/kg)				
1,1,1-Trichloroethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,1,2,2-Tetrachloroethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	1.2 UJ	1.1 U	1.1 U	1 U
1,1,2-Trichloroethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,1-Dichloroethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,1-Dichloroethene	1.2 U	1.1 U	1.1 U	1 U
1,2,4-Trichlorobenzene	1.2 UJ	1.1 U	1.1 UJ	1 U
1,2-Dibromo-3-chloropropane	1.2 UJ	1.1 U	1.1 U	1 U
1,2-Dibromoethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,2-Dichlorobenzene	1.2 UJ	1.1 U	1.1 UJ	1 U
1,2-Dichloroethane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,2-Dichloropropane	1.2 UJ	1.1 U	1.1 UJ	1 U
1,3-Dichlorobenzene	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
1,4-Dichlorobenzene	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
2-Butanone	2.9 U	2.7 U	2.8 U	2.5 U
2-Hexanone	2.9 U	2.7 U	2.8 U	2.5 U
4-Methyl-2-pentanone	2.9 UJ	2.7 UJ	2.8 UJ	2.5 UJ
Acetone	15 U	13 U	14 U	13 U
Benzene	1.2 UJ	1.1 U	1.1 UJ	1 U
Bromodichloromethane	1.2 UJ	1.1 U	1.1 UJ	1 U
Bromoform	1.2 UJ	1.1 U	1.1 UJ	1 U
Bromomethane	1.2 U	1.1 U	1.1 U	1 U
Carbon disulfide	5.8 U	5.4 U	5.6 U	5 U
Carbon tetrachloride	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
Chlorobenzene	1.2 UJ	1.1 U	1.1 UJ	1 U
Chloroethane	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
Chloroform	1.2 UJ	1.1 U	1.1 UJ	1 U
Chloromethane	1.2 U	1.1 U	1.1 U	1 U
cis-1,2-Dichloroethene	1.2 UJ	1.1 U	1.1 UJ	1 U
cis-1,3-Dichloropropene	1.2 UJ	1.1 U	1.1 UJ	1 U
Cyclohexane	1.2 UJ	1.1 U	1.1 U	1 U
Dibromochloromethane	1.2 UJ	1.1 U	1.1 UJ	1 U
Dichlorodifluoromethane (Freon-12)	1.2 UJ	1.1 U	1.1 U	1 U
Ethylbenzene	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
Isopropylbenzene	1.2 UJ	1.1 U	1.1 UJ	1 U
m- and p-Xylene	2.3 UJ	2.2 U	2.2 UJ	2 U
Methyl acetate	5.8 U	5.4 U	5.6 U	5 U
Methylcyclohexane	1.2 UJ	1.1 U	1.1 UJ	1 U
Methylene chloride	5.8 U	5.4 U	5.6 UJ	5 U
Methyl-tert-butyl ether (MTBE)	1.2 U	1.1 U	1.1 U	1 U
o-Xylene	1.2 UJ	1.1 U	1.1 UJ	1 U
Styrene	1.2 UJ	1.1 U	1.1 UJ	1 U
Tetrachloroethene	1.2 UJ	1.1 U	1.1 UJ	1 U
Toluene	1.2 UJ	1.1 U	1.1 UJ	1 U
trans-1,2-Dichloroethene	1.2 UJ	1.1 U	1.1 UJ	1 U
trans-1,3-Dichloropropene	1.2 UJ	1.1 U	1.1 UJ	1 U
Trichloroethene	1.2 UJ	1.1 U	1.1 UJ	1 U
Trichlorofluoromethane (Freon-11)	1.2 UJ	1.1 UJ	1.1 UJ	1 UJ
Vinyl chloride	1.2 U	1.1 U	1.1 U	1 U
Semivolatile Organic Compounds (µg/kg)				
1,1-Biphenyl	120 U	120 U	110 U	120 U
2,4,5-Trichlorophenol	120 U	120 U	110 U	120 U
2,4,6-Trichlorophenol	120 U	120 U	110 U	120 U
2,4-Dichlorophenol	120 U	120 U	110 U	120 U
2,4-Dimethylphenol	120 U	120 U	110 U	120 U
2,4-Dinitrophenol	350 U	360 U	340 U	350 U
2,4-Dinitrotoluene	120 U	120 U	110 U	120 U
2,6-Dinitrotoluene	120 U	120 U	110 U	120 U
2-Chloronaphthalene	120 U	120 U	110 U	120 U
2-Chlorophenol	120 U	120 U	110 U	120 U
2-Methylnaphthalene	29 UJ	30 U	28 U	29 U

CTO WE29
Yorktown Site 32
Validated Composite Surface and Subsurface Soil Analytical Results

Station ID	YS32-SO08			
Sample ID	YS32-SS08-0312	YS32-SS08P-0312	YS32-SB08-06-24-0312	YS32-SB08P-06-24-0312
Sample Date	03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name				
2-Methylphenol	120 U	120 U	110 U	120 U
2-Nitroaniline	120 U	120 U	110 U	120 U
2-Nitrophenol	120 U	120 U	110 U	120 U
3- and 4-Methylphenol	230 U	240 U	220 U	230 U
3,3'-Dichlorobenzidine	120 U	120 U	110 U	120 U
3-Nitroaniline	120 U	120 U	110 U	120 U
4,6-Dinitro-2-methylphenol	350 U	360 U	340 U	350 U
4-Bromophenyl-phenylether	120 U	120 U	110 U	120 U
4-Chloro-3-methylphenol	120 U	120 U	110 U	120 U
4-Chloroaniline	120 U	120 U	110 U	120 U
4-Chlorophenyl-phenylether	120 U	120 U	110 U	120 U
4-Nitroaniline	120 U	120 U	110 U	120 U
4-Nitrophenol	120 U	120 U	110 U	120 U
Acenaphthene	29 UJ	30 U	28 U	29 U
Acenaphthylene	29 U	30 U	28 U	29 U
Acetophenone	120 U	120 U	110 U	120 U
Anthracene	29 U	30 U	28 U	29 U
Atrazine	120 U	120 U	110 U	120 U
Benzaldehyde	120 U	120 U	110 U	120 U
Benzo(a)anthracene	29 U	30 U	27 J	28 J
Benzo(a)pyrene	29 U	30 U	11 J	13 J
Benzo(b)fluoranthene	29 U	30 U	21 J	24 J
Benzo(g,h,i)perylene	29 U	30 U	28 U	29 U
Benzo(k)fluoranthene	29 U	30 U	28 U	29 U
bis(2-Chloroethoxy)methane	120 U	120 U	110 U	120 U
bis(2-Chloroethyl)ether	120 U	120 U	110 U	120 U
bis(2-Chloroisopropyl)ether	120 U	120 U	110 U	120 U
bis(2-Ethylhexyl)phthalate	120 U	120 U	110 U	120 U
Butylbenzylphthalate	120 U	120 U	110 U	120 U
Caprolactam	230 U	240 U	220 U	230 U
Carbazole	120 U	120 U	110 U	120 U
Chrysene	29 U	30 U	14 J	17 J
Dibenz(a,h)anthracene	29 U	30 U	28 U	29 U
Dibenzofuran	120 U	120 U	110 U	120 U
Diethylphthalate	120 U	120 U	110 U	120 U
Dimethyl phthalate	120 U	120 U	110 U	120 U
Di-n-butylphthalate	120 U	120 U	110 U	120 U
Di-n-octylphthalate	120 U	120 U	110 U	120 U
Fluoranthene	29 U	30 U	33 J	36 J
Fluorene	29 U	30 U	28 U	29 U
Hexachlorobenzene	120 U	120 U	110 U	120 U
Hexachlorobutadiene	120 U	120 U	110 U	120 U
Hexachlorocyclopentadiene	120 U	120 U	110 U	120 U
Hexachloroethane	120 U	120 U	110 U	120 U
Indeno(1,2,3-cd)pyrene	29 U	30 U	28 U	29 U
Isophorone	120 U	120 U	110 U	120 U
Naphthalene	29 U	30 U	28 U	29 U
n-Nitroso-di-n-propylamine	120 U	120 U	110 U	120 U
n-Nitrosodiphenylamine	230 U	240 U	220 U	230 U
Nitrobenzene	120 U	120 U	110 U	120 U
Pentachlorophenol	350 U	360 U	340 U	350 U
Phenanthrene	29 U	30 U	28 U	29 U
Phenol	120 U	120 U	110 U	120 U
Pyrene	29 U	30 U	29 J	38

CTO WE29

Yorktown Site 32

Validated Composite Surface and Subsurface Soil Analytical Results

Station ID	YS32-SO08			
Sample ID	YS32-SS08-0312	YS32-SS08P-0312	YS32-SB08-06-24-0312	YS32-SB08P-06-24-0312
Sample Date	03/01/12	03/01/12	03/01/12	03/01/12
Chemical Name				
Pesticide/Polychlorinated Biphenyls (µg/kg)				
4,4'-DDD	0.77 J	1.2 J	8.6 J	44 J
4,4'-DDE	6.2 J	11 J	51 J	63 J
4,4'-DDT	2.3 J	2.8 J	15 J	36 J
Aldrin	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
alpha-BHC	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
alpha-Chlordane	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Aroclor-1016	23 U	24 U	22 U	23 U
Aroclor-1221	23 U	24 U	22 U	23 U
Aroclor-1232	23 U	24 U	22 U	23 U
Aroclor-1242	23 U	24 U	22 U	23 U
Aroclor-1248	23 U	24 U	22 U	23 U
Aroclor-1254	23 U	24 U	22 U	23 U
Aroclor-1260	12 U	12 U	11 U	12 U
Aroclor-1268	23 U	12 J	920 J	270 J
beta-BHC	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
delta-BHC	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Dieldrin	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endosulfan I	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endosulfan II	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endosulfan sulfate	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endrin	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endrin aldehyde	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Endrin ketone	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
gamma-BHC (Lindane)	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
gamma-Chlordane	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Heptachlor	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Heptachlor epoxide	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Methoxychlor	1.2 U	1.2 UJ	1.1 UJ	1.2 UJ
Toxaphene	23 U	24 UJ	22 UJ	23 UJ
Total Metals (mg/kg)				
Aluminum	6,290 J	10,300 J	5,840	5,660
Antimony	0.935 UJ	0.948 U	0.897 UJ	0.922 U
Arsenic	2.61 J	3.8 J	2.5 J	3.22 J
Barium	43.5 J	86.8 J	28.1	28.7
Beryllium	0.416 J	0.83 J	0.549 J	0.415 J
Cadmium	0.35 J	0.321 J	0.292 J	0.154 J
Calcium	2,140	2,010	5,440 J	8,740 J
Chromium	10.1 J	16	21.8 J	9.87 J
Cobalt	2.66 J	6.59 J	4.11	3.07
Copper	4.88 J	11.4 J	5.8	7.41
Iron	10,100 J	22,100 J	15,500	13,600
Lead	18.4	16.1	14.5	18.5
Magnesium	751 J	1,040 J	1,670 J	557 J
Manganese	82.6 J	187 J	125 J	79.5 J
Mercury	0.0392	0.0318	0.0424	0.0449
Nickel	4.31 J	8.51 J	7.77 J	4.38 J
Potassium	452 J	622 J	583 J	466 J
Selenium	4.21 U	4.26 U	4.04 U	4.15 U
Silver	0.0442 J	0.0917 J	0.0654 J	0.384 J
Sodium	210 U	213 U	62.1 J	75.2 J
Thallium	0.0755 J	0.157 J	0.0529 J	0.0607 J
Vanadium	15.2 J	29.6 J	17.5	14.6
Zinc	23.4 J	40.4 J	39	29.2

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Notes:

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

CTO WE29
Yorktown Site 32
Validated Groundwater Analytical Results

Sample ID	YS32-GW01-0512	YS32-GW02-0512	YS32-GW03-0512	YS32-GW04-0512	YS32-GW04P-0512	YS32-GW05-0512
Sample Date	5/17/12	5/17/12	5/17/12	5/17/12	5/17/12	5/17/12
Chemical Name						
Total Metals (UG/L)						
Cadmium	4 U	4 U	4 U	4 U	4 U	4 U
Mercury	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Silver	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Dissolved Metals (UG/L)						
Cadmium	4 U	4 U	4 U	4 U	4 U	4 U
Mercury	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Silver	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U

\\ariadne\Proj\CLEANII\BASES\Yorktown\Site 32 (SSA 25)\SI report\pre-draft\Appendix\Appendix D - Analytical Data\[Validated groundwater data.XLSX], Hillary Ott, 07/18/2012

Notes:

NS - Not sampled

U - The material was analyzed for, but not detected

UG/L - Micrograms per liter

Appendix F
Data Validation Reports

Data Validation Summary

Yorktown, WE29 Site 32

TO: Clairette Campbell/VBO
Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: July 13, 2012

Introduction

The following data validation report discusses the data validation process and findings for ENCO Labs for SDG CH029-014.

Samples were analyzed using the following analytical methods:

- SW6020A Metals
- SW7470A/SW7471B Mercury
- SW8260B Volatiles
- SW8270D Semivolatiles
- SW8270D_SIM Semivolatiles
- SW8081B Pesticides
- SW8082A PCBs-Aroclors

The samples included in this SDG are listed in the table below.

Sample Name	Matrix
YS32-SS08-0312	Soil
YS32-SS08P-0312	Soil
YS32-SB08-06-24-0312	Soil
YS32-SB08P-06-24-0312	Soil
YS32-TB030112	Water

Sample Name	Matrix
YS32-SS01-0312	Soil
YS32-SS02-0312	Soil
YS32-SS03-0312	Soil
YS32-SS04-0312	Soil
YS32-SS05-0312	Soil
YS32-SS06-0312	Soil
YS32-SS07-0312	Soil
YS32-SS04P-0312	Soil
YS32-SB01-06-24-0312	Soil
YS32-SB02-06-24-0312	Soil
YS32-SB03-06-24-0312	Soil
YS32-SB04-06-24-0312	Soil
YS32-SB05-06-24-0312	Soil
YS32-SB06-06-24-0312	Soil
YS32-SB07-06-24-0312	Soil
YS32-SB04P-06-24-0312	Soil
YS32-EB030112	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Site 32, Sewage Treatment Plant #2 Sludge Drying Bed Site Investigation Naval Weapons Station Yorktown, Virginia (January 2012), Region III Modifications for Organic Data Review (EPA 1994), and Region III Modifications for Inorganic Data Review (EPA 1993), as applicable:

- Data Completeness
- Technical Holding Times
- Instrument Tuning
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Matrix Spike Recoveries
- Field Duplicates
- Serial Dilution

- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDGs were received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 3/1/12. Samples were received at the laboratory on 3/2/12. All sample preparation analysis was performed within holding time requirements.

Matrix Spike/Spike Duplicate

Several compounds in methods SW6020A, SW8260B, SW8081B, and SW8270D_SIM exhibited low recoveries in the MS for spiked samples YS32-SS08-0312 and YS32-SB08-06-24-0312. 1,2-Dibromo-3-chloropropane did not meet RPD criteria between the MS and MSD for spiked sample YS32-SS08-0312. Affected data are summarized in **Attachment 1**.

Surrogates

Surrogates for samples YS32-SB08-06-24-0312 and YS32-SB08P-06-24-0312, and YS32-SS08P-0312 exceeded criteria for methods SW8082A and SW8081B. Affected data are summarized in **Attachment 1**.

Field Duplicate Precision

Several compounds for the native and field duplicates listed below did not meet precision criteria in methods SW8081B and SW6020A. Affected data are summarized in **Attachment 1.**

Sample ID
YS32-SS08P-0312
YS32-SS08-0312
YS32-SB08-06-24-0312
YS32-SB08P-06-24-0312

Column Confirmation

Several compounds did not meet column confirmation criteria in methods SW8081B and SW8082A for samples YS32-SS08P-0312 and YS32-SB08-06-24-0312. Affected data are summarized in **Attachment 1**.

Calibration

2-Butanone and 4-methyl-2-pentanone did not meet initial calibration criteria for several samples. Various compounds in method SW8260B exhibited low recoveries in the continuing calibration for several samples. Affected data are summarized in **Attachment 1**.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,

Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation

Value	Description
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Data Validation Summary

Yorktown, WE29 Site 32

TO: Clairette Campbell/VBO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: July 13, 2012

Introduction

The following data validation report discusses the data validation process and findings for ENCO Labs for SDG CH029-015.

Samples were analyzed using the following analytical methods:

- SW6020A Metals
- SW7470A Mercury

The samples included in this SDG are listed in the table below.

Sample Name	Matrix
YS32-SB07-15-17-0312	Soil
YS32-EB030612	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Site 32, Sewage Treatment Plant #2 Sludge Drying Bed Site Investigation Naval Weapons Station Yorktown, Virginia (January 2012) and Region III Modifications for Inorganic Data Review (EPA 1993), as applicable:

- Data Completeness
- Technical Holding Times
- Instrument Tuning
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Matrix Spike Recoveries
- Field Duplicates
- Serial Dilution
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDGs were received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 3/6/12. Samples were received at the laboratory on 3/7/12. All sample preparation analysis was performed within holding time requirements.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,

Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation

Value	Description
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Data Validation Summary

Yorktown, WE29 Site 32

TO: Clairette Campbell/VBO

Anita Dodson/VBO

FROM: Tiffany McGlynn/GNV

CC: Herb Kelly/GNV

DATE: July 13, 2012

Introduction

The following data validation report discusses the data validation process and findings for ENCO Labs for SDG CH029-022.

Samples were analyzed using the following analytical methods:

- SW6020A Metals
- SW7470A Mercury

The samples included in this SDG are listed in the table below.

Sample Name	Matrix
YS32-GW01-0512	Water
YS32-GW02-0512	Water
YS32-GW03-0512	Water
YS32-GW04-0512	Water
YS32-GW04P-0512	Water
YS32-GW05-0512	Water
YS32-EB01-051712-GW	Water

Data Evaluation

Data was evaluated in accordance with the analytical methods and with the criteria found in the following guidance documents: Sampling and Analysis Plan (Field Sampling Plan and

Quality Assurance Project Plan) Site 32, Sewage Treatment Plant #2 Sludge Drying Bed Site Investigation Naval Weapons Station Yorktown, Virginia (January 2012) and Region III Modifications for Inorganic Data Review (EPA 1993), as applicable:

- Data Completeness
- Technical Holding Times
- Instrument Tuning
- Initial/Continuing Calibrations
- Blanks
- Internal Standards
- Laboratory Control Samples
- Matrix Spike Recoveries
- Field Duplicates
- Serial Dilution
- Identification/Quantitation
- Reporting Limits

Overall Evaluation of Data/Potential Usability Issues

Specific details regarding qualification of the data are addressed in the sections below. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte, the validator has chosen the qualifier that best indicates possible bias in the results and qualified these data accordingly.

Data Completeness

The SDGs were received complete and intact.

Technical Holding Times

According to the chain of custody records, sampling was performed on 5/17/12. Samples were received at the laboratory on 5/18/12. All sample preparation analysis was performed within holding time requirements.

Conclusion

These data can be used in the project decision-making process as qualified by the data quality evaluation process.

Please do not hesitate to contact us about this validation report.

Sincerely,

Tiffany McGlynn

Qualification Flags

Exclude	More appropriate data exist for this analyte.
R	Data were rejected for use.
UL	Analyte not detected, quantitation limit is potentially biased low.
UJ	Analyte not detected, estimated quantitation limit.
U	Analyte not detected.
B	Not detected substantially above the level reported in laboratory or field blanks.
L	Analyte present, estimated value potentially biased low.
K	Analyte present, estimated value potentially biased high.
N	Analyte identification presumptive; no second column analysis performed or GC/MS tentative identification.
J	Analyte present, estimated value.
NJ	Analysis indicates the presence of an analyte that was "tentatively identified" and the associated value represents its approximate concentration.
None	Placeholder for calculating quality control issues that do not require flagging.
=	Analyte was detected at a concentration greater than the quantitation limit.

Qualifier Code Reference

Value	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other
PD	Pesticide Degradation

Value	Description
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Yorktown WE29 Site 32
Attachment 1 Change Qual. Table
SDG CH029-014

Sample ID	Compound	Q Flag	Qual Code
YS32-SS08-0312	Antimony	UJ	MSL
YS32-SS08-0312	Barium	J	FD
YS32-SS08-0312	Cobalt	J	FD
YS32-SS08-0312	Copper	J	FD
YS32-SS08-0312	Magnesium	J	FD
YS32-SS08-0312	Manganese	J	FD
YS32-SS08-0312	Nickel	J	FD
YS32-SS08-0312	Vanadium	J	FD
YS32-SS08-0312	Zinc	J	FD
YS32-SS08-0312	4,4'-DDE	J	FD
YS32-SS08-0312	4,4'-DDT	J	2C
YS32-SS08-0312	Dichlorodifluoromethane (Freon-12)	UJ	MSL
YS32-SS08-0312	Chloroethane	UJ	CCL
YS32-SS08-0312	Trichlorofluoromethane (Freon-11)	UJ	CCL
YS32-SS08-0312	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UJ	MSL
YS32-SS08-0312	trans-1,2-Dichloroethene	UJ	MSL
YS32-SS08-0312	cis-1,2-Dichloroethene	UJ	MSL
YS32-SS08-0312	1,1-Dichloroethane	UJ	MSL
YS32-SS08-0312	Chloroform	UJ	MSL
YS32-SS08-0312	1,1,1-Trichloroethane	UJ	MSL
YS32-SS08-0312	Cyclohexane	UJ	MSL
YS32-SS08-0312	Methylcyclohexane	UJ	MSL
YS32-SS08-0312	Carbon tetrachloride	UJ	CCL
YS32-SS08-0312	1,2-Dichloroethane	UJ	MSL
YS32-SS08-0312	Benzene	UJ	MSL
YS32-SS08-0312	Trichloroethene	UJ	MSL
YS32-SS08-0312	1,2-Dichloropropane	UJ	MSL
YS32-SS08-0312	Bromodichloromethane	UJ	MSL
YS32-SS08-0312	4-Methyl-2-pentanone	UJ	ICL
YS32-SS08-0312	cis-1,3-Dichloropropene	UJ	MSL
YS32-SS08-0312	Toluene	UJ	MSL
YS32-SS08-0312	trans-1,3-Dichloropropene	UJ	MSL
YS32-SS08-0312	1,1,2-Trichloroethane	UJ	MSL
YS32-SS08-0312	Tetrachloroethene	UJ	MSL
YS32-SS08-0312	Dibromochloromethane	UJ	MSL
YS32-SS08-0312	1,2-Dibromoethane	UJ	MSL
YS32-SS08-0312	Chlorobenzene	UJ	MSL
YS32-SS08-0312	Ethylbenzene	UJ	CCL
YS32-SS08-0312	m- and p-Xylene	UJ	MSL
YS32-SS08-0312	o-Xylene	UJ	MSL
YS32-SS08-0312	Bromoform	UJ	MSL
YS32-SS08-0312	Styrene	UJ	MSL
YS32-SS08-0312	Isopropylbenzene	UJ	MSL

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Sample ID	Compound	Q Flag	Qual Code
YS32-SS08-0312	1,1,2,2-Tetrachloroethane	UJ	MSL
YS32-SS08-0312	1,2,4-Trichlorobenzene	UJ	MSL
YS32-SS08-0312	1,3-Dichlorobenzene	UJ	CCL
YS32-SS08-0312	1,4-Dichlorobenzene	UJ	CCL
YS32-SS08-0312	1,2-Dichlorobenzene	UJ	MSL
YS32-SS08-0312	1,2-Dibromo-3-chloropropane	UJ	MDP
YS32-SS08-0312	2-Methylnaphthalene	UJ	MSL
YS32-SS08-0312	Acenaphthene	UJ	MSL
YS32-SS08-0312	Aluminum	J	FD
YS32-SS08-0312	Iron	J	FD
YS32-SS08P-0312	Barium	J	FD
YS32-SS08P-0312	Cobalt	J	FD
YS32-SS08P-0312	Copper	J	FD
YS32-SS08P-0312	Magnesium	J	FD
YS32-SS08P-0312	Nickel	J	FD
YS32-SS08P-0312	Vanadium	J	FD
YS32-SS08P-0312	Zinc	J	FD
YS32-SS08P-0312	alpha-BHC	UJ	SSL
YS32-SS08P-0312	gamma-BHC (Lindane)	UJ	SSL
YS32-SS08P-0312	beta-BHC	UJ	SSL
YS32-SS08P-0312	delta-BHC	UJ	SSL
YS32-SS08P-0312	Heptachlor	UJ	SSL
YS32-SS08P-0312	Aldrin	UJ	SSL
YS32-SS08P-0312	Heptachlor epoxide	UJ	SSL
YS32-SS08P-0312	gamma-Chlordane	UJ	SSL
YS32-SS08P-0312	alpha-Chlordane	UJ	SSL
YS32-SS08P-0312	4,4'-DDE	J	FD
YS32-SS08P-0312	Endosulfan I	UJ	SSL
YS32-SS08P-0312	Dieldrin	UJ	SSL
YS32-SS08P-0312	Endrin	UJ	SSL
YS32-SS08P-0312	4,4'-DDD	J	2C
YS32-SS08P-0312	Endosulfan II	UJ	SSL
YS32-SS08P-0312	4,4'-DDT	J	2C
YS32-SS08P-0312	Endrin aldehyde	UJ	SSL
YS32-SS08P-0312	Methoxychlor	UJ	SSL
YS32-SS08P-0312	Endosulfan sulfate	UJ	SSL
YS32-SS08P-0312	Endrin ketone	UJ	SSL
YS32-SS08P-0312	Toxaphene	UJ	SSL
YS32-SS08P-0312	Aroclor-1268	J	2C
YS32-SS08P-0312	Chloroethane	UJ	CCL
YS32-SS08P-0312	Trichlorofluoromethane (Freon-11)	UJ	CCL
YS32-SS08P-0312	Carbon tetrachloride	UJ	CCL
YS32-SS08P-0312	4-Methyl-2-pentanone	UJ	ICL

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Attachment 1 Change Qual. Table
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Sample ID	Compound	Q Flag	Qual Code
YS32-SS08P-0312	Ethylbenzene	UJ	CCL
YS32-SS08P-0312	1,3-Dichlorobenzene	UJ	CCL
YS32-SS08P-0312	1,4-Dichlorobenzene	UJ	CCL
YS32-SS08P-0312	Aluminum	J	FD
YS32-SS08P-0312	Iron	J	FD
YS32-SS08P-0312	Manganese	J	FD
YS32-SB08-06-24-0312	Antimony	UJ	MSL
YS32-SB08-06-24-0312	Calcium	J	FD
YS32-SB08-06-24-0312	Chromium	J	MSL
YS32-SB08-06-24-0312	Magnesium	J	MSL
YS32-SB08-06-24-0312	Nickel	J	FD
YS32-SB08-06-24-0312	alpha-BHC	UJ	SSL
YS32-SB08-06-24-0312	gamma-BHC (Lindane)	UJ	SSL
YS32-SB08-06-24-0312	beta-BHC	UJ	SSL
YS32-SB08-06-24-0312	delta-BHC	UJ	SSL
YS32-SB08-06-24-0312	Heptachlor	UJ	SSL
YS32-SB08-06-24-0312	Aldrin	UJ	SSL
YS32-SB08-06-24-0312	Heptachlor epoxide	UJ	SSL
YS32-SB08-06-24-0312	gamma-Chlordane	UJ	MSL
YS32-SB08-06-24-0312	alpha-Chlordane	UJ	SSL
YS32-SB08-06-24-0312	4,4'-DDE	J	MSL
YS32-SB08-06-24-0312	Endosulfan I	UJ	SSL
YS32-SB08-06-24-0312	Dieldrin	UJ	SSL
YS32-SB08-06-24-0312	Endrin	UJ	SSL
YS32-SB08-06-24-0312	4,4'-DDD	J	2C
YS32-SB08-06-24-0312	Endosulfan II	UJ	SSL
YS32-SB08-06-24-0312	4,4'-DDT	J	SSL
YS32-SB08-06-24-0312	Endrin aldehyde	UJ	SSL
YS32-SB08-06-24-0312	Methoxychlor	UJ	SSL
YS32-SB08-06-24-0312	Endosulfan sulfate	UJ	MSL
YS32-SB08-06-24-0312	Endrin ketone	UJ	SSL
YS32-SB08-06-24-0312	Toxaphene	UJ	SSL
YS32-SB08-06-24-0312	Aroclor-1268	J	SSH
YS32-SB08-06-24-0312	Chloroethane	UJ	CCL
YS32-SB08-06-24-0312	Trichlorofluoromethane (Freon-11)	UJ	CCL
YS32-SB08-06-24-0312	Methylene chloride	UJ	MSL
YS32-SB08-06-24-0312	trans-1,2-Dichloroethene	UJ	MSL
YS32-SB08-06-24-0312	cis-1,2-Dichloroethene	UJ	MSL
YS32-SB08-06-24-0312	1,1-Dichloroethane	UJ	MSL
YS32-SB08-06-24-0312	Chloroform	UJ	MSL
YS32-SB08-06-24-0312	1,1,1-Trichloroethane	UJ	MSL
YS32-SB08-06-24-0312	Methylcyclohexane	UJ	MSL
YS32-SB08-06-24-0312	Carbon tetrachloride	UJ	CCL

Yorktown WE29 Site 32
Attachment 1 Change Qual. Table
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Sample ID	Compound	Q Flag	Qual Code
YS32-SB08-06-24-0312	1,2-Dichloroethane	UJ	MSL
YS32-SB08-06-24-0312	Benzene	UJ	MSL
YS32-SB08-06-24-0312	Trichloroethene	UJ	MSL
YS32-SB08-06-24-0312	1,2-Dichloropropane	UJ	MSL
YS32-SB08-06-24-0312	Bromodichloromethane	UJ	MSL
YS32-SB08-06-24-0312	4-Methyl-2-pentanone	UJ	ICL
YS32-SB08-06-24-0312	cis-1,3-Dichloropropene	UJ	MSL
YS32-SB08-06-24-0312	Toluene	UJ	MSL
YS32-SB08-06-24-0312	trans-1,3-Dichloropropene	UJ	MSL
YS32-SB08-06-24-0312	1,1,2-Trichloroethane	UJ	MSL
YS32-SB08-06-24-0312	Tetrachloroethene	UJ	MSL
YS32-SB08-06-24-0312	Dibromochloromethane	UJ	MSL
YS32-SB08-06-24-0312	1,2-Dibromoethane	UJ	MSL
YS32-SB08-06-24-0312	Chlorobenzene	UJ	MSL
YS32-SB08-06-24-0312	Ethylbenzene	UJ	CCL
YS32-SB08-06-24-0312	m- and p-Xylene	UJ	MSL
YS32-SB08-06-24-0312	o-Xylene	UJ	MSL
YS32-SB08-06-24-0312	Bromoform	UJ	MSL
YS32-SB08-06-24-0312	Styrene	UJ	MSL
YS32-SB08-06-24-0312	Isopropylbenzene	UJ	MSL
YS32-SB08-06-24-0312	1,1,2,2-Tetrachloroethane	UJ	MSL
YS32-SB08-06-24-0312	1,2,4-Trichlorobenzene	UJ	MSL
YS32-SB08-06-24-0312	1,3-Dichlorobenzene	UJ	CCL
YS32-SB08-06-24-0312	1,4-Dichlorobenzene	UJ	CCL
YS32-SB08-06-24-0312	1,2-Dichlorobenzene	UJ	MSL
YS32-SB08-06-24-0312	Manganese	J	FD
YS32-SB08P-06-24-0312	Calcium	J	FD
YS32-SB08P-06-24-0312	Chromium	J	FD
YS32-SB08P-06-24-0312	Magnesium	J	FD
YS32-SB08P-06-24-0312	Manganese	J	FD
YS32-SB08P-06-24-0312	Nickel	J	FD
YS32-SB08P-06-24-0312	alpha-BHC	UJ	SSL
YS32-SB08P-06-24-0312	gamma-BHC (Lindane)	UJ	SSL
YS32-SB08P-06-24-0312	beta-BHC	UJ	SSL
YS32-SB08P-06-24-0312	delta-BHC	UJ	SSL
YS32-SB08P-06-24-0312	Heptachlor	UJ	SSL
YS32-SB08P-06-24-0312	Aldrin	UJ	SSL
YS32-SB08P-06-24-0312	Heptachlor epoxide	UJ	SSL
YS32-SB08P-06-24-0312	gamma-Chlordane	UJ	SSL
YS32-SB08P-06-24-0312	alpha-Chlordane	UJ	SSL
YS32-SB08P-06-24-0312	4,4'-DDE	J	SSL
YS32-SB08P-06-24-0312	Endosulfan I	UJ	SSL
YS32-SB08P-06-24-0312	Dieldrin	UJ	SSL

Yorktown WE29 Site 32
Attachment 1 Change Qual. Table
SDG CH029-014

Sample ID	Compound	Q Flag	Qual Code
YS32-SB08P-06-24-0312	Endrin	UJ	SSL
YS32-SB08P-06-24-0312	4,4'-DDD	J	SSL
YS32-SB08P-06-24-0312	Endosulfan II	UJ	SSL
YS32-SB08P-06-24-0312	4,4'-DDT	J	SSL
YS32-SB08P-06-24-0312	Endrin aldehyde	UJ	SSL
YS32-SB08P-06-24-0312	Methoxychlor	UJ	SSL
YS32-SB08P-06-24-0312	Endosulfan sulfate	UJ	SSL
YS32-SB08P-06-24-0312	Endrin ketone	UJ	SSL
YS32-SB08P-06-24-0312	Toxaphene	UJ	SSL
YS32-SB08P-06-24-0312	Aroclor-1268	J	SSH
YS32-SB08P-06-24-0312	Chloroethane	UJ	CCL
YS32-SB08P-06-24-0312	Trichlorofluoromethane (Freon-11)	UJ	CCL
YS32-SB08P-06-24-0312	Carbon tetrachloride	UJ	CCL
YS32-SB08P-06-24-0312	4-Methyl-2-pentanone	UJ	ICL
YS32-SB08P-06-24-0312	Ethylbenzene	UJ	CCL
YS32-SB08P-06-24-0312	1,3-Dichlorobenzene	UJ	CCL
YS32-SB08P-06-24-0312	1,4-Dichlorobenzene	UJ	CCL
YS32-TB030112	2-Butanone	UJ	ICL
YS32-TB030112	4-Methyl-2-pentanone	UJ	ICL
YS32-EB030112	2-Butanone	UJ	ICL
YS32-EB030112	4-Methyl-2-pentanone	UJ	ICL

Appendix G
Screening Level Ecological Risk Assessment

APPENDIX G

Ecological Risk Assessment

G.1 Introduction

This appendix contains a screening ecological risk assessment (SERA), constituting Steps 1 and 2 of the ecological risk assessment (ERA) process, and the first step (Step 3A) of a baseline ecological risk assessment (BERA) for the terrestrial (upland) portion of Site 32. The wetland portion of Site 32 has been previously evaluated (CH2M HILL, 2008).

G.1.1 Ecological Risk Assessment Process

This ERA was conducted in accordance with the *Navy Policy for Conducting Ecological Risk Assessments* (CNO, 1999) and the Navy guidance for implementing this ERA policy (NAVFAC, 2003). The Navy ERA policy and guidance, which describe a process consisting of eight steps organized into three tiers, are conceptually similar to the 8-step ERA process outlined in USEPA ERA guidance for the Superfund program (USEPA, 1997). For both sets of guidance, Steps 1 and 2 involve conducting a SERA using very conservative assumptions. The BERA represents Steps 3 through 7. The BERA uses less conservative (but more realistic) assumptions and site-specific data to refine the risk estimates from the SERA for components that fail the initial screening. Step 8 addresses risk management issues. The major differences between the Navy ERA policy/guidance and the USEPA ERA guidance are:

- Navy policy/guidance provides clearly defined criteria for exiting the ERA process at specific points
- Navy policy/guidance divides Step 3 (the first step of the BERA) into two distinct sub-steps (Steps 3A and 3B), with a potential exit point after Step 3A
- Navy policy/guidance incorporates risk management considerations throughout all tiers of the ERA process

ERAs are conducted using a tiered, step-wise approach and are punctuated with Scientific Management Decision Points (SMDPs). SMDPs represent points in the ERA process where agreement on conclusions, actions, or methodologies is needed so that the ERA process can continue (or terminate) in a technically defensible manner. The results of the ERA at a particular SMDP are used to determine how the ERA process should proceed, for example, to the next step in the process or directly to a later step. The process continues until a final decision has been reached (remedial action if unacceptable risks are identified, or no further action if risks are acceptable). The process can also be iterative if data needs are identified at any step; the needed data are collected and the process starts again at the point appropriate to the type of data collected.

The screening (preliminary) problem formulation is the first step of an ERA and establishes the goals, scope, and focus of the SERA. Step 1 of the ERA process is intended to answer two main questions:

- Do complete exposure pathways exist?
- Are sufficient data available to conduct the SERA?

If no complete exposure pathways exist, the ERA process terminates at Step 1 with a conclusion of negligible (acceptable) risk because exposure, and thus potential risk, can only occur if complete exposure pathways exist. If one or more complete exposure pathways are known to exist, or are likely to exist, the ERA process continues to Step 2 but only evaluates those pathways that have been determined to be “critical” (ecologically important); that is, represent exposures to sensitive receptors that are associated with the predominant fate and transport mechanisms at the site (USEPA, 1997). An evaluation of the available data is then conducted to determine if they are adequate to support the SERA. If not, additional data are collected before the ERA process continues. The second step of the ERA process involves conducting a screening exposure assessment, a screening effects assessment, and a screening risk calculation (risk characterization).

The results of the SERA are used to evaluate the potential for unacceptable ecological risks based upon very conservative assumptions. If the results of the SERA suggest that further ecological risk evaluation is warranted, the ERA process proceeds to the BERA (Steps 3 through 7), which is a more detailed phase of the ERA process, for the pathways, chemicals, receptors, and areas identified in the SERA. As previously indicated, the first step of the BERA (Step 3) is divided into two distinct sub-steps (3A and 3B) in Navy ERA guidance.

Step 3 of the USEPA ERA guidance consists of the following activities (USEPA, 1997):

1) Refinement of the chemicals of potential concern (COPCs) from the SERA
2) Further characterizing the potential ecological effects of contaminants
3) Refining information on contaminant fate and transport, complete exposure pathways, and receptors potentially at risk
4) Selecting assessment endpoints
5) Refining the conceptual model and risk hypotheses from the SERA

Step 3A of the Navy policy/guidance (refinement of conservative exposure assumptions) corresponds to the first activity, previously listed, for the USEPA ERA guidance. In Step 3A, a refined evaluation of exposure estimates is conducted using less conservative (but more realistic) assumptions and additional methodologies relative to those used in the SERA, which is intended to be a very conservative assessment (NAVFAC, 2003). Examples of less conservative (but more realistic) exposure assumptions include using central tendency (e.g., mean or median) estimates (rather than high-end or maximums) for media concentrations, bioaccumulation factors (BAFs), and exposure parameters. Examples of additional methodologies include the consideration of background concentrations, bioavailability, and detection frequency (CNO, 1999; NAVFAC, 2003).

If risk estimates (and their associated uncertainty) are acceptable following Step 3A (see **Section G.5**), the site will meet the conditions of the exit criterion specified in the Navy policy/guidance. If the Step 3A evaluation does not support a determination of acceptable risk within acceptable uncertainty, the site continues to Step 3B.

Step 3B of the Navy policy/guidance (problem formulation) corresponds conceptually to the last four activities, previously listed, for Step 3 of the USEPA ERA guidance. In Step 3B, the preliminary conceptual model from the SERA is refined based upon the results of the Step 3A evaluation to develop a revised list of key receptors, critical exposure pathways, key COPCs, assessment endpoints, measurement endpoints, and risk hypotheses. Based upon the refined conceptual model, the lines of evidence to be used in characterizing risk are determined. Agreement on the refined conceptual model, COPCs, exposure pathways, endpoints, and risk hypotheses constitutes the SMDP at the end of Step 3 in both Navy and USEPA ERA guidance.

Following the completion of Step 3, a decision point is reached with two potential outcomes. If the refined risk estimates are acceptable for each selected assessment endpoint, the investigation proceeds to risk characterization (Step 7) to document this conclusion, and the ERA process terminates. If the uncertainties associated with the refined risk estimates are unacceptable and/or the risk estimates indicate that unacceptable risks may exist, site-specific studies might be required and the ERA process continues (Steps 4 through 6). Step 4 is a work planning step where additional site-specific studies are scoped and designed. Step 5 consists of the verification of the field sampling design developed in Step 4 while Step 6 constitutes the site investigation and data analysis phase of the process. The scope (the spatial extent of sampling) and components (the collection of biological data such as tissue samples and toxicity testing) of any site-specific studies are determined by the conclusions of Step 3 and the pathways/endpoints associated with the potential unacceptable risks.

Step 7 consists of the documentation and synthesis of the information and data identified in Steps 1 through 3 (no additional study) or Steps 1 through 6 (additional study). In this step, risk is evaluated and characterized using both quantitative and qualitative methods. Conclusions are made as to whether or not there is a reasonable potential for unacceptable ecological risk, and if there is a potential for unacceptable ecological risk, the

magnitude of that risk. The results of the completed BERA (Step 7) are used to make any necessary risk management decisions (Step 8) related to current or future risks. Possible decisions include:

- Adequate information is available to conclude that no unacceptable ecological risks exist. The assessment should stop at Step 7.
- Adequate information is available to conclude that unacceptable ecological risks exist for which remedial actions or controls are warranted. Whether remedial actions or controls are taken, and the specific actions or controls taken, will depend upon a number of risk management factors such as the results of human health risk assessments (if applicable) and the potential impact of the remedial action or control itself on the habitats and biota present. This analysis would occur as part of Step 8.
- Adequate information is not available to estimate risk or the risk estimate is believed to be too conservative or uncertain to recommend remediation. The assessment should be refined.

G.2 Problem Formulation

Problem formulation establishes the goals, scope, and focus of the ERA. As part of problem formulation, the ecological setting of Site 32 is characterized in terms of the habitats and biota known or likely to be present. The types and concentrations of chemicals that are present in ecologically relevant media are also described based upon available analytical data. Surface soil (0 to 6 inches below ground surface [bgs]) is the primary ecologically relevant medium at the site. Subsurface soils (6 to 24 inches bgs) are also evaluated, per Region 3 BTAG guidance, because some ecological receptors may be exposed to soils at these depths. Groundwater is also evaluated as a potential transport medium to downgradient water bodies.

A conceptual model is developed that describes source areas, transport pathways and exposure media, exposure pathways and routes, and receptors. Assessment endpoints, measurement endpoints, and risk hypotheses are developed to evaluate those receptors for which critical exposure pathways exist. The fate, transport, and toxicological properties of the chemicals present at Site 32, particularly the potential for bioaccumulation, are also considered during this process.

G.2.1 Environmental Setting

Site 32 was formerly known as Site Screening Area (SSA) 25 and historically consisted of Sewage Treatment Plant #2 (STP #2) and the wetland area downgradient of this former plant. Site 32 is bordered by dense tree cover to the north, the York River further to the east, and Ballard Creek to the south (**Figure 2-1**). The approximate centerline of Ballard Creek, which meanders throughout the downgradient wetland portion of Site 32, represents the property boundary between WPNSTA Yorktown and the National Park Service Colonial National Historic Park (**Figure 2-2**) (CH2M HILL, 2008).

The terrestrial portion of Site 32 (the subject of this ERA) encompasses the footprint of the former STP #2 and is approximately 1.4 acres in size, while the total site study area (that also includes the wetland area) is approximately 8 acres. During its operational period, the STP reportedly managed only sanitary waste from the base. STP #2, prior to being dismantled and removed in 2000, was an inactive treatment plant consisting of settling tanks, a clarifier (Imhoff) tank with two chambers, trickling filter, chlorination unit, and sludge drying beds. Wastewater first entered the plant through the Imhoff tank where the wastewater passed through the grit chamber before continuing into the primary Imhoff chamber, which operated as a primary settling basin for the waste. The wastewater was then passed through either the secondary Imhoff chamber or the trickling filter for biological treatment. The wastewater was then chlorinated in the chlorination unit and discharged directly to the wetland area bordering Ballard Creek through a regulated outfall. Sludge that had settled in the Imhoff tank was periodically removed and placed in the sludge drying bed.

The STP #2 trickling filter, which was installed in 1952, used elemental mercury (about 4 to 6 ounces) as a water seal in the pivot point. Although this seal was maintained, it is likely that mercury leaked into the trickling filter tank and was subsequently discharged to the Site 32 wetland via the STP outfall. It is believed that treatment plant operations ceased before the early 1970s, since the use of mercury seals on trickling filters, like those used

at STP #2, have been prohibited in Virginia since 1971. The former STP #2 clarifier and settling tanks were filled with rainwater and substantial vegetation was growing in the drying beds during early assessment activities associated with the WPNSTA ERP (early 1990s). Beaded elemental mercury was discovered around the base of the trickling filter during the demolition process. The source of this mercury was likely the mercury-containing bearings located in the distributor arms of the trickling filter tank. Based on anecdotal evidence, a total of twelve drums of mercury contaminated soils were excavated and disposed of during the removal of the trickling filter. Confirmation samples indicated no residual mercury contamination following the removal of the STP buildings and infrastructure.

The wetlands area (about 6.6 acres in size) has been previously evaluated (CH2M HILL, 2008). Based upon this evaluation, a non-time-critical removal action was initiated in 2009 to remove contaminated sediment in the vicinity of the former STP outfall. A total of 1,361 cubic yards (2,041 tons) of contaminated sediment was removed from Site 32 and disposed of off-site. Following excavation, the area was backfilled with a 3:1 mixture of sand and topsoil, graded, and revegetated with smooth alder, buttonbush, and bald cypress. Restoration activities for the embankment and hillside included backfilling, compacting, grading, fertilizing, and seeding with a grass seed mixture of annual rye grass, partridge pea, switchgrass, and Virginia wild rye grass (Shaw, 2009).

The upland portion of Site 32 slopes moderately from the north to the south at elevations ranging from 30 to 20 feet above mean sea level. Beyond the facility perimeter fence line, the site slopes steeply towards the downgradient wetland area (**Figure 2-2**). The upland portion of Site 32 in the vicinity of the former STP structures is currently an open field that is periodically maintained (mowed) by facility personnel. The remaining upland areas around the margins of the former structures and along the two wetland impoundments are wooded. Though a biological survey of the area has not been performed, small mammals and their predators, including raptors, would be expected to use the area. Canopy tree species include American sycamore, loblolly pine, sweet gum, and yellow poplar (CH2M HILL, 2008).

The current and potential future use for Site 32 is as a wetland area and is not anticipated to change for the foreseeable future. Groundwater beneath the upland portion of Site 32 (Yorktown-Eastover aquifer) flows predominantly to the south, radially toward the wetland area.

G.2.2 Data Used in the ERA

Soil samples collected as part of this SI (in 2012) were quantitatively evaluated in this ERA. Since ecological exposures are generally confined to the top 2 feet of the soil column, the soil data used in this ERA were generally confined to this depth range but were evaluated separately as surface samples (0 to 6 inches) and subsurface samples (6 to 24 inches).

Although ecological receptors do not typically have direct exposure to groundwater, groundwater data collected as part of this SI were also evaluated in this ERA. This was done to provide a conservative evaluation of the potential for significant contaminant transport from the upland areas of the site via groundwater to downgradient receiving water bodies and the subsequent potential exposure of ecological receptors in these water bodies.

The samples used in this ERA are listed in **Table G-1** and are shown on **Figure 4-1** of the SI report. The analytical data for these samples can be found in **Appendix E**.

G.2.3 Conceptual Model

The conceptual model relates potentially exposed receptor populations with potential source areas based upon physical site characteristics and complete exposure pathways. Important components of the conceptual model are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptors. Actual or potential exposures of ecological receptors associated with a site are determined by identifying the most likely, and most important, mechanisms and pathways of contaminant release and transport. A complete exposure pathway has three components:

1. A source or sources of contamination that results in a release to the environment
2. A pathway and mechanism of chemical transport through an environmental medium

3. An exposure or contact point for an ecological receptor

Figure G-1 illustrates a diagrammatic conceptual model for Site 32. Key components of this conceptual model are discussed in the following subsections.

Source Areas

The source of potential contamination at Site 32 is the former STP, as shown on **Figure 1-2** of the SI report**.** Potential source areas related to this former wastewater treatment plant are discussed in more detail in **Section 2** of the SI report.

Transport Pathways and Exposure Media

A transport pathway describes the mechanisms whereby site-related chemicals, once released, may be transported from a source to ecologically relevant media (such as surface soil) where exposures may occur. These transport pathways are shown on **Figure G-1**.

The primary release mechanisms and transport pathways at the site include:

- Possible surface runoff from source areas to other areas of the site
- Infiltration, percolation, and leaching of contaminants to groundwater and subsequent discharge to the surface water and sediment of downgradient water bodies (wetlands downgradient of Beaver Pond)
- Uptake from the surface soil and accumulation in the tissues of terrestrial biota

Exposure media for ecological receptors are typically limited to surface water, surface sediment, and surface soil. Surface water and sediment are not evaluated in this ERA because the site does not contain wetlands or water bodies, and downgradient wetland areas have been previously evaluated (CH2M HILL, 2008) and remediated (Shaw, 2009). Subsurface soils (6 to 24 inches bgs) are also evaluated because some ecological receptors may be exposed to soils at these depths. Groundwater is generally considered only as a transport medium since there are no ecological exposures to groundwater until it discharges to a water body or surfaces as a seep. In this ERA, groundwater is evaluated as a potential transport medium to downgradient water bodies (wetlands downgradient of Beaver Pond). Air is not addressed in this ERA since this medium is not likely to result in significant contributions to total exposures.

Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. **Figure G-1** shows the potentially complete exposure pathways to ecological receptors associated with Site 32, which include:

- Direct contact with site-related chemicals in surface soil for lower trophic level receptors (such as plants and soil invertebrates).
- Potential ingestion of site-related chemicals via food webs by avian, mammalian, and reptilian terrestrial receptors.

As discussed previously, there are no complete exposure pathways for aquatic receptors on the upland portion of the site due to the lack of wetland and aquatic habitats. However, groundwater is evaluated as a potential transport medium to downgradient water bodies (wetlands downgradient of Beaver Pond).

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. The most common exposure routes are dermal contact, direct uptake, ingestion, and inhalation. Terrestrial plants may be exposed to chemicals present in surface soils through their root surfaces during water and nutrient uptake. Terrestrial invertebrates may be exposed to chemicals in surface soil through dermal contact and ingestion.

Animals may be exposed to chemicals through the following routes:

- Inhalation of gaseous chemicals or of chemicals adhered to airborne particulate matter
- Incidental ingestion of contaminated abiotic media (soil) during feeding or preening activities
- Ingestion of contaminated water
- Ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs
- Dermal contact with contaminated abiotic media

These routes, where applicable, are depicted on **Figure G-1**.

Incidental ingestion of soil and exposure via food webs are the primary exposure routes for upper trophic level receptors (such as birds and mammals). The contribution to the total dose from the inhalation route is generally insignificant for upper trophic level ecological receptors relative to ingestion pathways. Hence, the air pathway is not generally considered for ecological receptors. Exposure to chemicals present in surface soil via dermal contact may occur but is unlikely to represent a major exposure pathway for most upper trophic level receptors because fur or feathers minimize transfer of chemicals across dermal tissue. Incidental ingestion of surface soil during feeding, preening, or grooming activities is, however, considered in the risk estimates. Direct contact is considered for lower trophic level receptors (soil invertebrates).

Direct ingestion of drinking water is only considered when a permanent or semi-permanent source of water with a salinity below 15 parts per thousand, the approximate toxic threshold for wildlife receptors (Humphreys, 1988), exists on a site. There are no permanent or semi-permanent sources of water on the upland portion of the site. Although the downgradient wetland area does contain water of sufficiently low salinity, it is separated from the upland portion of the site by a very steep slope. Thus, exposure via direct ingestion of drinking water is not included in this ERA.

Receptors

Because of the complexity of natural systems, it is generally not practical to directly assess the potential impacts to all ecological receptors present at a site. Therefore, specific receptor species (such as red-tailed hawk) or species groups (such as plants) are selected as surrogates to evaluate potential risks to larger components of the ecological community (guilds; such as carnivorous birds) used to represent the assessment endpoints (e.g., survival and reproduction of carnivorous birds). Selection criteria typically include those species that:

- Are known to occur, or are likely to occur, at the site
- Have a particular ecological, economic, or aesthetic value
- Are representative of taxonomic groups, life history traits, and/or trophic levels in the habitats present for which complete exposure pathways are likely to exist
- Can, because of toxicological sensitivity or potential exposure magnitude, be expected to represent potentially sensitive populations

The following upper trophic level receptor species have been chosen for exposure modeling in terrestrial habitats based upon the previously listed criteria:

- Mourning dove (*Zenaida macroura*) - terrestrial avian herbivore
- American robin (*Turdus migratorius*) - terrestrial avian invertivore
- Red-tailed hawk (*Buteo jamaicensis*) - terrestrial avian carnivore
- Meadow vole (*Microtus pennsylvanicus*) - terrestrial mammalian herbivore
- Short-tailed shrew (*Blarina brevicauda*) - terrestrial mammalian invertivore
- Red fox (*Vulpes vulpes*) - terrestrial mammalian carnivore

Upper trophic level receptor species quantitatively evaluated in this ERA were limited to birds and mammals, the taxonomic groups with the most available information regarding exposure and toxicological effects. Lower trophic level receptor species were evaluated based upon those taxonomic groupings for which soil screening values have

been developed. As such, specific species of plants or soil invertebrates in terrestrial habitats were not chosen as receptors because of the limited information available for specific species and because these receptors were evaluated on a community level via a comparison of chemical concentrations in soil to soil screening values.

Amphibians are typically selected as a receptor group only when freshwater aquatic or wetland habitats are present on, or in the contaminant transport pathways (as defined in the conceptual model) of, a site. This is not the case at Site 32 based upon the lack of these habitats on the upland portion of the site. Amphibians were included as a receptor group during the evaluation of the wetlands downgradient of Beaver Pond (CH2M HILL, 2008).

Reptiles are an applicable receptor group. Individual species of reptiles are not, however, selected for evaluation because of the general lack of available toxicological information for this taxonomic group for direct effects and effects from exposures via food webs. Potential risks to reptiles from food web exposures are evaluated using other fauna (birds and mammals) as surrogates. Similarly, potential risks to this group from direct exposures to surface soil are evaluated using soil screening values developed for other taxonomic groups (described above). This is discussed further in **Section G.6**.

Endpoints and Risk Hypotheses

The conclusion of the problem formulation includes the selection of ecological endpoints and risk hypotheses, which are based upon the conceptual model. Two types of endpoints, assessment endpoints and measurement endpoints, are defined as part of the ERA process (USEPA, 1997). An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1997) and discussed in detail in Suter (1989, 1990, 1993). Risk hypotheses are testable hypotheses about the relationship among the assessment endpoints and their predicted responses when exposed to contaminants.

Endpoints define ecological attributes that are to be protected (assessment endpoints) and measurable characteristics of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to a site (USEPA, 1997). Assessment endpoints contain an entity (such as a hawk population) and an attribute of that entity (such as survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as specific exposure route or contaminant sensitivity, with the receptor then used to represent the assessment endpoint in the risk evaluation.

Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem itself. Effects on individual organisms are important for some receptors, such as rare and endangered species; population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study. However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population or community level. In addition, use of criteria values designed to protect the majority of the components of a community (such as Ambient Water Quality Criteria [AWQC] for the Protection of Aquatic Life) can be useful in evaluating potential community- and/or population-level effects.

Table G-2 shows the assessment endpoints, risk hypotheses, and measurement endpoints used in the ERA. **Table G-2** also shows the receptors associated with each endpoint.

G.3 Exposure Assessment

The principal activity associated with the exposure assessment is the estimation of chemical concentrations in applicable media, termed exposure point concentrations (EPCs), to which the receptors may be exposed. This is accomplished through the selection of appropriate sets of the available analytical data using a set of criteria (such

as validation status and sampling date). Once the analytical data sets are selected, EPCs are calculated as a particular point on the distribution of concentrations. At the screening level (SERA; Step 2), the EPC is the maximum detected concentration. At the baseline level (BERA; Step 3A), EPCs are central tendency estimates (such as the arithmetic mean). EPCs are then used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors.

For conservatism, the maximum (SERA) and mean (BERA) reporting limits for chemicals analyzed for but not detected were also compared to medium-specific ecological screening values (ESVs) and (where applicable) used for food web exposure modeling. This was done to determine if reporting limits were less than chemical concentrations at which potential adverse effects to ecological receptors may occur.

G.3.1 Selection Criteria for Analytical Data

Available analytical data (described in **Section G.2.2**) were selected for use in the ERA based upon the following:

- Data must have been validated by a qualified data validator using acceptable data validation methods. Rejected (R) values were not used in the ERA. Unqualified data and data qualified as J (estimated), L (biased low), or K (biased high) were treated as detected. Data qualified as U (undetected) or B (blank contamination) were treated as non-detected.
- For samples with duplicate analyses, the higher of the two concentrations was used, for conservatism, when both values were detects or when both values were non-detects. In cases where one result was a detection and the other a non-detect, the detected value was used in the assessment.
- For non-detected results, the sample quantitation (reporting) limit (SQL) was used to represent the concentration. When calculating statistics (such as the arithmetic mean), one-half of the SQL was used for non-detected results.

G.3.2 Exposure Point Concentrations

EPCs are calculated as a particular point on the distribution of concentrations. At the screening level, the EPC is the maximum detected concentration. At the baseline level, EPCs are typically central tendency estimates (such as the arithmetic mean), which provide a more representative estimate of potential exposures and risks to receptor populations (the focus of the selected assessment endpoints). In this ERA, the maximum, arithmetic mean, and 95 percent upper confidence limit (UCL) of the arithmetic mean concentrations were evaluated for direct exposures. Exposures via food webs also utilized the maximum, arithmetic mean, and 95 percent UCL of the arithmetic mean. These three medium-specific EPCs were also used in bioaccumulation and food web models to estimate exposures to upper trophic level receptors. Dietary items for which tissue concentrations were modeled included terrestrial plants, soil invertebrates, and small mammals. Incidental ingestion of soil, but not ingestion of drinking water (due to the lack of a permanent drinking water source on the upland portion of the site), was included when calculating the total exposure. The models and parameter values used for calculating these tissue concentrations are outlined in the following subsections.

Not all chemicals were evaluated for food web exposures. Only those chemicals with the potential to bioaccumulate to a significant extent, as defined in Table 4-2 of USEPA (2000), were evaluated. This list of bioaccumulating chemicals is provided in **Table G-3** for chemicals relevant to Site 32.

For the screening (SERA) exposure estimates, the uptake of chemicals from the abiotic medium (surface soil) into food items was based upon conservative (e.g., 90^{th} percentile) bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) from the literature, where available. The 90^{th} percentile is generally recommended to provide for a conservative screening assessment (Sample et al., 1998a; 1998b; Bechtel Jacobs, 1998b). If 90^{th} percentile values were not available in the cited reference, the maximum value was used, if available. If only central tendency (e.g., median) values were reported, they were used for both the SERA and BERA. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily

available for a chemical in the literature. In some cases, chemical concentrations in food items were directly estimated from maximum surface soil concentrations using available literature-based regression models.

BCFs and BAFs used for baseline (BERA) exposure estimates were based upon, or modeled from, central tendency estimates (e.g., median or mean). Baseline values considered both the distribution of the data (e.g., normal or log normal) and the recommendations in the cited reference. Geometric means were preferred for log normal distributions and arithmetic means for normal distributions. In some cases, neither distribution was applicable or the distribution was biased by an outlying value. In these cases, point estimates like the median were then considered. Where an individual study (as opposed to a compilation of multiple studies) was cited, the best available value was sometimes a single value or the derivation was not specified. Default (assumed) factors of 1.0 were used only when data were not readily available for a chemical in the literature. In some cases, chemical concentrations in food items were directly estimated from mean surface soil concentrations using available literature-based regression models.

- In the BERA, using central tendency estimates (rather than high-end values or maximums) for exposure parameters such as BAFs provides a more representative estimate of potential exposures and risks to receptor populations (which are the focus of the selected assessment endpoints) of upper trophic level receptors. Since these upper trophic level receptors are highly mobile, they would be expected to effectively average their exposure over time as they forage within the area defining their home range. Average prey concentrations are most appropriately estimated using central tendency estimates of media concentrations and accumulation factors. For example, the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) specify the calculation of an average daily dose. Increasing the representativeness of the exposure estimates relative to population-level effects is consistent with the intent of a BERA. In cases where adequate spatial sampling coverage exists, mean concentrations are also appropriate for evaluating potential risks to populations of lower trophic level receptors because the members of the population are expected to be found throughout an area (where suitable habitat is present), rather than concentrated in one particular location. While effects to 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. For this ERA, the receptor populations of interest are those that utilize all or part of the upland portion of the site, but such use in not necessarily exclusive to the site for the entire population.

Terrestrial Plants

For most chemicals, tissue concentrations in the above-ground vegetative portion of terrestrial plants were estimated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-plant BAFs obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Table G-4**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table G-5**.

The BAF values used were based upon root uptake from soil and upon the ratio between dry-weight soil and dry-weight plant tissue. Literature values based upon the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BAF by an estimated solids content for terrestrial plants (15 percent [0.15]; Sample et al., 1997).

For inorganic chemicals lacking literature-based, chemical-specific BAFs or applicable algorithms, a soil-to-plant BAF of 1.0 was used. For non-ionic organic chemicals (with a log K_{ow} of between 3 and 8) without literature-based BAFs, soil-to-plant BAFs were estimated using the rinsed foliage algorithm provided in Figure 5B of USEPA (2007j):

$$log\ BAF = (-0.4057)\ (log\ K_{ow}) + 1.781$$

where: BAF = Soil-to-plant BAF (unitless; dry-weight basis)
K_{ow} = Octanol-water partitioning coefficient (unitless)

The log K_{ow} values used in this equation are listed in **Table G-3**.

Soil Invertebrates (Earthworms)

For most chemicals, tissue concentrations in soil invertebrates (earthworms) were estimated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by chemical-specific soil-to-invertebrate BCFs or BAFs obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Table G-6**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table G-5**.

BCFs are calculated by dividing the concentration of a chemical in earthworm tissue by the concentration of that same chemical in the surrounding environmental medium (in this case, soil) without accounting for uptake via the diet. BAFs consider both direct exposure to soil and exposure via the diet. Because earthworms consume soil, BAFs are more appropriate values and were used when available. BAFs based upon depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses when selecting BAF values because direct ingestion of soil is accounted for separately in the food web model.

The BCF/BAF values selected were based upon the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based upon the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BCF/BAF by the estimated solids content for earthworms (16 percent [0.16]; USEPA, 1993). For chemicals without available measured BAFs/BCFs, an earthworm BAF was estimated using available regression equations from the literature, was estimated using data for similar chemicals, or a BAF of 1.0 was assumed.

Small Mammals

Whole-body tissue concentrations in small mammals were estimated using one of two methodologies. For chemicals with literature-based soil-to-small mammal BAFs, the small mammal tissue concentration was calculated by multiplying the maximum (SERA) or mean (BERA) surface soil concentration for each bioaccumulative chemical by a chemical-specific soil-to-small mammal BAF obtained from the literature. These BAFs, for both the SERA and BERA, are listed in **Table G-7**. For some chemicals, tissue concentrations were directly estimated from surface soil concentrations using regression equations; these algorithms are listed in **Table G-5**.

The BAF values selected were based upon the ratio between dry-weight soil and whole-body dry-weight tissue. Literature values based upon the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for small mammals (32 percent [0.32]; USEPA, 1993).

For chemicals without soil-to-small mammal BAF values or algorithms, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for these small mammals is via the diet, it was assumed that the concentration of each bioaccumulative chemical in the small mammal's tissues was equal to the chemical concentration in its diet multiplied by a diet to whole-body BAF derived from the literature. The small mammal tissue concentration was calculated as follows:

$$TC_x = [[\sum_i (FC_{xi})(PDF_i)] + [(SC_x)(PDS)]] (BAF_{diet\text{-}whole\ body})$$

where:

TC_x	=	Small mammal tissue concentration for chemical x (mg/kg, dry weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
SC_x	=	Concentration of chemical x in soil (mg/kg, dry weight)
PDS	=	Proportion of diet composed of soil (dry weight basis)
BAF	=	Diet to whole-body BAF (unitless, dry weight basis)

This equation is basically a weighted average of the chemical concentration in the various dietary components (including soil ingestion) for the small mammal, multiplied by a diet-to-whole body BAF, and thus excludes water ingestion.

For chemicals lacking diet to whole-body BAF values (not to be confused with the soil-to-small mammal BAFs listed in **Table G-7**), a diet to whole-body BAF of one was assumed. The use of a diet to whole-body BAF of one is likely to result in a conservative estimate of chemical concentrations for chemicals that are not known to biomagnify in terrestrial food webs and a reasonable estimate of chemical concentrations for chemicals that are known to bioaccumulate or biomagnify, based upon reported literature values. For example, a maximum diet to whole-body BAF value of 1.0 was reported by Simmons and McKee (1992) for PCBs based upon laboratory studies with white-footed mice. Menzie et al. (1992) reported diet to whole-body BAF values for DDT of 0.3 for voles and 0.2 for short-tailed shrews. Reported diet to whole-body BAF values for dioxin were only slightly above one (1.4) for the deer mouse (USEPA, 1990).

Dietary Intakes

Upper trophic level receptor exposures via the food web to chemicals present in surface soil were determined by estimating the chemical concentrations in each relevant dietary component for each receptor, as described in the previous subsection. Incidental ingestion of surface soil was included when calculating the total exposure. Direct ingestion of drinking water was not included.

Dietary intakes for each upper trophic level receptor were calculated using the following formula (modified from USEPA [1993]):

$$DI_x = \frac{[\left[\sum_i (FIR)(FC_{xi})(PDF_i)\right] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

where:

	DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
	FIR	=	Food ingestion rate (kg/day, dry weight)
	FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
	PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
	SC_x	=	Concentration of chemical x in soil (mg/kg, dry weight)
	PDS	=	Proportion of diet composed of soil (dry weight basis)
	WIR	=	Water ingestion rate (L/day)
	WC_x	=	Concentration of chemical x in water (mg/L)
	BW	=	Body weight (kg)

Incidental ingestion of soil was modeled as a dietary component rather than using a separate soil ingestion rate. Water ingestion was set to zero. Parameter values for the selected receptors (see **Section G.2.3.4**) are listed in **Tables G-8** (screening) and **G-9** (baseline). When measured food ingestion rates were not available for a receptor from the literature, the rates were estimated using allometric equations from Nagy (2001). For receptors that consume small mammals (red fox and red-tailed hawk), it was assumed that the small mammal portion of the diet was composed of equal parts voles (herbivores) and shrews (insectivores).

The exposure parameter values were selected to provide for a conservative evaluation at the screening level (Step 2). Examples of these conservative assumptions include:

- All of the dietary items consumed by the receptor are obtained from the site (i.e., an Area Use Factor [AUF] of one was assumed) at the point of maximum concentration.
- Chemicals are 100 percent bioavailable.
- Maximum food ingestion rates were used (calculated maximum ingestion rates using allometric equations were based upon the maximum adult body weight).
- Minimum adult body weights were used.

For the baseline (Step 3A) estimates:

- Central tendency estimates (e.g., mean, median, or midpoint) for adult body weight and ingestion rates were used. Central tendency estimates for these exposure parameters are more relevant for a BERA because they

better represent the characteristics of a greater proportion of the individuals in the population. Populations or communities (rather than individual organisms) were emphasized when developing the assessment endpoints for the ERA.

An AUF of 1.0 was retained in Step 3A.

G.4 Effects Assessment

The effects assessment defines the methods and data used to define an adverse ecological effect. For this ERA, effects data are available from multiple lines of evidence, as follows:

- **Ecological Screening Values (ESVs) for Surface Soil** - Analytical surface soil data are compared to the surface soil ESVs developed in **Section G.4.1**.
- **ESVs for Surface Water** - Analytical groundwater data are compared to literature-based surface water ESVs developed in **Section G.4.1**.
- **Toxicity Reference Values (TRVs) for Ingestion Exposures** - Food web exposure estimates are compared to ingestion-based TRVs developed in **Section G.4.2** for upper trophic level receptors.
- **Bioavailability Measures** - Additional data were collected to help evaluate chemical-specific bioavailability in abiotic media.

In addition, comparison of site surface soil and groundwater concentrations to facility background concentrations was conducted as an additional line of evidence (see **Section G.5**).

G.4.1 Medium-Specific ESVs

Medium-specific ESVs were established for each ecologically relevant medium. Based upon the conceptual model (**Figure G-1**), exposure to surface (and shallow subsurface) soils, and possible indirect exposure to groundwater, are the potentially complete pathways.

Soil ESVs

The soil ESVs used in the ERA are summarized in **Table G-10**. When more than one ESV was available (e.g., fauna and flora) from a particular source for a chemical, the lowest of these values was selected.

Surface Water ESVs

The surface water ESVs used to screen groundwater considered the salinity of the receiving water body to determine whether to apply freshwater or marine values. Because the measured salinity of the downgradient wetland area was typically less than 1 ppt (CH2M HILL, 2008), freshwater ESVs were used. The values used in the ERA are summarized in **Table G-11**.

The surface water ESVs used in the ERA considered Region 3 BTAG screening values (USEPA, 2006b) as well as additional ESVs available from the literature. When more than one ESV was available (e.g., fauna and flora) from a particular source for a chemical, the lowest of these values was selected. The ESVs for chemicals known to bioaccumulate in aquatic food webs were based upon the final chronic value (rather than the final residue value) as per USEPA (1996a, 2009) and Suter and Tsao (1996). The use of final chronic values is intended to protect aquatic receptors from direct exposures to chemicals in surface water, rather than from exposure via food webs.

G.4.2 Ingestion TRVs

Ingestion TRVs for dietary exposures were derived for each bioaccumulative chemical evaluated in the ERA. TRVs were derived for both mammalian and avian receptors, the only two taxonomic groups for which sufficient toxicological information was generally available for the range of bioaccumulative chemicals evaluated. Toxicological information from the literature for wildlife species most closely related to the receptor species were used, where available, but were supplemented by laboratory studies of non-wildlife species (e.g., laboratory mice) where necessary. The ingestion TRVs are expressed as milligrams of the chemical per kilogram body weight of the receptor per day (mg/kg-BW/day).

Survival, growth, and reproduction were emphasized as toxicological endpoints because they are the most relevant, ecologically, to maintaining viable populations and because they are generally the most studied toxicological endpoints for ecological receptors. Endpoints based upon reproduction were generally preferred to those based upon growth which were preferred to those based upon survival. If several chronic toxicological studies were available from the literature, the most appropriate study was selected for each receptor species based upon study design, study methodology, study duration, study endpoint, and test species.

Ingestion TRVs were derived for both chronic No Observed Adverse Effect Level (NOAEL) and chronic Lowest Observed Effect Level (LOAEL) endpoints. The applicable uncertainty factors from **Table G-12** were used to derive these TRVs where appropriate (uncertainty factors were not generally applied to TRVs obtained from Eco-SSL documents because these TRVs often encompassed multiple studies). Because assessment endpoints were based upon population- or community-level effects, no intraspecies uncertainty factors were applied. Because there are no threatened or endangered species known to occur in the upland portion of Site 32, the application of additional uncertainty factors for this class of receptors is not applicable to the ERA. Taxonomic class-type uncertainty factors were also not applied because the TRVs selected were typically derived based upon data from a broad range of taxonomic groups. Maximum Acceptable Toxicant Concentrations (MATCs), defined as the geometric mean of the NOAEL and LOAEL, were also calculated. Ingestion TRVs for mammals and birds are listed in **Tables G-13** and **G-14**, respectively.

G.4.3 Bioavailability Measures

Data collected to evaluate the potential chemical-specific bioavailability in abiotic media included:

- **Groundwater** - Dissolved metals

G.5 Risk Characterization

The risk characterization portion of the ERA uses the information generated during the three previous parts of the ERA (problem formulation, exposure assessment, and effects assessment) to estimate potential risks to ecological receptors at the level of conservatism applied (screening or baseline).

G.5.1 SERA Approach

The main objective of risk characterization at the screening level (termed risk calculation) is to derive a list of COPCs. As part of this risk calculation, the maximum exposure concentrations (abiotic media) or maximum exposure doses (upper trophic level receptors) are compared with the corresponding ESVs or TRVs to derive risk estimates using the hazard quotient (HQ) method. HQs are calculated by dividing the chemical concentration in the medium being evaluated by the corresponding medium-specific ESV or by dividing the exposure dose by the corresponding ingestion-based TRV. HQs equaling or exceeding one indicate the potential for unacceptable risk since the chemical concentration or dose (exposure) equals or exceeds the ESV or TRV (effect); these chemicals are identified as COPCs at Step 2. However, ESVs/TRVs and exposure estimates are derived using intentionally conservative assumptions at the screening level such that HQs greater than or equal to one do not necessarily indicate that unacceptable risks are present. Rather, it identifies chemical-pathway-receptor combinations requiring further evaluation using less conservative (but more realistic) exposure scenarios and assumptions. HQs less than one indicate that unacceptable risks are unlikely, enabling a conclusion of negligible (acceptable) risk to be reached with high confidence.

In addition to chemicals that exceed medium-specific ESVs based upon maximum detected concentrations, or that exceed TRVs based upon maximum ingestion doses, the following also applies to COPC selection at Step 2:

- Non-detected chemicals were retained as COPCs if the maximum detection limit exceeded the ESV for that medium or if the ingestion dose calculated using the maximum detection limit exceeded the TRV.
- All detected chemicals lacking a TRV and/or ESV were retained as COPCs.

- The essential nutrients calcium, magnesium, potassium, and sodium were excluded as potential COPCs since they are essential macronutrients that are needed in relatively high concentrations for normal metabolism, growth, and reproduction.

G.5.2 BERA Approach

COPCs from the SERA are reevaluated in the first step of the BERA (Step 3A). As discussed previously, this reevaluation involves using less conservative (but more realistic) assumptions about exposures and a comparison of these revised exposure estimates (based upon central tendency estimates of media concentrations, BAFs, and/or exposure parameters) with ESVs and TRVs.

In addition to chemicals that exceed medium-specific ESVs based upon mean detected concentrations, or that exceed TRVs based upon mean ingestion doses, the following also applies to COPC selection at Step 3A:

- All detected chemicals lacking a TRV and/or ESV were retained as COPCs for risk evaluation.
- Ingestion-based (food web) COPCs were based upon a comparison of mean and 95% UCL exposure doses with ingestion TRVs based upon the NOAEL, MATC, and LOAEL. An exceedance of the MATC was generally considered an unacceptable risk at Step 3A, although chemicals that exceeded the MATC, but not the LOAEL, are discussed for possible risk management considerations. Exceedances of the LOAEL are almost always considered unacceptable and thus do not normally need to be discussed by the risk managers. Dose estimates that are less than the MATC are generally considered acceptable and also normally do not need to be discussed by the risk managers except in limited cases (e.g., listed species are present). Thus, it is generally only those results between the MATC and LOAEL that risk managers need to decide are unacceptable or not.

For Step 3A, the following additional factors were also considered:

- **Background Concentrations.** Facility-specific background concentrations were also considered in the reevaluation for soil and groundwater. The background evaluation consisted of a direct comparison of site concentrations to the upper tolerance limits (UTLs) developed for inorganics in the background study in a manner analogous to the comparison to ESVs. Soil background 95 percent UTL values have been developed separately for surface and subsurface soils. The background 95 percent UTL values for groundwater have been derived for both the Yorktown-Eastover aquifer (deep) and the Cornwallis Cave aquifer (shallow).

G.5.3 Comparison With Ecological Screening Values

As discussed in **Section G.3.2**, the maximum, arithmetic mean, and 95% UCL of the arithmetic mean concentrations were compared with ESVs. Chemicals were excluded from further consideration in the SERA if the HQ based upon the maximum concentration was less than 1. Chemicals were excluded from further consideration in the BERA if the HQ based upon the 95% UCL was less than 1, although chemicals with HQs slightly above one based upon the 95% UCL but less than one based upon the mean were also considered for exclusion in the risk evaluation based upon factors such as the spatial pattern of ESV exceedances.

Surface Soil

Maximum, mean, and 95% UCL surface soil concentrations are compared to soil ESVs for plants and soil invertebrates in **Table G-15. Table G-15** also contains a comparison against background UTLs for metals that exceeded soil ESVs based upon 95% UCL concentrations.

Three metals (aluminum, iron, and mercury) exceeded ESVs based upon maximum detected concentrations (**Table G-15**). The ESVs for aluminum and iron were based upon soil pH, which was not measured. Thus, aluminum, iron, and mercury were identified as Step 2 COPCs. One metal (selenium) and one SVOC (atrazine) were not detected but maximum detection limits exceeded ESVs. These two chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL concentrations in surface soil are also compared with ESVs in **Table G-15**. Only mercury had a HQ that exceeded one based upon the 95% UCL concentration; mercury also exceeded the background UTL. Iron, but not aluminum, exceeded the background UTL. Thus, mercury and iron were identified as Step 3A COPCs for

further risk evaluation (see **Section G.5.5**). Two chemicals (selenium and atrazine) were not detected but mean concentrations based upon detection limits (95% UCL values could not be calculated since only a single sample was analyzed for these two chemicals) exceeded ESVs. These chemicals were not identified as Step 3A COPCs but are discussed in the uncertainty section (**Section G.6**).

Subsurface Soil

Maximum, mean, and 95% UCL subsurface soil concentrations are compared to soil ESVs for plants and soil invertebrates in **Table G-16. Table G-16** also contains a comparison against background UTLs for metals that exceeded soil ESVs based upon 95% UCL concentrations.

Three metals (aluminum, iron, and mercury) exceeded ESVs based upon maximum detected concentrations (**Table G-16**). The ESVs for aluminum and iron were based upon soil pH, which was not measured. Thus, aluminum, iron, and mercury were identified as Step 2 COPCs. One metal (selenium) and one SVOC (atrazine) were not detected but maximum detection limits exceeded ESVs. These two chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL concentrations in surface soil are also compared with ESVs in **Table G-16**. Only mercury had a HQ that exceeded one based upon the 95% UCL concentration; mercury also exceeded the background UTL. Neither iron nor aluminum exceeded the background UTL. Thus, mercury was identified as a Step 3A COPC for further risk evaluation (see **Section G.5.5**). Two chemicals (selenium and atrazine) were not detected but mean concentrations based upon detection limits (95% UCL values could not be calculated since only a single sample was analyzed for these two chemicals) exceeded ESVs. These chemicals were not identified as Step 3A COPCs but are discussed in the uncertainty section (**Section G.6**).

Groundwater

Although ecological receptors do not typically have direct exposure to groundwater, surface water ESVs were compared to site groundwater data in order to provide a conservative evaluation of the potential for significant contaminant transport via groundwater to the water bodies (wetlands) located downgradient of the site. The groundwater evaluation provided in the ERA was a modified version of the initial (screening) groundwater evaluation method provided in the decision tree of USEPA (2008b). Modifications included the use of mean concentrations and dilution factors in Step 3A, consistent with the less conservative (but more realistic) assumptions applied as part of the Step 3A evaluation.

Although both total and dissolved groundwater data were included in the screening tables, only dissolved metals data were considered when selecting COPCs because chemicals in groundwater are most likely to travel dissolved in water rather than adhered to particles since they must travel through soil pores. Similarly, when groundwater discharges to a water body (at which time ecological exposures become possible), the bulk of the discharged chemicals are likely to be dissolved in water since the discharge must pass through the pores in the underlying sediments. Thus, the dissolved concentrations are likely to be more representative of what would be transported via the groundwater than the total concentrations. Once discharged, the dissolved metal fraction in water (filtered samples) is more representative of the bioavailable fraction to aquatic receptors than the total metal fraction (unfiltered samples) (USEPA, 1996a). This is reflected in how the most recent Ambient Water Quality Criteria have been developed for many metals, that is, they are based upon the dissolved fraction (USEPA, 2009).

Maximum, mean, and 95% UCL groundwater concentrations are compared to ESVs in **Table G-17**. **Table G-17** also contains a comparison against background UTLs for metals that exceeded ESVs based upon 95% UCL concentrations.

No chemicals were detected in site groundwater samples (**Table G-17**). Cadmium exceeded screening values based upon maximum detected concentrations in both filtered and unfiltered samples. Thus, cadmium was identified as a Step 2 COPC.

The comparison of maximum undiluted groundwater concentrations with surface water ESVs is very conservative and likely significantly overestimates potential ecological exposures to sediment pore water in the biologically active zone and, especially, in the water column. The mean concentration is likely to provide a more realistic

estimate of potential transport/exposure because groundwater discharge to the water bodies is expected to be diffuse rather than concentrated at particular points. Groundwater is also unlikely to be discharged undiluted. In the absence of site-specific dilution factors, Buchman (1999) recommends using a dilution factor of 10 to account for the dilution expected during migration to surface water bodies.

One metal (cadmium) was not detected but 95 percent UCL concentrations based upon detection limits exceeded ESVs. This chemical was not identified as a Step 3A COPC but is discussed in the uncertainty section (**Section G.6**). However, mean detection limits were less than 10 times the ESV (so would be less than one with a dilution factor of 10 applied).

G.5.4 Terrestrial Food Web Exposures

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing maximum surface soil concentrations with the lower of the available bird and mammal Eco-SSLs for the chemicals listed in **Table G-3**. These Eco-SSL values are listed in **Table G-18**. Chemicals that exceeded the Eco-SSLs based upon the maximum surface soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. Chemicals that were on the bioaccumulative chemicals list (**Table G-3**) and did not have Eco-SSLs were automatically included in site-specific food web modeling. The final Step 2 food web COPCs were selected based upon a comparison of maximum exposure doses from site-specific food web modeling with the NOAEL-based ingestion TRV. Those chemicals with an exposure dose exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 3A, ingestion-based (food web) COPCs were based upon a comparison of mean and 95% UCL exposure doses with ingestion TRVs based upon the NOAEL, MATC, and LOAEL. An exceedance of the 95% UCL-based MATC was considered an unacceptable risk at Step 3A, although chemicals that exceed the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Table G-19 shows the results of the initial screening against bird and mammal Eco-SSLs. Those chemicals exceeding the Eco-SSLs based upon the maximum detected surface soil concentration (cadmium and lead) were retained for site-specific food web modeling; the remaining chemicals with concentrations below the bird and mammal Eco-SSLs were not evaluated further for terrestrial food web exposures. Selenium was also retained because it was not detected but maximum reporting limits exceeded the Eco-SSL value.

HQs based upon maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Table G-20** (calculations are shown in **Tables G-21 through G-26**)**.** Based upon a comparison to NOAELs, mercury and selenium had HQs exceeding one for one or more receptors. The exceedance for selenium was based upon maximum reporting limits. Ingestion TRVs were not available for any receptor for 4-bromophenyl-phenylether and 4-chlorophenyl-phenylether, neither of which was detected in surface soil.

HQs based upon 95% UCL and mean exposure doses for each upper trophic level terrestrial receptor are listed in **Table G-27** (calculations are shown in **Tables G-28 through G-33**)**.** Because selenium was only analyzed for in a single sample, a 95% UCL could not be calculated for this chemical. Based upon a comparison to NOAELs, no chemical had a HQ exceeding one. Because there were no exceedances based upon the MATC or LOAEL, no Step 3A COPCs were identified for terrestrial food web exposures and risks from this exposure pathway are considered acceptable.

G.5.5 Risk Evaluation

In this section, the various lines of evidence discussed in the previous section are integrated in order to evaluate the potential for unacceptable risks.

Terrestrial Habitats

Nine assessment endpoints were developed for terrestrial habitats at Site 32 (**Table G-2**). Lines of evidence for terrestrial habitats included:

- Comparison of surface soil and shallow subsurface soil concentrations with ESVs
- Comparison of modeled dietary doses with ingestion TRVs

- Comparison of site surface and shallow subsurface soil concentrations with background concentrations

In both surface and subsurface soils, only mercury had a 95% UCL-based HQ that exceeded one and also exceeded the background UTL. Mercury exceeded ESVs and UTLs in only a single surface soil sample from location SS-03, which was not directly associated with any of the former STP structures (**Figure 4-1**). The magnitude of the 95% UCL HQ was relatively low (1.13) and the mean HQ was less than one (0.63) (**Table G-15**). Similarly, in subsurface soils, mercury exceeded ESVs and UTLs in only a single sample from location SB-07, which was associated with the former location of the trickling filter (**Figure 4-1**). The magnitude of the 95% UCL HQ was relatively low (1.33) and the mean HQ was less than one (0.81) (**Table G-16**). However, the maximum residual soil concentrations of mercury detected in Site 32 surface soil (0.24 mg/kg) and subsurface soil (0.25 mg/kg) are consistent with the maximum concentration detected in background soils (0.24 mg/kg) from the facility. Given the habitat present on the site (periodically mowed grass), these potential exposures for mercury are considered to be within the acceptable risk range on a site-wide basis, especially when considering other ESVs from the literature (which range from 0.30 to 36.0 mg/kg for various lower trophic level receptors [Efroymson et al., 1997a; 1997b; CCME, 2007; Beyer, 1990; MSHPE, 2000; 2001]), none of which are less than the maximum surface (0.24 mg/kg) or subsurface (0.25 mg/kg) site soil concentration, and maximum background concentrations, which are consistent with maximum site soil concentrations.

In surface soils, iron also exceeded the background UTL, and soil pH, on which its ESV is based, was not measured in site soils. The exceedance of the background UTL was of low magnitude (ratio of 1.11) and there were no background exceedances in subsurface soils (whose UTL was notably higher than the surface soil UTL [32,000 mg/kg versus 19,900 mg/kg]). It is unlikely that this slight exceedance of the surface soil background UTL is biologically significant.

No chemical had a MATC HQ exceeding one based upon the 95% UCL exposure dose. Thus, risks from terrestrial food web exposures are considered acceptable.

Aquatic Habitats

No chemicals were identified as Step 3A COPCs for further risk evaluation in groundwater. Based upon the results of this evaluation, groundwater does not appear to be a significant transport medium for site-related constituents to the downgradient wetlands, and site-related constituents that might reach these water bodies via groundwater would not pose an unacceptable risk to aquatic biota.

G.5.6 Risk Summary and Conclusions

For terrestrial habitats, risks for lower trophic level receptors (plants and invertebrates) are acceptable on a site-wide basis, particularly given the current and future habitat (periodically mowed field). No chemical had a MATC HQ exceeding one based upon the 95% UCL exposure dose. Thus, risks from terrestrial food web exposures are acceptable. Groundwater does not appear to be a significant transport medium for site-related constituents to the downgradient wetlands, and site-related constituents in groundwater are unlikely to pose a significant risk to aquatic biota.

G.6 Uncertainties

Uncertainties are present in all risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based upon incomplete information. In addition, the use of various models (for uptake and food web exposures) carries with it some associated uncertainty as to how well the model reflects actual conditions. Since conservative assumptions were generally used in the exposure and effects assessments, these uncertainties are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to ecological receptors.

The ERA uses “standard” methods and typical ranges of values for EPCs (maximum, mean, and 95 percent UCL), TRVs (NOAEL, MATC, LOAEL), and other parameters. This results in risk estimates that adequately span the risk range from extremely conservative (screening estimates) to central tendency (mean baseline estimates). The

uncertainties associated with many of the particular inputs to the risk estimates are discussed below. What constitutes an unacceptable risk within this risk range is ultimately a risk management decision.

The uncertainties in this ERA are mainly attributable to the following factors:

- Reporting Limits - Reporting limits for some undetected analytes exceeded applicable ESVs in some media. **Table G-34** summarizes these constituents, by medium, and reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the ESV. Because these constituents were not detected, they are not known to be present on the site but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (that is, higher ratios are indicative of a greater likelihood that chemicals are present at concentrations that exceed the screening value relative to lower ratios). In surface and subsurface soils, two undetected chemicals exceeded reporting limits but the mean ratio was five or less. In groundwater, mean reporting limits were less than 10 times ESVs.

  In summary, there were no chemicals with very high mean ratios, suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits for the vast majority of samples and analytes, these uncertainties are considered acceptable and are unlikely to impact the conclusions of the ERA.

- Duplicate Analyses - When evaluating samples with field duplicates, the value used in the ERA was always the detect when one result was a detect and the duplicate was a non-detect, regardless of whether or not the non-detected value was higher. In these cases, the use of the detect has less uncertainty since it represents an actual measured value (versus an upper limit bound) and the two samples will have identical or similar reporting limits.

- Selection of COPCs - Chemicals without available ESVs for a medium were not retained as COPCs for risk evaluation unless they were detected. These uncertainties are unlikely to impact the conclusions of the ERA since these chemicals are not known to be present on the site.

- Ingestion Screening Values - Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with non-wildlife species. This is a typical limitation and extrapolation for ERAs because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet. It is difficult to predict if these extrapolations would result in overestimating or underestimating potential risks.

  A second uncertainty related to the derivation of ingestion TRVs applies to metals. Most of the toxicological studies on which the ingestion TRVs for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Because the analytical samples on which site-specific exposure estimates were based measured total metal, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, this is likely to result in an overestimation of potential risks for these chemicals but not to the extent that it would unduly impact the conclusions of the ERA.

  A third source of uncertainty related to the derivation of ingestion-based TRVs applies to mercury and selenium. The ingestion-based TRVs used for these two metals were based on organometallic (methylated) forms. TRVs for inorganic forms tend to be substantially higher. Given that inorganic forms likely contribute significantly to the total mercury and selenium, the use of TRVs based upon organometallic forms tends to make the TRVs for these metals extremely conservative and likely overestimates potential risk.

- Chemical Mixtures - Information on the toxicological effects of chemical interactions is generally lacking for ecological receptors, which required (as is standard for ERAs) that the chemicals be evaluated on a compound-by-compound basis during the comparison to ESVs and TRVs. This could result in an underestimation of risk (if there are additive or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

- Receptor Species Selection - Reptiles were selected as receptors in the ERA, but were not evaluated quantitatively even when exposure pathways were likely to be complete. For food web exposures, this taxon was evaluated using other fauna (birds and mammals) as surrogates due to the general lack of taxon-specific toxicological data. This represents an uncertainty in the ERA.

  It was also assumed that any reptiles present on the site were not exposed to significantly higher concentrations of chemicals and were not more sensitive to chemicals than other receptor species evaluated in the ERA. This assumption was a source of uncertainty in the ERA. In addition, there is some uncertainty associated with the use of specific receptor species to represent larger groups of organisms (guilds).

- Calculation of the Total Exposure Dose - For most constituents, the contribution to the total dose from the inhalation route is insignificant for upper trophic level ecological receptors, especially relative to ingestion pathways. Thus, and given the general lack of data for evaluating this pathway (USEPA, 1999), the air pathway is not generally included in the total dose calculations for these ecological receptors. This could lead to an underestimation of the total dose to which these receptors are exposed. However, this underestimation is likely to be very small since volatile organic compounds (the constituents most likely to contribute to exposures via the inhalation route) were not detected in site soils. Exposure to chemicals present in surface soil via dermal contact may occur but is unlikely to represent a major exposure pathway for most upper trophic level receptors because fur or feathers minimize transfer of chemicals across dermal tissue. As for the inhalation pathway, there is a general lack of data for evaluating this pathway (USEPA, 1999) and not including this pathway in the calculation of the total dose is not likely to significantly underestimate total exposure, especially since incidental ingestion of surface soil during feeding, preening, or grooming activities is included in the total dose calculations.

- Food Web Exposure Modeling - Chemical concentrations in terrestrial food items (plants, soil invertebrates [earthworms], and small mammals) were modeled from measured surface soil concentrations and were not directly measured. The use of generic, literature-derived exposure models and bioaccumulation factors introduces some uncertainty into the resulting estimates. The values selected and methodology employed were intended to provide a conservative (Step 2) or reasonable (Step 3A) estimate of potential food web exposure concentrations.

  Another source of uncertainty is the use of default assumptions for exposure parameters such as BCFs and BAFs. Although BCFs or BAFs for many bioaccumulative chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty.

  Area use factors were assumed to equal one. This is a conservative assumption since a significant percentage of each upper trophic level receptor species' time could be spent foraging off-site in unimpacted areas or in areas where chemical concentrations are expected to be significantly lower.

- Mean Versus Maximum Media Concentrations - As is typical in an ERA, a finite number of samples of environmental media are used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based upon the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the *Wildlife Exposure Factors Handbook* (USEPA, 1993), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the

ERA, the use of maximum chemical concentrations (rather than mean concentrations) in the SERA to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the BERA evaluation. The 95% UCL of the arithmetic mean was used quantitatively in the BERA portion of this ERA to represent the average exposure scenarios.

- Evaluation of the Groundwater Transport Pathway - Potential ecological risks from groundwater discharge to downgradient surface water bodies (wetlands) were indirectly evaluated through a comparison of groundwater concentrations from site wells with surface water ecological screening values. Surface water, pore water, and/or sediment samples were not collected from these water bodies as part of this SI but were previously evaluated (CH2M HILL, 2008). The direct screening of groundwater data is normally the first step in such an evaluation (e.g., USEPA, 2008b), with surface water, pore water, and/or sediment samples only collected from the receiving water body or bodies if the initial screening indicates the potential for significant transport and exposure from this pathway. Based upon the results of the groundwater screening, potential ecological risks were not high enough to warrant further evaluation or additional sample collection in the receiving water body.
- Comparisons to Background Concentrations - Background concentrations were used to judge the site-relatedness of individual chemicals. If site concentrations were consistent with background levels, it was assumed that the concentrations were not related to known site-related source areas. There exists the possibility that concentrations below background were indeed site-related, rendering the assumption false. However the potential impact of this possibility is minimal since chemicals at concentrations consistent with background should exhibit no different ecological effects than commonly occurring in areas not affected by releases, regardless of their source.

G.7 References for Appendix G

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TABLE G-1

Samples Used in the Ecological Risk Assessment

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Station ID	Sample ID	Sample Date	Depth (inches)	Area
Surface Soil				
YS32-GW01	YS32-SS01-0312	3/1/2012	0-6	--
YS32-GW02	YS32-SS02-0312	3/1/2012	0-6	--
YS32-GW03	YS32-SS03-0312	3/1/2012	0-6	--
YS32-GW04	YS32-SS04-0312	3/1/2012	0-6	--
YS32-GW04	YS32-SS04P-0312	3/1/2012	0-6	--
YS32-GW05	YS32-SS05-0312	3/1/2012	0-6	--
YS32-SO06	YS32-SS06-0312	3/1/2012	0-6	Imhoff tank area
YS32-SO07	YS32-SS07-0312	3/1/2012	0-6	Trickling filter area
YS32-SO08	YS32-SS08-0312	3/1/2012	0-6	Sludge drying beds (composite)
YS32-SO08	YS32-SS08P-0312	3/1/2012	0-6	Sludge drying beds (composite)
Subsurface Soil				
YS32-GW01	YS32-SB01-06-24-0312	3/1/2012	6-24	--
YS32-GW02	YS32-SB02-06-24-0312	3/1/2012	6-24	--
YS32-GW03	YS32-SB03-06-24-0312	3/1/2012	6-24	--
YS32-GW04	YS32-SB04-06-24-0312	3/1/2012	6-24	--
YS32-GW04	YS32-SB04P-06-24-0312	3/1/2012	6-24	--
YS32-GW05	YS32-SB05-06-24-0312	3/1/2012	6-24	--
YS32-SO06	YS32-SB06-06-24-0312	3/1/2012	6-24	Imhoff tank area
YS32-SO07	YS32-SB07-06-24-0312	3/1/2012	6-24	Trickling filter area
YS32-SO08	YS32-SB08-06-24-0312	3/1/2012	6-24	Sludge drying beds (composite)
YS32-SO08	YS32-SB08P-06-24-0312	3/1/2012	6-24	Sludge drying beds (composite)
Groundwater				
YS32-GW01	YS32-GW01-0512	5/17/2012	--	--
YS32-GW02	YS32-GW02-0512	5/17/2012	--	--
YS32-GW03	YS32-GW03-0512	5/17/2012	--	--
YS32-GW04	YS32-GW04-0512	5/17/2012	--	--
YS32-GW04	YS32-GW04P-0512	5/17/2012	--	--
YS32-GW05	YS32-GW05-0512	5/17/2012	--	--

Shaded cells indicate field duplicates

TABLE G-2

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect soil invertebrate communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values	Soil invertebrates
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect terrestrial plant communities?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Comparison of maximum (SERA) and mean (BERA) chemical concentrations in surface soil with soil screening values Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA (birds and mammals used as surrogates)	Reptiles
Survival, growth, and reproduction of avian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants (seeds) from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	Mourning dove
Survival, growth, and reproduction of avian terrestrial invertivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	American robin
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	Red-tailed hawk

TABLE G-2

Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of mammalian terrestrial herbivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume plants from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	Meadow vole
Survival, growth, and reproduction of mammalian terrestrial invertivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume soil invertebrates from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	Short-tailed shrew
Survival, growth, and reproduction of mammalian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals from the site?	Comparison of modeled dietary intakes using maximum (SERA) and mean (BERA) surface soil concentrations with literature-based ingestion TRVs; ratios >1 based upon the NOAEL-LOAEL range indicate an effect	Red fox

TABLE G-3

Bioaccumulative Chemicals List and Log K_{ow} Values

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Metals			
Arsenic	-- - --	--	--
Cadmium	-- - --	--	--
Chromium[1]	-- - --	--	--
Copper	-- - --	--	--
Lead	-- - --	--	--
Mercury[2]	-- - --	--	--
Nickel	-- - --	--	--
Selenium	-- - --	--	--
Silver	-- - --	--	--
Zinc	-- - --	--	--
Polychlorinated Biphenyls[3]			
Aroclor-1016	Not reported	5.60	Sample et al. 1996
Aroclor-1221	Not reported	4.70	Jones et al. 1997
Aroclor-1232	Not reported	5.10	Jones et al. 1997
Aroclor-1242	Not reported	5.60	Jones et al. 1997
Aroclor-1248	Not reported	6.20	Jones et al. 1997
Aroclor-1254	Not reported	6.50	Jones et al. 1997
Aroclor-1260	Not reported	6.80	Jones et al. 1997
Aroclor-1268	Not reported	6.80	Aroclor-1260
Pesticides			
4,4'-DDD	5.90 - 6.65	6.10	USEPA 1995a
4,4'-DDE	5.63 - 6.96	6.76	USEPA 1995a
4,4'-DDT	5.56 - 7.01	6.53	USEPA 1995a
Aldrin	5.11 - 7.50	6.50	USEPA 1995a
alpha-BHC	3.75 - 3.81	3.80	USEPA 1995a
alpha-Chlordane[4]	5.80 - 6.41	6.32	USEPA 1995a
beta-BHC	3.75 - 3.84	3.81	USEPA 1995a
delta-BHC	Not reported	4.10	USEPA 1996b
Dieldrin	3.63 - 6.20	5.37	USEPA 1995a
Endosulfan I	3.55 - 3.85	3.83	USEPA 1995a
Endosulfan II	3.62 - 4.52	4.52	USEPA 1995a
Endrin	2.92 - 5.20	5.06	USEPA 1995a
gamma-BHC (Lindane)	3.61 - 3.90	3.73	USEPA 1995a
gamma-Chlordane[4]	5.80 - 6.41	6.32	USEPA 1995a
Heptachlor	4.93 - 6.26	6.26	USEPA 1995a
Heptachlor epoxide	3.50 - 5.40	5.00	USEPA 1995a
Methoxychlor	4.20 - 5.60	5.08	USEPA 1995a
Toxaphene	4.33 - 5.56	5.50	USEPA 1995a
Volatile and Semivolatile Organic Compounds			
1,1,2,2-Tetrachloroethane[5]	2.31 - 2.64	2.39	USEPA 1995a
1,2,4-Trichlorobenzene	3.89 - 4.23	4.01	USEPA 1995a
1,2-Dichlorobenzene	3.20 - 3.61	3.43	USEPA 1995a
1,3-Dichlorobenzene	Not reported	3.50	USEPA 1996b

TABLE G-3

Bioaccumulative Chemicals List and Log K_{ow} Values

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
1,4-Dichlorobenzene	3.26 - 3.62	3.42	USEPA 1995a
4-Bromophenyl-phenylether	4.89 - 5.24	5.00	USEPA 1995a
4-Chlorophenyl-phenylether	4.08 - 5.09	4.95	USEPA 1995a
Acenaphthene	3.77 - 4.49	3.92	USEPA 1995a
Acenaphthylene	Not reported	4.10	USEPA 1996b
Anthracene	4.44 - 4.80	4.55	USEPA 1995a
Benzo(a)anthracene	5.61 - 5.79	5.70	USEPA 1995a
Benzo(a)pyrene	5.98 - 6.34	6.11	USEPA 1995a
Benzo(b)fluoranthene	5.79 - 6.40	6.20	USEPA 1995a
Benzo(g,h,i)perylene	6.58 - 7.05	6.70	USEPA 1995a
Benzo(k)fluoranthene	6.12 - 6.27	6.20	USEPA 1995a
Chrysene	5.41 - 5.79	5.70	USEPA 1995a
Dibenz(a,h)anthracene	6.50 - 6.88	6.69	USEPA 1995a
Fluoranthene	4.84 - 5.39	5.12	USEPA 1995a
Fluorene	4.04 - 4.40	4.21	USEPA 1995a
Hexachlorobenzene	5.23 - 6.92	5.89	USEPA 1995a
Hexachlorobutadiene	4.74 - 5.16	4.81	USEPA 1995a
Hexachlorocyclopentadiene	5.05 - 5.51	5.39	USEPA 1995a
Hexachloroethane	3.82 - 4.14	4.00	USEPA 1995a
Indeno(1,2,3-cd)pyrene	6.58 - 6.72	6.65	USEPA 1995a
Pentachlorophenol	5.01 - 5.24	5.09	USEPA 1995a
Phenanthrene	4.37 - 4.57	4.55	USEPA 1995a
Pyrene	4.76 - 5.52	5.11	USEPA 1995a

[1] Listed as chromium VI but applied to total chromium

[2] Listed as methylmercury but applied to total mercury

[3] PCB congeners 8, 18, 28, 44, 52, 66, 77, 81, 101, 105, 118, 126, 128, 138, 153, 156, 169, 170, 180, 187, 195, 206, and 209 are also listed in USEPA (2000)

[4] Listed as "chlordane"

[5] Listed as "tetrachloroethane"

TABLE G-4

Soil Bioconcentration Factors For Plants (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	See Table G-5	--	--	See Table G-5	--
Cadmium	--	See Table G-5	--	--	See Table G-5	--
Chromium	0.084	90th percentile	Bechtel Jacobs 1998a	0.041	Median	Bechtel Jacobs 1998a; USEPA 2007j
Copper	--	See Table G-5	--	--	See Table G-5	--
Lead	--	See Table G-5	--	--	See Table G-5	--
Mercury	--	See Table G-5	--	--	See Table G-5	--
Nickel	--	See Table G-5	--	--	See Table G-5	--
Selenium	--	See Table G-5	--	--	See Table G-5	--
Silver	0.037	90th percentile	Bechtel Jacobs 1998a	0.014	Median	Bechtel Jacobs 1998a; USEPA 2007j
Zinc	--	See Table G-5	--	--	See Table G-5	--
Pesticides						
4,4'-DDD	--	See Table G-5	--	--	See Table G-5	--
4,4'-DDE	--	See Table G-5	--	--	See Table G-5	--
4,4'-DDT	--	See Table G-5	--	--	See Table G-5	--
Aldrin	0.139	Calculated[1]	USEPA 2007j	0.139	Calculated	USEPA 2007j
alpha-BHC	1.735	Calculated	USEPA 2007j	1.735	Calculated	USEPA 2007j
alpha-Chlordane	0.165	Calculated	USEPA 2007j	0.165	Calculated	USEPA 2007j
beta-BHC	1.719	Calculated	USEPA 2007j	1.719	Calculated	USEPA 2007j
delta-BHC	1.311	Calculated	USEPA 2007j	1.311	Calculated	USEPA 2007j
Dieldrin	1.500	90th percentile	USEPA 2007j	0.410	Median	USEPA 2007j
Endosulfan I	1.687	Calculated	USEPA 2007j	1.687	Calculated	USEPA 2007j
Endosulfan II	0.886	Calculated	USEPA 2007j	0.886	Calculated	USEPA 2007j
Endrin	0.535	Calculated	USEPA 2007j	0.535	Calculated	USEPA 2007j
gamma-BHC (Lindane)	1.852	Calculated	USEPA 2007j	1.852	Calculated	USEPA 2007j
gamma-Chlordane	0.165	Calculated	USEPA 2007j	0.165	Calculated	USEPA 2007j
Heptachlor	0.174	Calculated	USEPA 2007j	0.174	Calculated	USEPA 2007j
Heptachlor epoxide	0.566	Calculated	USEPA 2007j	0.566	Calculated	USEPA 2007j

TABLE G-4

Soil Bioconcentration Factors For Plants (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Methoxychlor	0.525	Calculated	USEPA 2007j	0.525	Calculated	USEPA 2007j
Toxaphene	0.355	Calculated	USEPA 2007j	0.355	Calculated	USEPA 2007j
Polychlorinated Biphenyls						
Aroclor-1016	0.323	Calculated	USEPA 2007j	0.323	Calculated	USEPA 2007j
Aroclor-1221	0.749	Calculated	USEPA 2007j	0.749	Calculated	USEPA 2007j
Aroclor-1232	0.515	Calculated	USEPA 2007j	0.515	Calculated	USEPA 2007j
Aroclor-1242	0.323	Calculated	USEPA 2007j	0.323	Calculated	USEPA 2007j
Aroclor-1248	0.184	Calculated	USEPA 2007j	0.184	Calculated	USEPA 2007j
Aroclor-1254	0.139	Calculated	USEPA 2007j	0.139	Calculated	USEPA 2007j
Aroclor-1260	0.105	Calculated	USEPA 2007j	0.105	Calculated	USEPA 2007j
Aroclor-1268	0.105	Calculated	USEPA 2007j	0.105	Calculated	USEPA 2007j
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	1.000	Assumed	--	1.000	Assumed	--
1,2,4-Trichlorobenzene	1.426	Calculated	USEPA 2007j	1.426	Calculated	USEPA 2007j
1,2-Dichlorobenzene	2.452	Calculated	USEPA 2007j	2.452	Calculated	USEPA 2007j
1,3-Dichlorobenzene	2.296	Calculated	USEPA 2007j	2.296	Calculated	USEPA 2007j
1,4-Dichlorobenzene	2.475	Calculated	USEPA 2007j	2.475	Calculated	USEPA 2007j
4-Bromophenyl-phenylether	0.566	Calculated	USEPA 2007j	0.566	Calculated	USEPA 2007j
4-Chlorophenyl-phenylether	0.593	Calculated	USEPA 2007j	0.593	Calculated	USEPA 2007j
Acenaphthene	--	See Table G-5	--	--	See Table G-5	--
Acenaphthylene	--	See Table G-5	--	--	See Table G-5	--
Anthracene	--	See Table G-5	--	--	See Table G-5	--
Benzo(a)anthracene	--	See Table G-5	--	--	See Table G-5	--
Benzo(a)pyrene	--	See Table G-5	--	--	See Table G-5	--
Benzo(b)fluoranthene	0.480	Maximum	USEPA 2007j	0.310	Median	USEPA 2007j
Benzo(g,h,i)perylene	--	See Table G-5	--	--	See Table G-5	--
Benzo(k)fluoranthene	--	See Table G-5	--	--	See Table G-5	--
Chrysene	--	See Table G-5	--	--	See Table G-5	--
Dibenz(a,h)anthracene	0.230	Maximum	USEPA 2007j	0.130	Median	USEPA 2007j
Fluoranthene	4.700	90th percentile	USEPA 2007j	0.500	Median	USEPA 2007j

TABLE G-4

Soil Bioconcentration Factors For Plants (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Fluorene	--	See Table G-5	--	--	See Table G-5	--
Hexachlorobenzene	0.246	Calculated	USEPA 2007j	0.246	Calculated	USEPA 2007j
Hexachlorobutadiene	0.675	Calculated	USEPA 2007j	0.675	Calculated	USEPA 2007j
Hexachlorocyclopentadiene	0.393	Calculated	USEPA 2007j	0.393	Calculated	USEPA 2007j
Hexachloroethane	1.439	Calculated	USEPA 2007j	1.439	Calculated	USEPA 2007j
Indeno(1,2,3-cd)pyrene	0.150	Maximum	USEPA 2007j	0.110	Median	USEPA 2007j
Pentachlorophenol	30.10	90th percentile	USEPA 2007j	5.930	Median	USEPA 2007j
Phenanthrene	--	See Table G-5	--	--	See Table G-5	--
Pyrene	2.400	90th percentile	USEPA 2007j	0.720	Median	USEPA 2007j

[1] Calculated as described in the text using the "selected" log K_{ow} from Table G-3

TABLE G-5

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Plants[1]	Reference	Soil Invertebrates[2]	Reference	Small Mammal Herbivores[3]	Reference	Small Mammal Insectivores[3]	Reference
Metals								
Arsenic	$C_p = e^{(-1.992 + 0.564(\ln Cs))}$	Bechtel Jacobs 1998a	$C_w = e^{(-1.421 + 0.706(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_m = e^{(-5.6531 + 1.1382(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(-4.8471 + 0.8188(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Cadmium	$C_p = e^{(-0.476 + 0.546(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(2.114 + 0.795(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_m = e^{(-1.2571 + 0.4723(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(0.8150 + 0.9638(\ln Cs))}$	Sample et al. 1998b
Chromium	--	--	--	--	$C_m = e^{(-1.4599 + 0.7338(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-1.4599 + 0.7338(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Copper	$C_p = e^{(0.669 + 0.394(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(1.675 + 0.264(\ln Cs))}$	Sample et al. 1998a	$C_m = e^{(2.0420 + 0.1444(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(2.1042 + 0.1783(\ln Cs))}$	Sample et al. 1998b
Lead	$C_p = e^{(-1.328 + 0.561(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(-0.218 + 0.807(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_m = e^{(-0.6114 + 0.5181(\ln Cs))}$	Sample et al. 1998b	$C_m = e^{(0.4819 + 0.4869(\ln Cs))}$	Sample et al. 1998b
Mercury	$C_p = e^{(-0.996 + 0.544(\ln Cs))}$	Bechtel Jacobs 1998a	--	--	--	--	--	--
Nickel	$C_p = e^{(-2.224 + 0.748(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	--	--	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.2462 + 0.4658(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Selenium	$C_p = e^{(-0.678 + 1.104(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(-0.075 + 0.733(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(-0.4158 + 0.3764(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j
Zinc	$C_p = e^{(1.575 + 0.555(\ln Cs))}$	Bechtel Jacobs 1998a; USEPA 2007j	$C_w = e^{(4.449 + 0.328(\ln Cs))}$	Sample et al. 1998a; USEPA 2007j	$C_m = e^{(4.3632 + 0.0706(\ln Cs))}$	Sample et al. 1998b; USEPA 2007j	$C_m = e^{(4.2479 + 0.1324(\ln Cs))}$	Sample et al. 1998b
Pesticides								
4,4'-DDD	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(1.1613 + 0.6975(\ln Cs))}$	USEPA 2007j	--	--	--	--
4,4'-DDE	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(2.4771 + 0.8804(\ln Cs))}$	USEPA 2007j	--	--	--	--
4,4'-DDT	$C_p = e^{(-2.5119 + 0.7524(\ln Cs))}$	USEPA 2007j	$C_w = e^{(2.1247 + 0.8689(\ln Cs))}$	USEPA 2007j	--	--	--	--
PCBs								
Aroclor-1016	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1221	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1232	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1242	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1248	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1254	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1260	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
Aroclor-1268	--	--	$C_w = e^{(1.410 + 1.361(\ln Cs))}$	Sample et al. 1998a	--	--	--	--
PAHs								
Acenaphthene	$C_p = e^{(-5.562 - 0.8556(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Acenaphthylene	$C_p = e^{(-1.144 + 0.791(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Anthracene	$C_p = e^{(-0.9887 + 0.7784(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--

TABLE G-5

Bioconcentration/Bioaccumulation Factor Models (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Plants[1]	Reference	Soil Invertebrates[2]	Reference	Small Mammal Herbivores[3]	Reference	Small Mammal Insectivores[3]	Reference
Benzo(a)anthracene	$C_p = e^{(-2.7078 + 0.5944(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Benzo(a)pyrene	$C_p = e^{(-2.0615 + 0.9750(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Benzo(g,h,i)perylene	$C_p = e^{(-0.9313 + 1.1829(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Benzo(k)fluoranthene	$C_p = e^{(-2.1579 + 0.8595(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Chrysene	$C_p = e^{(-2.7078 + 0.5944(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Fluorene	$C_p = e^{(-5.562 - 0.8556(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--
Phenanthrene	$C_p = e^{(-0.1665 + 0.6203(\ln Cs))}$	USEPA 2007j	--	--	--	--	--	--

[1] Where C_p = Concentration in aboveground portion of plant (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

[2] Where C_w = Concentration in earthworm (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

[3] Where C_m = Concentration in whole-body small mammal (mg/kg dry wt) and C_s = Concentration in soil (mg/kg dry wt)

TABLE G-6

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	see Table G-5	--	--	see Table G-5	--
Cadmium	--	see Table G-5	--	--	see Table G-5	--
Chromium	3.162	90th percentile	Sample et al. 1998a	0.320	Geometric mean	Sample et al. 1998a
Copper	--	see Table G-5	--	--	see Table G-5	--
Lead	--	see Table G-5	--	--	see Table G-5	--
Mercury	20.63	90th percentile	Sample et al. 1998a	1.186	Geometric mean	Sample et al. 1998a
Nickel	4.730	90th percentile	Sample et al. 1998a	1.656	Arithmetic mean	Sample et al. 1998a
Selenium	--	see Table G-5	--	--	see Table G-5	--
Silver	15.34	90th percentile	Sample et al. 1998a	2.045	Median	Sample et al. 1998a; USEPA 2007j
Zinc	--	see Table G-5	--	--	see Table G-5	--
Pesticides						
4,4'-DDD	--	see Table G-5	--	--	see Table G-5	--
4,4'-DDE	--	see Table G-5	--	--	see Table G-5	--
4,4'-DDT	--	see Table G-5	--	--	see Table G-5	--
Aldrin	3.30	Mean	Edwards and Bohlen 1992	3.30	Mean	Edwards and Bohlen 1992
alpha-BHC	1.00	Assumed	--	1.00	Assumed	--
alpha-Chlordane	4.00	Mean	Edwards and Bohlen 1992	4.00	Mean	Edwards and Bohlen 1992
beta-BHC	1.00	Assumed	--	1.00	Assumed	--
delta-BHC	1.00	Assumed	--	1.00	Assumed	--
Dieldrin	52.1	90th percentile	USEPA 2007j	13.5	Median	USEPA 2007j
Endosulfan I	1.00	Assumed	--	1.00	Assumed	--
Endosulfan II	1.00	Assumed	--	1.00	Assumed	--
Endrin	3.60	Mean	Edwards and Bohlen 1992	3.60	Mean	Edwards and Bohlen 1992
gamma-BHC (Lindane)	26.6	Maximum	Romijn et al. 1994	13.7	Mean	Romijn et al. 1994
gamma-Chlordane	4.00	Mean	Edwards and Bohlen 1992	4.00	Mean	Edwards and Bohlen 1992
Heptachlor	3.00	Mean	Edwards and Bohlen 1992	3.00	Mean	Edwards and Bohlen 1992
Heptachlor epoxide	10.0	Mean	Beyer and Gish 1980	10.0	Mean	Beyer and Gish 1980
Methoxychlor	1.00	Assumed	--	1.00	Assumed	--

TABLE G-6

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Toxaphene	1.00	Assumed	--	1.00	Assumed	--
Polychlorinated Biphenyls						
Aroclor-1016	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1221	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1232	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1242	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1248	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1254	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1260	--	see Table G-5	--	--	see Table G-5	--
Aroclor-1268	--	see Table G-5	--	--	see Table G-5	--
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	1.00	Assumed	--	1.00	Assumed	--
1,2,4-Trichlorobenzene	0.56	Mean	Beyer 1996	0.56	Mean	Beyer 1996
1,2-Dichlorobenzene	1.00	Assumed	--	1.00	Assumed	--
1,3-Dichlorobenzene	1.00	Assumed	--	1.00	Assumed	--
1,4-Dichlorobenzene	1.00	Assumed	--	1.00	Assumed	--
4-Bromophenyl-phenylethe	1.00	Assumed	--	1.00	Assumed	--
4-Chlorophenyl-phenylethe	1.00	Assumed	--	1.00	Assumed	--
Acenaphthene	0.30	Median	Beyer and Stafford 1993	0.30	Median	Beyer and Stafford 1993
Acenaphthylene	0.22	Median	Beyer and Stafford 1993	0.22	Median	Beyer and Stafford 1993
Anthracene	0.32	Median	Beyer and Stafford 1993	0.32	Median	Beyer and Stafford 1993
Benzo(a)anthracene	0.27	Median	Beyer and Stafford 1993	0.27	Median	Beyer and Stafford 1993
Benzo(a)pyrene	0.34	Median	Beyer and Stafford 1993	0.34	Median	Beyer and Stafford 1993
Benzo(b)fluoranthene	0.21	Median	Beyer and Stafford 1993	0.21	Median	Beyer and Stafford 1993
Benzo(g,h,i)perylene	0.15	Median	Beyer and Stafford 1993	0.15	Median	Beyer and Stafford 1993
Benzo(k)fluoranthene	0.21	Median	Beyer and Stafford 1993	0.21	Median	Beyer and Stafford 1993
Chrysene	0.44	Median	Beyer and Stafford 1993	0.44	Median	Beyer and Stafford 1993
Dibenz(a,h)anthracene	0.49	Median	Beyer and Stafford 1993	0.49	Median	Beyer and Stafford 1993
Fluoranthene	0.37	Median	Beyer and Stafford 1993	0.37	Median	Beyer and Stafford 1993
Fluorene	0.20	Median	Beyer and Stafford 1993	0.20	Median	Beyer and Stafford 1993

TABLE G-6

Soil Bioaccumulation Factors For Soil Invertebrates (Dry Weight)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Hexachlorobenzene	1.69	Mean	Beyer 1996	1.69	Mean	Beyer 1996
Hexachlorobutadiene	1.00	Assumed	--	1.00	Assumed	--
Hexachlorocyclopentadiene	1.00	Assumed	--	1.00	Assumed	--
Hexachloroethane	1.00	Assumed	--	1.00	Assumed	--
Indeno(1,2,3-cd)pyrene	0.41	Median	Beyer and Stafford 1993	0.41	Median	Beyer and Stafford 1993
Pentachlorophenol	88.1	90th percentile	USEPA 2007j	14.6	Median	USEPA 2007j
Phenanthrene	0.28	Median	Beyer and Stafford 1993	0.28	Median	Beyer and Stafford 1993
Pyrene	0.39	Median	Beyer and Stafford 1993	0.39	Median	Beyer and Stafford 1993

TABLE G-7a

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Herbivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	see Table G-5	--	--	see Table G-5	--
Cadmium	--	see Table G-5	--	--	see Table G-5	--
Chromium	--	see Table G-5	--	--	see Table G-5	--
Copper	--	see Table G-5	--	--	see Table G-5	--
Lead	--	see Table G-5	--	--	see Table G-5	--
Mercury	0.192	90th percentile	Sample et al. 1998b	0.067	Geometric mean	Sample et al. 1998b
Nickel	--	see Table G-5	--	--	see Table G-5	--
Selenium	--	see Table G-5	--	--	see Table G-5	--
Silver	0.007	90th percentile	Sample et al. 1998b	0.006	Geometric mean	Sample et al. 1998b
Zinc	--	see Table G-5	--	--	see Table G-5	--
Pesticides						
4,4'-DDD	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4,4'-DDE	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4,4'-DDT	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aldrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
alpha-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
alpha-Chlordane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
beta-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
delta-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Dieldrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endosulfan I	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endosulfan II	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
gamma-BHC (Lindane)	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
gamma-Chlordane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Heptachlor	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Heptachlor epoxide	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Methoxychlor	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Toxaphene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3

TABLE G-7a

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Herbivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Polychlorinated Biphenyls						
Aroclor-1016	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1221	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1232	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1242	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1248	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1254	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1260	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1268	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,2,4-Trichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,2-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,3-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,4-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4-Bromophenyl-phenylether	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4-Chlorophenyl-phenylether	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Acenaphthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Acenaphthylene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(a)anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(a)pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(b)fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(g,h,i)perylene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(k)fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Chrysene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Dibenz(a,h)anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Fluorene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Hexachlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3

TABLE G-7a

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Herbivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Hexachlorobutadiene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Hexachlorocyclopentadiene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Hexachloroethane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Indeno(1,2,3-cd)pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Pentachlorophenol	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Phenanthrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j

NA - Not Available

TABLE G-7b

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Insectivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Metals						
Arsenic	--	see Table G-5	--	--	see Table G-5	--
Cadmium	--	see Table G-5	--	--	see Table G-5	--
Chromium	--	see Table G-5	--	--	see Table G-5	--
Copper	--	see Table G-5	--	--	see Table G-5	--
Lead	--	see Table G-5	--	--	see Table G-5	--
Mercury	0.192	90th percentile	Sample et al. 1998b	0.067	Geometric mean	Sample et al. 1998b
Nickel	--	see Table G-5	--	--	see Table G-5	--
Selenium	--	see Table G-5	--	--	see Table G-5	--
Silver	0.501	90th percentile	Sample et al. 1998b	0.036	Geometric mean	Sample et al. 1998b
Zinc	--	see Table G-5	--	--	see Table G-5	--
Pesticides						
4,4'-DDD	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4,4'-DDE	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4,4'-DDT	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aldrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
alpha-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
alpha-Chlordane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
beta-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
delta-BHC	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Dieldrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endosulfan I	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endosulfan II	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Endrin	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
gamma-BHC (Lindane)	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
gamma-Chlordane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Heptachlor	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Heptachlor epoxide	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Methoxychlor	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Toxaphene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3

TABLE G-7b

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Insectivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Polychlorinated Biphenyls						
Aroclor-1016	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1221	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1232	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1242	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1248	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1254	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1260	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Aroclor-1268	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Volatile and Semivolatile Organic Compounds						
1,1,2,2-Tetrachloroethane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,2,4-Trichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,2-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,3-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
1,4-Dichlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4-Bromophenyl-phenylether	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
4-Chlorophenyl-phenylether	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Acenaphthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Acenaphthylene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(a)anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(a)pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(b)fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(g,h,i)perylene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Benzo(k)fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Chrysene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Dibenz(a,h)anthracene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Fluoranthene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Fluorene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Hexachlorobenzene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3

TABLE G-7b

Soil Bioaccumulation Factors For Small Mammals (Dry Weight) - Insectivores

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Screening (Step 2)			Baseline (Step 3A)		
	Value	Basis	Reference	Value	Basis	Reference
Hexachlorobutadiene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Hexachlorocyclopentadiene	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Hexachloroethane	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Indeno(1,2,3-cd)pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Pentachlorophenol	NA	--	See Section G.3.3.3	NA	--	See Section G.3.3.3
Phenanthrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j
Pyrene	0.0	Assumed	USEPA 2007j	0.0	Assumed	USEPA 2007j

NA - Not Available

TABLE G-8

Exposure Parameters for Upper Trophic Level Ecological Receptors - Screening

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)		Dietary Composition (percent)				Soil Ingestion (percent)	
Receptor	Value	Reference	Value	Reference	Value	Reference	Terrestrial Plants	Soil Invertebrates	Small Mammals	Reference	Value	Reference
Birds												
American robin	0.0635	USEPA 1993	0.0129	allometric equation (USEPA 1993)[1]	0.0051	Levey and Karasov 1989	0	95.4	0	exclusive diet	4.6	Sample and Suter 1994
Mourning dove	0.1050	Tomlinson et al. 1994	0.0175	allometric equation (USEPA 1993)[1]	0.0209	allometric equation (Nagy 2001)[3]	95.0	0	0	Tomlinson et al. 1994	5.0	Assumed based upon diet
Red-tailed hawk	0.957	USEPA 1993	0.0680	allometric equation (USEPA 1993)[1]	0.0395	Sample and Suter 1994	0	0	100	USEPA 1993; Sample and Suter 1994	0	Sample and Suter 1994
Mammals												
Meadow vole	0.0300	Silva and Downing 1995	0.0133	USEPA 1993	0.0031	USEPA 1993	95.6	2.0	0	USEPA 1993	2.4	Beyer et al. 1994
Red fox	3.17	Silva and Downing 1995	0.4115	allometric equation (USEPA 1993)[2]	0.1476	Sample and Suter 1994	7.0	2.8	87.4	USEPA 1993	2.8	Beyer et al. 1994
Short-tailed shrew	0.0133	USEPA 1993	0.0048	USEPA 1993	0.0019	USEPA 1993	4.7	82.3	0	USEPA 1993; Sample and Suter 1994	13.0	Sample and Suter 1994

1 - All birds equation: $0.059\ (BW)^{0.67}$ (maximum body weight used: robin - 0.103 kg; dove - 0.163 kg; hawk - 1.235 kg)

2 - All mammals equation: $0.099\ (BW)^{0.90}$ (maximum body weight used: 4.87 kg)

3 - All birds equation: $(0.638*((BW*1000)^{0.685}))/1000$ (maximum body weight used: 0.163 kg)

TABLE G-9

Exposure Parameters for Upper Trophic Level Ecological Receptors - Baseline

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Receptor	Body Weight (kg)		Water Ingestion Rate (L/day)		Food Ingestion Rate (kg/day - dry)		Dietary Composition (percent)				Soil Ingestion (percent)	
	Value	Reference	Value	Reference	Value	Reference	Terrestrial Plants	Soil Invertebrates	Small Mammals	Reference	Value	Reference
Birds												
American robin	0.077	USEPA 1993	0.0106	allometric equation (USEPA 1993)[1]	0.0038	Levey and Karasov 1989	0	95.4	0	exclusive diet	4.6	Sample and Suter 1994
Mourning dove	0.127	Tomlinson et al. 1994	0.0148	allometric equation (USEPA 1993)[1]	0.0176	allometric equation (Nagy 2001)[3]	95.0	0.0	0	Tomlinson et al. 1994	5.0	Assumed based upon diet
Red-tailed hawk	1.126	Sample and Suter 1994	0.0639	allometric equation (USEPA 1993)[1]	0.0360	Sample and Suter 1994	0	0	100	USEPA 1993; Sample and Suter 1994	0	Sample and Suter 1994
Mammals												
Meadow vole	0.043	Silva and Downing 1995	0.0090	USEPA 1993	0.0021	USEPA 1993	95.6	2.0	0	USEPA 1993	2.4	Beyer et al. 1994
Red fox	4.06	Silva and Downing 1995	0.3494	allometric equation (USEPA 1993)[2]	0.1231	Sample and Suter 1994	7.0	2.8	87.4	USEPA 1993	2.8	Beyer et al. 1994
Short-tailed shrew	0.017	USEPA 1993	0.0038	USEPA 1993	0.0015	USEPA 1993	4.7	82.3	0	USEPA 1993; Sample and Suter 1994	13.0	Sample and Suter 1994

1 - All birds equation: $0.059\ (BW)^{0.67}$

2 - All mammals equation: $0.099\ (BW)^{0.90}$

3 - All birds equation: $(0.638*((BW*1000)^{0.685}))/1000$

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Inorganics					
Aluminum	pH < 5.5	--	Eco-SSL	USEPA 2003a	
Antimony	78.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005a	
Arsenic	18.0	mg/kg	Eco-SSL - Plant	USEPA 2005b	
Barium	330	mg/kg	Eco-SSL - Invertebrate	USEPA 2005c	
Beryllium	40.0	mg/kg	Eco-SSL - Invertebrate	USEPA 2005d	
Cadmium	32.0	mg/kg	Eco-SSL - Plant	USEPA 2005e	
Chromium	64.0	mg/kg	Soil Quality Guideline	CCME 2007	
Cobalt	13.0	mg/kg	Eco-SSL - Plant	USEPA 2005f	
Copper	70.0	mg/kg	Eco-SSL - Plant	USEPA 2007a	
Iron	5 < pH > 8	--	Eco-SSL	USEPA 2003b	
Lead	120	mg/kg	Eco-SSL - Plant	USEPA 2005g	
Manganese	220	mg/kg	Eco-SSL - Plant	USEPA 2007b	
Mercury	0.10	mg/kg	Invertebrate	Efroymson et al. 1997b	
Nickel	38.0	mg/kg	Eco-SSL - Plant	USEPA 2007c	
Selenium	0.52	mg/kg	Eco-SSL - Plant	USEPA 2007d	
Silver	560	mg/kg	Eco-SSL - Plant	USEPA 2006a	
Thallium	1.00	mg/kg	Plant	Efroymson et al. 1997a	
Vanadium	130	mg/kg	Soil Quality Guideline	CCME 2007	
Zinc	120	mg/kg	Eco-SSL - Invertebrate	USEPA 2007e	
Pesticides					
4,4'-DDD	583	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
4,4'-DDE	114	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
4,4'-DDT	100	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Aldrin	3.63	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
alpha-BHC	226	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
alpha-Chlordane	11.0	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
beta-BHC	342	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
delta-BHC	226	µg/kg		alpha-BHC value	
Dieldrin	10.5	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Endosulfan I	6.32	µg/kg		MHSPE 2000	Geometric mean of target and intervention values

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
Endosulfan II	6.32	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
Endosulfan sulfate	6.32	µg/kg		Endosulfan value	
Endrin	1.95	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Endrin aldehyde	1.95	µg/kg		Endrin value	
Endrin ketone	1.95	µg/kg		Endrin value	
gamma-BHC (Lindane)	7.75	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
gamma-Chlordane	11.0	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
Heptachlor	52.9	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
Heptachlor epoxide	52.9	µg/kg		Heptachlor value	
Methoxychlor	500	µg/kg		Beyer 1990	B value
Toxaphene	500	µg/kg		Beyer 1990	B value
Polychlorinated Biphenyls					
Aroclor-1016	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1221	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1232	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1242	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1248	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1254	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1260	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Aroclor-1268	8,000	µg/kg	Plant	Efroymson et al. 1997a	Lowest EC50 (40,000); UF of 5
Semivolatile Organic Compounds					
1,1-Biphenyl	13,600	µg/kg	Plant	Efroymson et al. 1997a	EC50 (68,000); UF of 5
2,4,5-Trichlorophenol	1,350	µg/kg	Plant	Efroymson et al. 1997a	NOEC
2,4,6-Trichlorophenol	580	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 58,000; UF of 100
2,4-Dichlorophenol	500	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
2,4-Dimethylphenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
2,4-Dinitrophenol	20,000	µg/kg	Plant	Efroymson et al. 1997a	NOEC
2,4-Dinitrotoluene	11,000	µg/kg	Plant/Invertebrate	NRCC 2006	

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
2,6-Dinitrotoluene	8,500	µg/kg	Plant/Invertebrate	NRCC 2006	
2-Chloronaphthalene	see LMW PAHs				
2-Chlorophenol	500	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
2-Methylnaphthalene	see LMW PAHs				
2-Methylphenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
2-Nitrophenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
3- and 4-Methylphenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
4,6-Dinitro-2-methylphenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
4-Chloro-3-methylphenol	500	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
4-Chloroaniline	500	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
4-Methylphenol	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
4-Nitrophenol	380	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 38,000; UF of 100
Acenaphthene	see LMW PAHs				
Acenaphthylene	see LMW PAHs				
Anthracene	see LMW PAHs				
Atrazine	11.9	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Benzo(a)anthracene	see HMW PAHs				
Benzo(a)pyrene	see HMW PAHs				
Benzo(b)fluoranthene	see HMW PAHs				
Benzo(g,h,i)perylene	see HMW PAHs				
Benzo(k)fluoranthene	see HMW PAHs				

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
bis(2-Ethylhexyl)phthalate	30,000	µg/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Butylbenzylphthalate	30,000	µg/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Chrysene	see HMW PAHs				
Dibenz(a,h)anthracene	see HMW PAHs				
Diethylphthalate	26,800	µg/kg	Plant	Efroymson et al. 1997a	EC50 (134,000); UF of 5
Dimethyl phthalate	10,640	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 1,064,000; UF of 100
Di-n-butylphthalate	40,000	µg/kg	Plant	Efroymson et al. 1997a	LOEC (200,000); UF of 5
Di-n-octylphthalate	30,000	µg/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Fluoranthene	see LMW PAHs				
Fluorene	see LMW PAHs				
Hexachlorobenzene	1,000	µg/kg		Beyer 1990	B value
Hexachlorocyclopentadiene	2,000	µg/kg	Plant	Efroymson et al. 1997a	LOEC (10,000); UF of 5
Indeno(1,2,3-cd)pyrene	see HMW PAHs				
Naphthalene	see LMW PAHs				
Nitrobenzene	2,260	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 226,000; UF of 100
n-Nitrosodiphenylamine	1,090	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 109,000; UF of 100
PAH (HMW)	18,000	µg/kg	Eco-SSL - Invertebrate	USEPA 2007i	
PAH (LMW)	29,000	µg/kg	Eco-SSL - Invertebrate	USEPA 2007i	
Pentachlorophenol	5,000	µg/kg	Eco-SSL - Plant	USEPA 2007h	
Phenanthrene	see LMW PAHs				
Phenol	1,880	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 188,000; UF of 100
Pyrene	see HMW PAHs				
Volatile Organic Compounds					
1,1,1-Trichloroethane	1,025	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
1,1,2,2-Tetrachloroethane	5,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
1,1,2-Trichloroethane	2,000	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
1,1-Dichloroethane	548	µg/kg		MHSPE 2000	Geometric mean of target and intervention values

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
1,1-Dichloroethene	173	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
1,2,3-Trichlorobenzene	1,150	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 115,000; UF of 100
1,2,4-Trichlorobenzene	1,270	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 127,000; UF of 100
1,2-Dibromoethane	300	µg/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
1,2-Dichlorobenzene	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
1,2-Dichloroethane	2,190	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
1,2-Dichloropropane	38,800	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 3,880,000; UF of 100
1,3-Dichlorobenzene	1,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
1,4-Dichlorobenzene	1,280	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 128,000; UF of 100
Benzene	1,140	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Bromoform	300	µg/kg	Plant	CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Carbon tetrachloride	3,400	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Chlorobenzene	2,400	µg/kg	Invertebrate	Efroymson et al. 1997b	LC50 of 240,000; UF of 100
Chloroethane	5,000	µg/kg		CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
Chloroform	1,844	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Chloromethane	5,000	µg/kg		CCME 2007	Interim Remediation Criteria (IRC) for residential/parkland
cis-1,2-Dichloroethene	447	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
cis-1,3-Dichloropropene	5,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
Cyclohexane	6,000	µg/kg		Beyer 1990	B value
Ethylbenzene	1,815	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Methylene chloride	1,250	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
m- and p-Xylene	1,300	µg/kg		MHSPE 2000; 2001	Xylenes, total

TABLE G-10

Soil Ecological Screening Values (ESVs) for Plants and Soil Invertebrates

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Type/Receptor	Reference	Comments
o-Xylene	1,300	µg/kg		MHSPE 2000; 2001	Xylenes, total
Styrene	64,000	µg/kg	Plant	Efroymson et al. 1997a	EC50 (320,000); UF of 5
Tetrachloroethene	179	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Toluene	40,000	µg/kg	Plant	Efroymson et al. 1997a	EC50 (200,000); UF of 5
trans-1,2-Dichloroethene	447	µg/kg		MHSPE 2000	Geometric mean of target and intervention values
trans-1,3-Dichloropropene	5,000	µg/kg		CCME 2007; Beyer 1990	Interim Remediation Criteria (IRC) for residential/parkland; B value
Trichloroethene	500	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Vinyl chloride	412	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values
Xylene, total	1,300	µg/kg		MHSPE 2000; 2001	Geometric mean of target and SRC values

TABLE G-11

Ecological Screening Values (ESVs) for Water

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	ESV	Units	Hardness (mg/L)	Type	Reference	Comments[1]
Inorganics (Total)						
Cadmium	0.27	µg/L	100	Fresh	USEPA 2009	AWQC
Mercury	0.91	µg/L		Fresh	USEPA 2009	AWQC
Silver	0.36	µg/L		Fresh	Suter and Tsao 1996	SCV
Dissolved Metals						
Cadmium	0.25	µg/L	100	Fresh	USEPA 2009	AWQC
Mercury	0.77	µg/L		Fresh	USEPA 2009	AWQC
Silver	0.36	µg/L		Fresh	Suter and Tsao 1996	SCV

1 - AWQC - Ambient Water Quality Criterion; SCV - Secondary Chronic Value

TABLE G-12

Uncertainty Factors Used In the ERA

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Convert From	Convert To	Uncertainty Factor
Chronic NOAEL or NOEC	Chronic NOAEL or NOEC	1
Chronic LOAEL or LOEC	Chronic NOAEL or NOEC	5
Chronic NOAEL or NOEC	Chronic LOAEL or LOEC	5
Subchronic NOAEL or NOEC	Chronic NOAEL or NOEC	10
Subchronic LOAEL or LOEC	Chronic NOAEL or NOEC	20
Acute NOAEL or NOEC	Chronic NOAEL or NOEC	30
Acute LOAEL or LOEC	Chronic NOAEL or NOEC	50
LD50 or LC50	Chronic NOAEL or NOEC	100

Uncertainty factors from Wentsel et al. (1996)

Durations are defined as follows (USEPA 1999; Sample et al. 1996):

- Acute: <3 days (plants, invertebrates) and <14 days (fish, birds, mammals)
- Subchronic: 3 - 6 days (plants, invertebrates) and 14 - 90 days (fish, birds, mammals)
- Chronic: >7 days (plants, invertebrates) and >90 days or during critical life stage (fish, birds, mammals)

TABLE G-13
Ingestion-Based Toxicity Reference Values (TRVs) for Mammals
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Vole	Fox	Shrew
Metals														
Arsenic	Arsenite (As+3)	mouse	0.03	3 generations	oral in water/food	reproduction	1.26	Sample et al. 1996	0.25 a	--	0.56	X		X
Arsenic	--	dog	--	8 weeks	oral in diet	survival, growth, reproduction	1.66	USEPA 2005b	1.04	USEPA 2005b	1.31		X	
Cadmium	--	rat	--	2 weeks	oral in water	survival, growth, reproduction	7.70	USEPA 2005e	0.77	USEPA 2005e	2.43	X	X	X
Chromium	Cr+3	multiple	--	--	oral	survival, growth, reproduction	12.0 b	--	2.40	USEPA 2008a	5.37	X	X	X
Copper	--	pig	--	4 weeks	oral in diet	survival, growth, reproduction	9.34	USEPA 2007a	5.60	USEPA 2007a	7.23	X		X
Copper	Copper sulfate	mink	1.00	357 days	oral in diet	reproduction	15.1	Sample et al. 1996	11.7	Sample et al. 1996	13.3		X	
Lead	--	rat	--	7 weeks	oral in water	survival, growth, reproduction	8.90	USEPA 2005g	4.70	USEPA 2005g	6.47	X	X	X
Mercury	Methyl mercury chloride	rat	0.35	3 generations	oral in diet	reproduction	0.160	Sample et al. 1996	0.032	Sample et al. 1996	0.072	X		X
Mercury	Methyl mercury chloride	mink	1.00	93 days	oral in diet	survival/weight loss	0.25 c	Sample et al. 1996	0.15 c	Sample et al. 1996	0.19		X	
Nickel	--	mouse	--	35 days	oral	survival, growth, reproduction	3.40	USEPA 2007c	1.70	USEPA 2007c	2.40	X	X	X
Selenium	Potassium selenate	rat	0.35	1 year	oral in water	reproduction	0.33	Sample et al. 1996	0.20	Sample et al. 1996	0.26	X	X	X
Silver	--	pig	--	40 days	oral in diet	survival, growth, reproduction	60.2	USEPA 2006a	12.0 a	--	26.9	X	X	X
Zinc	--	multiple	--	--	oral	survival, growth, reproduction	377 b	--	75.4	USEPA 2007e	169	X	X	X
Pesticides														
4,4'-DDD	--	rat	--	15 days	oral (gavage)	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X
4,4'-DDE	--	rat	--	15 days	oral (gavage)	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X
4,4'-DDT	--	rat	--	15 days	oral (gavage)	survival, growth, reproduction	0.735	USEPA 2007f	0.147	USEPA 2007f	0.329	X	X	X
Aldrin	--	rat	0.35	3 generations	oral in diet	reproduction	1.00	Sample et al. 1996	0.20	Sample et al. 1996	0.45	X	X	X
alpha-BHC	Mixed isomers	rat	0.35	4 generations	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X
alpha-Chlordane	Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	Sample et al. 1996	4.58	Sample et al. 1996	6.48	X	X	X
beta-BHC	Mixed isomers	rat	0.35	4 generations	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X
delta-BHC	Mixed isomers	rat	0.35	4 generations	oral in diet	reproduction	3.20	Sample et al. 1996	1.60	Sample et al. 1996	2.26	X	X	X
Dieldrin	--	rat	--	750 days	oral in diet	survival, growth, reproduction	0.030	USEPA 2007g	0.015	USEPA 2007g	0.021	X	X	X
Endosulfan I	--	rat	0.35	30 days	oral (gavage)	fertility	0.75 b	--	0.15	Sample et al. 1996	0.34	X	X	X
Endosulfan II	--	rat	0.35	30 days	oral (gavage)	fertility	0.75 b	--	0.15	Sample et al. 1996	0.34	X	X	X
Endrin	--	mouse	0.03	120 days	oral in diet	reproduction	0.92	Sample et al. 1996	0.18 a	--	0.41	X	X	X
gamma-BHC (Lindane)	--	rat	0.35	3 generations	oral in diet	reproduction	40.0 b	--	8.00	Sample et al. 1996	17.9	X	X	X
gamma-Chlordane	Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	Sample et al. 1996	4.58	Sample et al. 1996	6.48	X	X	X
Heptachlor	--	mink	1.00	181 days	oral in diet	reproduction	1.00	Sample et al. 1996	0.20 a	--	0.45	X	X	X
Heptachlor epoxide	--	mink	1.00	181 days	oral in diet	reproduction	1.00	Heptachlor value	0.20 a	--	0.45	X	X	X
Methoxychlor	--	rat	0.35	11 months	oral in diet	reproduction	8.00	Sample et al. 1996	4.00	Sample et al. 1996	5.66	X	X	X
Toxaphene	--	rat	0.35	3 generations	oral in diet	reproduction	40.0 b	--	8.00	Sample et al. 1996	17.9	X	X	X
Polychlorinated Biphenyls														
Aroclor-1016	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.304	X		X
Aroclor-1016	--	mink	1.00	18 months	oral in diet	reproduction	3.43	Sample et al. 1996	1.37	Sample et al. 1996	2.17		X	
Aroclor-1221	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X
Aroclor-1221	--	mink	1.00	7 months	oral in diet	reproduction	0.685	Aroclor-1242 value	0.137 a	Aroclor-1242 value	0.31		X	
Aroclor-1232	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X
Aroclor-1232	--	mink	1.00	7 months	oral in diet	reproduction	0.685	Aroclor-1242 value	0.137 a	Aroclor-1242 value	0.31		X	
Aroclor-1242	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X
Aroclor-1242	--	mink	1.00	7 months	oral in diet	reproduction	0.685	Sample et al. 1996	0.137 a	--	0.31		X	
Aroclor-1248	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X
Aroclor-1248	--	mink	1.00	4.5 months	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.31		X	
Aroclor-1254	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Sample et al. 1996	0.136 a	--	0.30	X		X
Aroclor-1254	--	mink	1.00	4.5 months	oral in diet	reproduction	0.685	Sample et al. 1996	0.137	Sample et al. 1996	0.31		X	
Aroclor-1260	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X
Aroclor-1260	--	mink	1.00	4.5 months	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.31		X	
Aroclor-1268	--	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.680	Aroclor-1254 value	0.136 a	Aroclor-1254 value	0.30	X		X

TABLE G-13
Ingestion-Based Toxicity Reference Values (TRVs) for Mammals
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Vole	Fox	Shrew
Aroclor-1268	--	mink	1.00	4.5 months	oral in diet	reproduction	0.685	Aroclor-1254 value	0.137	Aroclor-1254 value	0.31		X	
Volatile and Semivolatile Organic Compounds														
1,1,2,2-Tetrachloroethane	--	rat	0.35	78 weeks	oral (gavage)	reproduction	380 b	--	76.0	ATSDR 2008	170	X	X	X
1,2,4-Trichlorobenzene	--	rat	0.35	3 generations	oral in water	reproduction	106	Coulston and Kolbye 1994	53.0	Coulston and Kolbye 1994	75.0	X	X	X
1,2-Dichlorobenzene	--	rat	0.35	chronic	oral	liver/kidney	429 b	--	85.7	Coulston and Kolbye 1994	192	X	X	X
1,3-Dichlorobenzene	--	rat	0.35	chronic	oral	liver/kidney	429 b	--	85.7	Value for 1,2-Dichlorobenzen	192	X	X	X
1,4-Dichlorobenzene	--	rat	0.35	2 generations	oral (gavage)	developmental	90.0	ATSDR 2006	30.0	ATSDR 2006	52.0	X	X	X
4-Bromophenyl-phenylethe	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
4-Chlorophenyl-phenylether	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
Acenaphthene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Acenaphthylene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Anthracene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Benzo(a)anthracene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Benzo(a)pyrene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Benzo(b)fluoranthene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Benzo(g,h,i)perylene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Benzo(k)fluoranthene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Chrysene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Dibenz(a,h)anthracene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Fluoranthene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Fluorene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Hexachlorobenzene	--	rat	0.35	4 generations	oral in diet	reproduction	4.00	ATSDR 2002	2.00	ATSDR 2002	2.83	X	X	X
Hexachlorobutadiene	--	rat	0.35	GD 1-22; LD 1-21	oral in diet	developmental	20.0	ATSDR 1994	2.00	ATSDR 1994	6.32	X	X	X
Hexachlorocyclopentadiene	--	mouse	0.03	GD 6-15	oral (gavage)	developmental	375 b	--	75.0	ATSDR 1999	168	X	X	X
Hexachloroethane	--	rat	0.35	GD 6-16	oral (gavage)	reproduction	500	ATSDR 1997	100	ATSDR 1997	224	X	X	X
Indeno(1,2,3-cd)pyrene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X
Pentachlorophenol	--	multiple	--	--	oral	survival, growth, reproduction	42.1 b	--	8.42	USEPA 2007h	18.8	X	X	X
Phenanthrene	--	rat	--	6 weeks	oral in diet	survival, growth, reproduction	328	USEPA 2007i	65.6	USEPA 2007i	147	X	X	X
Pyrene	--	mouse	--	65 weeks	oral in diet	survival, growth, reproduction	3.07	USEPA 2007i	0.62	USEPA 2007i	1.37	X	X	X

NA - Not Available

[a] Uncertainty factor of 5 applied to LOAEL

[b] Uncertainty factor of 5 applied to NOAEL

[c] Does not include subchronic uncertainty factor of 10 applied by Sample et al (1996) since the study duration meets the criteria for a chronic study in Table G-12

TABLE G-14
Ingestion-Based Toxicity Reference Values (TRVs) for Birds
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Robin	Dove	Hawk
Metals														
Arsenic	--	chicken	--	19 days	oral in diet	survival, growth,reproduction	11.2 b	--	2.24	USEPA 2005b	5.01		X	
Arsenic	Copper acetoarsenit	brown-headed cowbird	0.05	7 months	oral in diet	survival	7.38		2.46	Sample et al. 1996	4.26	X		X
Cadmium	--	multiple	--	--	oral in diet	survival, growth,reproduction	7.35 b	--	1.47	USEPA 2005e	3.29	X	X	X
Chromium	Cr+3	multiple	--	--	oral in diet	survival, growth,reproduction	13.3 b	--	2.66	USEPA 2008a	5.95	X	X	X
Copper	--	chicken	--	84 days	oral in diet	survival, growth,reproduction	12.1	USEPA 2007a	4.05	USEPA 2007a	7.00	X	X	X
Lead	--	chicken	--	4 weeks	oral in diet	survival, growth,reproduction	3.26	USEPA 2005g	1.63	USEPA 2005g	2.31		X	
Lead	Metallic	American kestrel	0.13	7 months	oral in diet	reproduction	19.3 b	--	3.85	Sample et al. 1996	8.61	X		X
Mercury	Mercury chloride	Japanese quail	0.15	1 year	oral in diet	reproduction	0.90	Sample et al. 1996	0.45	Sample et al. 1996	0.64		X	
Mercury	--	red-tailed hawk	1.10	12 weeks	oral in diet	survival/neurological	1.20	USEPA 1995b	0.49	USEPA 1995b	0.77	X		X
Nickel	--	multiple	--	--	oral in diet	survival, growth,reproduction	33.6 b	--	6.71	USEPA 2007c	15.0	X	X	X
Selenium	Selanomethionine	screech owl	0.20	13.7 weeks	oral in diet	reproduction	1.50	Sample et al. 1996	0.44	Sample et al. 1996	0.81	X		X
Selenium	--	chicken	--	2 weeks	oral in diet	survival, growth,reproduction	0.58	USEPA 2007d	0.29	USEPA 2007d	0.41		X	
Silver	--	turkey	--	5 weeks	oral in diet	survival, growth	20.2	USEPA 2006a	4.04 a	--	9.03	X	X	X
Zinc	--	multiple	--	--	oral in diet	survival, growth,reproduction	331 b	--	66.1	USEPA 2007e	148	X	X	X
Pesticides														
4,4'-DDD	--	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	DDT value	0.50	DDT value	1.58	X	X	
4,4'-DDD	--	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	DDE value	0.08	DDE value	0.18			X
4,4'-DDE	--	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	DDT value	0.50	DDT value	1.58	X	X	
4,4'-DDE	--	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	--	0.08	Blus 1996	0.18			X
4,4'-DDT	--	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	USEPA 1995b	0.50	USEPA 1995b	1.58	X	X	
4,4'-DDT	--	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	DDE value	0.08	DDE value	0.18			X
Aldrin	--	ring-necked pheasant	1.14	5 days	oral in diet	survival	0.351 b	--	0.070 e	Hill et al. 1975	0.157	X	X	X
alpha-BHC	Mixed isomers	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X	X	X
alpha-Chlordane	Chlordane	red-winged blackbird	0.06	84 days	oral in diet	survival	10.7	Sample et al. 1996	2.14	Sample et al. 1996	4.79	X		X
alpha-Chlordane	--	northern bobwhite	0.19	not specified	oral in diet	reproduction	5.95 b	--	1.19	Wiemeyer 1996	2.66		X	
beta-BHC	Mixed isomers	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X	X	X
delta-BHC	Mixed isomers	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	Sample et al. 1996	0.56	Sample et al. 1996	1.13	X	X	X
Dieldrin	--	mallard	--	24 days	oral in diet	survival, growth,reproduction	3.78	USEPA 2007g	0.071	USEPA 2007g	0.52	X	X	X
Endosulfan I	--	gray partridge	0.40	4 weeks	oral in diet	reproduction	50.0 b	--	10.0	Sample et al. 1996	22.4	X	X	X
Endosulfan II	--	gray partridge	0.40	4 weeks	oral in diet	reproduction	50.0 b	--	10.0	Sample et al. 1996	22.4	X	X	X
Endrin	--	mallard	1.15	>200 days	oral in diet	reproduction	1.50 b	--	0.30	Sample et al. 1996	0.67		X	
Endrin	--	screech owl	0.18	>83 days	oral in diet	reproduction	0.104	Sample et al. 1996	0.021 a	--	0.046	X		X
gamma-BHC (Lindane)	--	mallard	1.00	8 weeks	oral (intubation)	reproduction	20.0	Sample et al. 1996	4.00 a	--	8.94	X	X	X
gamma-Chlordane	Chlordane	red-winged blackbird	0.06	84 days	oral in diet	survival	10.7	Sample et al. 1996	2.14	Sample et al. 1996	4.79	X		X
gamma-Chlordane	--	northern bobwhite	0.19	not specified	oral in diet	reproduction	5.95 b	--	1.19	Wiemeyer 1996	2.66		X	
Heptachlor	--	ring-necked pheasant	1.14	5 days	oral in diet	survival	1.38 b	--	0.28 e	Hill et al. 1975	0.62	X	X	X
Heptachlor epoxide	--	ring-necked pheasant	1.14	5 days	oral in diet	survival	1.38 b	--	0.28 e	Heptachlor value	0.62	X	X	X
Methoxychlor	--	chicken	1.50	16 weeks	oral in diet	reproduction	1,775 b	--	355	Wiemeyer 1996	794	X	X	X
Toxaphene	--	American black duck	1.00	2 seasons	oral in diet	reproduction	5.00	Wiemeyer 1996	1.00	Wiemeyer 1996	2.24	X	X	X
Polychlorinated Biphenyls														
Aroclor-1016	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1016	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1221	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1221	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1232	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1232	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1242	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	

TABLE G-14
Ingestion-Based Toxicity Reference Values (TRVs) for Birds
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Chemical Form	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	Reference	NOAEL (mg/kg/d)	Reference	MATC (mg/kg/d)	Robin	Dove	Hawk
Aroclor-1242	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	--	0.41	Sample et al. 1996	0.92	X		X
Aroclor-1248	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1248	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1254	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Sample et al. 1996	0.36 a	--	0.80		X	
Aroclor-1254	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1260	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1260	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Aroclor-1268	--	ring-necked pheasant	1.00	17 weeks	oral	reproduction	1.80	Aroclor-1254 value	0.36 a	Aroclor-1254 value	0.80		X	
Aroclor-1268	--	screech owl	0.18	2 generations	oral in diet	reproduction	2.05 b	Aroclor-1242 value	0.41	Aroclor-1242 value	0.92	X		X
Volatile and Semivolatile Organic Compounds														
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
1,2,4-Trichlorobenzene	--	northern bobwhite	0.19	14 days	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X	X	X
1,2-Dichlorobenzene	--	northern bobwhite	0.19	14 days	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X	X	X
1,3-Dichlorobenzene	--	northern bobwhite	0.19	14 days	oral	survival	402 b	1,4-Dichlorobenzene value	80.4 d	1,4-Dichlorobenzene value	180	X	X	X
1,4-Dichlorobenzene	--	northern bobwhite	0.19	14 days	oral	survival	402 b	--	80.4 d	TERRETOX 2002	180	X	X	X
4-Bromophenyl-phenylethe	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
4-Chlorophenyl-phenylethe	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
Acenaphthene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Acenaphthylene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Anthracene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Benzo(a)anthracene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Benzo(a)pyrene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Rigdon and Neal 1963	15.9	X	X	X
Benzo(b)fluoranthene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Benzo(g,h,i)perylene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Benzo(k)fluoranthene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Chrysene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Dibenz(a,h)anthracene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Fluoranthene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Fluorene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Hexachlorobenzene	--	Japanese quail	0.15	90 days	oral in diet	reproduction	0.565	Coulston and Kolbye 1994; TERRETOX 2002	0.113	Coulston and Kolbye 1994; TERRETOX 2002	0.253	X	X	X
Hexachlorobutadiene	--	Japanese quail	0.15	90 days	oral in diet	reproduction	17.0 b	--	3.39	Coulston and Kolbye 1994; TERRETOX 2002	7.58	X	X	X
Hexachlorocyclopentadiene	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
Hexachloroethane	--	--	--	--	--	--	NA	--	NA	--	NA	X	X	X
Indeno(1,2,3-cd)pyrene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Pentachlorophenol	--	chicken	--	1 week	oral in diet	survival, growth	67.3	USEPA 2007h	6.73	USEPA 2007h	21.3	X	X	X
Phenanthrene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X
Pyrene	--	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	--	7.10 c	Benzo(a)pyrene value	15.9	X	X	X

NA - Not Available

[a] Uncertainty factor of 5 applied to LOAEL

[b] Uncertainty factor of 5 applied to NOAEL

[c] Subchronic (NOAEL) to chronic uncertainty factor of 10 applied

[d] Subchronic (LOAEL) to chronic uncertainty factor of 20 applied

[e] Uncertainty factor of 100 applied to LD50

TABLE G-15
Ecological Screening Statistics - Site 32 Surface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
Metals (MG/KG)																				
Aluminum	-- - --	1 / 1	10,300	10,300	YS32-SS08-0312	10,300	--	--	10,300	pH < 5.5	-- / --	--	**YES**	**--**	--	**YES**	12,200	0 / 1	0.84	NO
Antimony	0.95 - 0.95	0 / 1	--	--	--	0.47	--	--	0.47	78.0	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Arsenic	-- - --	1 / 1	3.80	3.80	YS32-SS08-0312	3.80	--	--	3.80	18.0	0 / 1	0.21	NO	--	--	NO	--	-- / --	--	NO
Barium	-- - --	1 / 1	86.8	86.8	YS32-SS08-0312	86.8	--	--	86.8	330	0 / 1	0.26	NO	--	--	NO	--	-- / --	--	NO
Beryllium	-- - --	1 / 1	0.83	0.83	YS32-SS08-0312	0.83	--	--	0.83	40.0	0 / 1	0.02	NO	--	--	NO	--	-- / --	--	NO
Cadmium	6.95 - 7.34	6 / 8	0.25	0.39	YS32-SS03-0312	1.14	1.50	2.15	0.59	32.0	0 / 8	0.01	NO	--	--	NO	--	-- / --	--	NO
Calcium [3]	-- - --	1 / 1	2,140	2,140	YS32-SS08-0312	2,140	--	--	2,140	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Chromium	-- - --	1 / 1	16.0	16.0	YS32-SS08-0312	16.0	--	--	16.0	64.0	0 / 1	0.25	NO	--	--	NO	--	-- / --	--	NO
Cobalt	-- - --	1 / 1	6.59	6.59	YS32-SS08-0312	6.59	--	--	6.59	13.0	0 / 1	0.51	NO	--	--	NO	--	-- / --	--	NO
Copper	-- - --	1 / 1	11.4	11.4	YS32-SS08-0312	11.4	--	--	11.4	70.0	0 / 1	0.16	NO	--	--	NO	--	-- / --	--	NO
Iron	-- - --	1 / 1	22,100	22,100	YS32-SS08-0312	22,100	--	--	22,100	5 < pH > 8	-- / --	--	**YES**	**--**	--	**YES**	19,900	1 / 1	1.11	**YES**
Lead	-- - --	1 / 1	18.4	18.4	YS32-SS08-0312	18.4	--	--	18.4	120	0 / 1	0.15	NO	--	--	NO	--	-- / --	--	NO
Magnesium [3]	-- - --	1 / 1	1,040	1,040	YS32-SS08-0312	1,040	--	--	1,040	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Manganese	-- - --	1 / 1	187	187	YS32-SS08-0312	187	--	--	187	220	0 / 1	0.85	NO	--	--	NO	--	-- / --	--	NO
Mercury	-- - --	8 / 8	0.023	0.24	YS32-SS03-0312	0.063	0.074	0.11	0.046	0.10	1 / 8	2.44	**YES**	1.13	0.63	**YES**	0.111	1 / 8	2.20	**YES**
Nickel	-- - --	1 / 1	8.51	8.51	YS32-SS08-0312	8.51	--	--	8.51	38.0	0 / 1	0.22	NO	--	--	NO	--	-- / --	--	NO
Potassium [3]	-- - --	1 / 1	622	622	YS32-SS08-0312	622	--	--	622	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Selenium	4.26 - 4.26	0 / 1	--	--	--	2.13	--	--	2.13	0.52	-- / --	8.19	**YES**	**--**	4.10	NO[4]	--	-- / --	--	NO[4]
Silver	0.15 - 0.16	4 / 8	0.092	0.20	YS32-SS05-0312	0.11	0.051	0.14	0.10	560	0 / 8	0.0004	NO	--	--	NO	--	-- / --	--	NO
Sodium [3]	213 - 213	0 / 1	--	--	--	107	--	--	107	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Thallium	-- - --	1 / 1	0.16	0.16	YS32-SS08-0312	0.16	--	--	0.16	1.00	0 / 1	0.16	NO	--	--	NO	--	-- / --	--	NO
Vanadium	-- - --	1 / 1	29.6	29.6	YS32-SS08-0312	29.6	--	--	29.6	130	0 / 1	0.23	NO	--	--	NO	--	-- / --	--	NO
Zinc	-- - --	1 / 1	40.4	40.4	YS32-SS08-0312	40.4	--	--	40.4	120	0 / 1	0.34	NO	--	--	NO	--	-- / --	--	NO
Pesticides (UG/KG)																				
4,4'-DDD	-- - --	1 / 1	1.20	1.20	YS32-SS08-0312	1.20	--	--	1.20	583	0 / 1	0.002	NO	--	--	NO	--	-- / --	--	NO
4,4'-DDE	-- - --	1 / 1	11.0	11.0	YS32-SS08-0312	11.0	--	--	11.0	114	0 / 1	0.10	NO	--	--	NO	--	-- / --	--	NO
4,4'-DDT	-- - --	1 / 1	2.80	2.80	YS32-SS08-0312	2.80	--	--	2.80	100	0 / 1	0.03	NO	--	--	NO	--	-- / --	--	NO
Aldrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	3.63	-- / --	0.33	NO	--	--	NO	--	-- / --	--	NO
alpha-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	226	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
alpha-Chlordane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	11.0	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
beta-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	342	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
delta-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	226	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Dieldrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	10.5	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
Endosulfan I	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endosulfan II	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endosulfan sulfate	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
Endrin aldehyde	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
Endrin ketone	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
gamma-BHC (Lindane)	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	7.75	-- / --	0.15	NO	--	--	NO	--	-- / --	--	NO
gamma-Chlordane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	11.0	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
Heptachlor	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	52.9	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
Heptachlor epoxide	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	52.9	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
Methoxychlor	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	500	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Toxaphene	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	500	-- / --	0.05	NO	--	--	NO	--	-- / --	--	NO

TABLE G-15
Ecological Screening Statistics - Site 32 Surface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
Polychlorinated Biphenyls (UG/KG)																				
Aroclor-1016	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1221	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1232	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1242	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1248	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1254	24.0 - 24.0	0 / 1	--	--	--	12.0	--	--	12.0	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1260	12.0 - 12.0	0 / 1	--	--	--	6.00	--	--	6.00	8,000	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1268	-- - --	1 / 1	12.0	12.0	YS32-SS08-0312	12.0	--	--	12.0	8,000	0 / 1	0.002	NO	--	--	NO	--	-- / --	--	NO
Semivolatile Organic Compounds (UG/KG)																				
1,1-Biphenyl	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	13,600	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2,4,5-Trichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,350	-- / --	0.09	NO	--	--	NO	--	-- / --	--	NO
2,4,6-Trichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	580	-- / --	0.21	NO	--	--	NO	--	-- / --	--	NO
2,4-Dichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
2,4-Dimethylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
2,4-Dinitrophenol	360 - 360	0 / 1	--	--	--	180	--	--	180	20,000	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
2,4-Dinitrotoluene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	11,000	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2,6-Dinitrotoluene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	8,500	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2-Chloronaphthalene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
2-Chlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
2-Methylnaphthalene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
2-Methylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
2-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
2-Nitrophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
3- and 4-Methylphenol	240 - 240	0 / 1	--	--	--	120	--	--	120	1,000	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
3,3'-Dichlorobenzidine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
3-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4,6-Dinitro-2-methylphenol	360 - 360	0 / 1	--	--	--	180	--	--	180	1,000	-- / --	0.36	NO	--	--	NO	--	-- / --	--	NO
4-Bromophenyl-phenylether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Chloro-3-methylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
4-Chloroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
4-Chlorophenyl-phenylether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Nitrophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	380	-- / --	0.32	NO	--	--	NO	--	-- / --	--	NO
Acenaphthene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Acenaphthylene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Acetophenone	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Anthracene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Atrazine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	11.9	-- / --	10.1	**YES**	--	5.04	NO[4]	--	-- / --	--	NO[4]
Benzaldehyde	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(a)anthracene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(a)pyrene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(b)fluoranthene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(g,h,i)perylene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(k)fluoranthene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
bis(2-Chloroethoxy)methane	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
bis(2-Chloroethyl)ether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO

TABLE G-15
Ecological Screening Statistics - Site 32 Surface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
bis(2-Chloroisopropyl)ether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
bis(2-Ethylhexyl)phthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Butylbenzylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Caprolactam	240 - 240	0 / 1	--	--	--	120	--	--	120	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbazole	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Chrysene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Dibenz(a,h)anthracene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Dibenzofuran	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Diethylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	26,800	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Dimethyl phthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	10,640	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Di-n-butylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	40,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Di-n-octylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Fluoranthene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Fluorene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Hexachlorobenzene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
Hexachlorobutadiene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Hexachlorocyclopentadiene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	2,000	-- / --	0.06	NO	--	--	NO	--	-- / --	--	NO
Hexachloroethane	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Indeno(1,2,3-cd)pyrene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Isophorone	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Naphthalene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
n-Nitroso-di-n-propylamine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
n-Nitrosodiphenylamine	240 - 240	0 / 1	--	--	--	120	--	--	120	1,090	-- / --	0.22	NO	--	--	NO	--	-- / --	--	NO
Nitrobenzene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	2,260	-- / --	0.05	NO	--	--	NO	--	-- / --	--	NO
PAH (HMW)	135 - 135	0 / 1	--	--	--	67.5	--	--	67.5	18,000	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
PAH (LMW)	180 - 180	0 / 1	--	--	--	90.0	--	--	90.0	29,000	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Pentachlorophenol	360 - 360	0 / 1	--	--	--	180	--	--	180	5,000	-- / --	0.07	NO	--	--	NO	--	-- / --	--	NO
Phenanthrene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Phenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,880	-- / --	0.06	NO	--	--	NO	--	-- / --	--	NO
Pyrene	30.0 - 30.0	0 / 1	--	--	--	15.0	--	--	15.0	HPAH	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Volatile Organic Compounds (UG/KG)																				
1,1,1-Trichloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,025	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,1,2,2-Tetrachloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-11	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
1,1,2-Trichloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	2,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,1-Dichloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	548	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
1,1-Dichloroethene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	173	-- / --	0.007	NO	--	--	NO	--	-- / --	--	NO
1,2,4-Trichlorobenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,270	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dibromo-3-chloropropane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
1,2-Dibromoethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	300	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichlorobenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	2,190	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichloropropane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	38,800	-- / --	0.00003	NO	--	--	NO	--	-- / --	--	NO
1,3-Dichlorobenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,4-Dichlorobenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,280	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
2-Butanone	2.90 - 2.90	0 / 1	--	--	--	1.45	--	--	1.45	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
2-Hexanone	2.90 - 2.90	0 / 1	--	--	--	1.45	--	--	1.45	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO

TABLE G-15
Ecological Screening Statistics - Site 32 Surface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
4-Methyl-2-pentanone	2.90 - 2.90	0 / 1	--	--	--	1.45	--	--	1.45	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Acetone	15.0 - 15.0	0 / 1	--	--	--	7.50	--	--	7.50	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,140	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Bromodichloromethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Bromoform	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	300	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Bromomethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbon disulfide	5.80 - 5.80	0 / 1	--	--	--	2.90	--	--	2.90	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbon tetrachloride	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	3,400	-- / --	0.0004	NO	--	--	NO	--	-- / --	--	NO
Chlorobenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	2,400	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Chloroethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Chloroform	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,844	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Chloromethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
cis-1,2-Dichloroethene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	447	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
cis-1,3-Dichloropropene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Cyclohexane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Dibromochloromethane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Dichlorodifluoromethane (Freon-12)	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Ethylbenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,815	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Isopropylbenzene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
m- and p-Xylene	2.30 - 2.30	0 / 1	--	--	--	1.15	--	--	1.15	1,300	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Methyl acetate	5.80 - 5.80	0 / 1	--	--	--	2.90	--	--	2.90	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Methylcyclohexane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Methylene chloride	5.80 - 5.80	0 / 1	--	--	--	2.90	--	--	2.90	1,250	-- / --	0.005	NO	--	--	NO	--	-- / --	--	NO
Methyl-tert-butyl ether (MTBE)	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
o-Xylene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1,300	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Styrene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	64,000	-- / --	0.00002	NO	--	--	NO	--	-- / --	--	NO
Tetrachloroethene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	179	-- / --	0.007	NO	--	--	NO	--	-- / --	--	NO
Toluene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	40,000	-- / --	0.00003	NO	--	--	NO	--	-- / --	--	NO
trans-1,2-Dichloroethene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	447	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
trans-1,3-Dichloropropene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Trichloroethene	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	500	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Trichlorofluoromethane (Freon-11)	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Vinyl chloride	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	412	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling Screening Value
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

TABLE G-16
Ecological Screening Statistics - Site 32 Subsurface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
Metals (MG/KG)																				
Aluminum	-- - --	1 / 1	5,840	5,840	YS32-SB08-06-24-0312	5,840	--	--	5,840	pH < 5.5	-- / --	--	**YES**	**--**	--	**YES**	13,000	0 / 1	0.45	NO
Antimony	0.92 - 0.92	0 / 1	--	--	--	0.46	--	--	0.46	78.0	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Arsenic	-- - --	1 / 1	3.22	3.22	YS32-SB08-06-24-0312	3.22	--	--	3.22	18.0	0 / 1	0.18	NO	--	--	NO	--	-- / --	--	NO
Barium	-- - --	1 / 1	28.7	28.7	YS32-SB08-06-24-0312	28.7	--	--	28.7	330	0 / 1	0.09	NO	--	--	NO	--	-- / --	--	NO
Beryllium	-- - --	1 / 1	0.55	0.55	YS32-SB08-06-24-0312	0.55	--	--	0.55	40.0	0 / 1	0.01	NO	--	--	NO	--	-- / --	--	NO
Cadmium	6.49 - 6.84	6 / 8	0.19	0.75	YS32-SB05-06-24-0312	1.17	1.34	2.07	0.69	32.0	0 / 8	0.02	NO	--	--	NO	--	-- / --	--	NO
Calcium [3]	-- - --	1 / 1	8,740	8,740	YS32-SB08-06-24-0312	8,740	--	--	8,740	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Chromium	-- - --	1 / 1	21.8	21.8	YS32-SB08-06-24-0312	21.8	--	--	21.8	64.0	0 / 1	0.34	NO	--	--	NO	--	-- / --	--	NO
Cobalt	-- - --	1 / 1	4.11	4.11	YS32-SB08-06-24-0312	4.11	--	--	4.11	13.0	0 / 1	0.32	NO	--	--	NO	--	-- / --	--	NO
Copper	-- - --	1 / 1	7.41	7.41	YS32-SB08-06-24-0312	7.41	--	--	7.41	70.0	0 / 1	0.11	NO	--	--	NO	--	-- / --	--	NO
Iron	-- - --	1 / 1	15,500	15,500	YS32-SB08-06-24-0312	15,500	--	--	15,500	5 < pH > 8	-- / --	--	**YES**	**--**	--	**YES**	32,000	0 / 1	0.48	NO
Lead	-- - --	1 / 1	18.5	18.5	YS32-SB08-06-24-0312	18.5	--	--	18.5	120	0 / 1	0.15	NO	--	--	NO	--	-- / --	--	NO
Magnesium [3]	-- - --	1 / 1	1,670	1,670	YS32-SB08-06-24-0312	1,670	--	--	1,670	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Manganese	-- - --	1 / 1	125	125	YS32-SB08-06-24-0312	125	--	--	125	220	0 / 1	0.57	NO	--	--	NO	--	-- / --	--	NO
Mercury	-- - --	8 / 8	0.013	0.25	YS32-SB07-06-24-0312	0.081	0.078	0.13	0.056	0.10	2 / 8	2.51	**YES**	1.33	0.81	**YES**	0.14	1 / 8	1.79	**YES**
Nickel	-- - --	1 / 1	7.77	7.77	YS32-SB08-06-24-0312	7.77	--	--	7.77	38.0	0 / 1	0.20	NO	--	--	NO	--	-- / --	--	NO
Potassium [3]	-- - --	1 / 1	583	583	YS32-SB08-06-24-0312	583	--	--	583	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Selenium	4.15 - 4.15	0 / 1	--	--	--	2.08	--	--	2.08	0.52	-- / --	7.98	**YES**	**--**	3.99	NO[4]	--	-- / --	--	NO[4]
Silver	0.14 - 0.17	5 / 8	0.073	1.15	YS32-SB04-06-24-0312	0.41	0.42	0.69	0.23	560	0 / 8	0.002	NO	--	--	NO	--	-- / --	--	NO
Sodium [3]	-- - --	1 / 1	75.2	75.2	YS32-SB08-06-24-0312	75.2	--	--	75.2	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Thallium	-- - --	1 / 1	0.061	0.061	YS32-SB08-06-24-0312	0.061	--	--	0.061	1.00	0 / 1	0.06	NO	--	--	NO	--	-- / --	--	NO
Vanadium	-- - --	1 / 1	17.5	17.5	YS32-SB08-06-24-0312	17.5	--	--	17.5	130	0 / 1	0.13	NO	--	--	NO	--	-- / --	--	NO
Zinc	-- - --	1 / 1	39.0	39.0	YS32-SB08-06-24-0312	39.0	--	--	39.0	120	0 / 1	0.33	NO	--	--	NO	--	-- / --	--	NO
Pesticides (UG/KG)																				
4,4'-DDD	-- - --	1 / 1	44.0	44.0	YS32-SB08-06-24-0312	44.0	--	--	44.0	583	0 / 1	0.08	NO	--	--	NO	--	-- / --	--	NO
4,4'-DDE	-- - --	1 / 1	63.0	63.0	YS32-SB08-06-24-0312	63.0	--	--	63.0	114	0 / 1	0.55	NO	--	--	NO	--	-- / --	--	NO
4,4'-DDT	-- - --	1 / 1	36.0	36.0	YS32-SB08-06-24-0312	36.0	--	--	36.0	100	0 / 1	0.36	NO	--	--	NO	--	-- / --	--	NO
Aldrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	3.63	-- / --	0.33	NO	--	--	NO	--	-- / --	--	NO
alpha-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	226	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
alpha-Chlordane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	11.0	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
beta-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	342	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
delta-BHC	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	226	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Dieldrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	10.5	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
Endosulfan I	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endosulfan II	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endosulfan sulfate	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	6.32	-- / --	0.19	NO	--	--	NO	--	-- / --	--	NO
Endrin	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
Endrin aldehyde	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
Endrin ketone	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	1.95	-- / --	0.62	NO	--	--	NO	--	-- / --	--	NO
gamma-BHC (Lindane)	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	7.75	-- / --	0.15	NO	--	--	NO	--	-- / --	--	NO
gamma-Chlordane	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	11.0	-- / --	0.11	NO	--	--	NO	--	-- / --	--	NO
Heptachlor	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	52.9	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
Heptachlor epoxide	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	52.9	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
Methoxychlor	1.20 - 1.20	0 / 1	--	--	--	0.60	--	--	0.60	500	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Toxaphene	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	500	-- / --	0.05	NO	--	--	NO	--	-- / --	--	NO

TABLE G-16
Ecological Screening Statistics - Site 32 Subsurface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
Polychlorinated Biphenyls (UG/KG)																				
Aroclor-1016	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1221	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1232	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1242	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1248	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1254	23.0 - 23.0	0 / 1	--	--	--	11.5	--	--	11.5	8,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1260	12.0 - 12.0	0 / 1	--	--	--	6.00	--	--	6.00	8,000	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Aroclor-1268	-- - --	1 / 1	920	920	YS32-SB08-06-24-0312	920	--	--	920	8,000	0 / 1	0.12	NO	--	--	NO	--	-- / --	--	NO
Semivolatile Organic Compounds (UG/KG)																				
1,1-Biphenyl	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	13,600	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2,4,5-Trichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,350	-- / --	0.09	NO	--	--	NO	--	-- / --	--	NO
2,4,6-Trichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	580	-- / --	0.21	NO	--	--	NO	--	-- / --	--	NO
2,4-Dichlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
2,4-Dimethylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
2,4-Dinitrophenol	350 - 350	0 / 1	--	--	--	175	--	--	175	20,000	-- / --	0.02	NO	--	--	NO	--	-- / --	--	NO
2,4-Dinitrotoluene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	11,000	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2,6-Dinitrotoluene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	8,500	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
2-Chloronaphthalene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
2-Chlorophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
2-Methylnaphthalene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
2-Methylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
2-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
2-Nitrophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
3- and 4-Methylphenol	230 - 230	0 / 1	--	--	--	115	--	--	115	1,000	-- / --	0.23	NO	--	--	NO	--	-- / --	--	NO
3,3'-Dichlorobenzidine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
3-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4,6-Dinitro-2-methylphenol	350 - 350	0 / 1	--	--	--	175	--	--	175	1,000	-- / --	0.35	NO	--	--	NO	--	-- / --	--	NO
4-Bromophenyl-phenylether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Chloro-3-methylphenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
4-Chloroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	500	-- / --	0.24	NO	--	--	NO	--	-- / --	--	NO
4-Chlorophenyl-phenylether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Nitroaniline	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
4-Nitrophenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	380	-- / --	0.32	NO	--	--	NO	--	-- / --	--	NO
Acenaphthene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Acenaphthylene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Acetophenone	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Anthracene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Atrazine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	11.9	-- / --	10.1	**YES**	**--**	5.04	NO[4]	--	-- / --	--	NO[4]
Benzaldehyde	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzo(a)anthracene	-- - --	1 / 1	28.0	28.0	YS32-SB08-06-24-0312	28.0	--	--	28.0	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Benzo(a)pyrene	-- - --	1 / 1	13.0	13.0	YS32-SB08-06-24-0312	13.0	--	--	13.0	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Benzo(b)fluoranthene	-- - --	1 / 1	24.0	24.0	YS32-SB08-06-24-0312	24.0	--	--	24.0	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Benzo(g,h,i)perylene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Benzo(k)fluoranthene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
bis(2-Chloroethoxy)methane	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
bis(2-Chloroethyl)ether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO

TABLE G-16
Ecological Screening Statistics - Site 32 Subsurface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
bis(2-Chloroisopropyl)ether	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
bis(2-Ethylhexyl)phthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Butylbenzylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Caprolactam	230 - 230	0 / 1	--	--	--	115	--	--	115	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbazole	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Chrysene	-- - --	1 / 1	17.0	17.0	YS32-SB08-06-24-0312	17.0	--	--	17.0	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Dibenz(a,h)anthracene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Dibenzofuran	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Diethylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	26,800	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Dimethyl phthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	10,640	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Di-n-butylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	40,000	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO
Di-n-octylphthalate	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	30,000	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Fluoranthene	-- - --	1 / 1	36.0	36.0	YS32-SB08-06-24-0312	36.0	--	--	36.0	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Fluorene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Hexachlorobenzene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,000	-- / --	0.12	NO	--	--	NO	--	-- / --	--	NO
Hexachlorobutadiene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Hexachlorocyclopentadiene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	2,000	-- / --	0.06	NO	--	--	NO	--	-- / --	--	NO
Hexachloroethane	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Indeno(1,2,3-cd)pyrene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Isophorone	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Naphthalene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
n-Nitroso-di-n-propylamine	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
n-Nitrosodiphenylamine	230 - 230	0 / 1	--	--	--	115	--	--	115	1,090	-- / --	0.21	NO	--	--	NO	--	-- / --	--	NO
Nitrobenzene	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	2,260	-- / --	0.05	NO	--	--	NO	--	-- / --	--	NO
PAH (HMW)	-- - --	1 / 1	178	178	YS32-SB08-06-24-0312	178	--	--	178	18,000	0 / 1	0.01	NO	--	--	NO	--	-- / --	--	NO
PAH (LMW)	-- - --	1 / 1	198	198	YS32-SB08-06-24-0312	198	--	--	198	29,000	0 / 1	0.01	NO	--	--	NO	--	-- / --	--	NO
Pentachlorophenol	350 - 350	0 / 1	--	--	--	175	--	--	175	5,000	-- / --	0.07	NO	--	--	NO	--	-- / --	--	NO
Phenanthrene	29.0 - 29.0	0 / 1	--	--	--	14.5	--	--	14.5	LPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Phenol	120 - 120	0 / 1	--	--	--	60.0	--	--	60.0	1,880	-- / --	0.06	NO	--	--	NO	--	-- / --	--	NO
Pyrene	-- - --	1 / 1	38.0	38.0	YS32-SB08-06-24-0312	38.0	--	--	38.0	HPAH	-- / --	--	NO	--	--	NO	--	-- / --	--	NO
Volatile Organic Compounds (UG/KG)																				
1,1,1-Trichloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,025	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,1,2,2-Tetrachloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-11	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
1,1,2-Trichloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	2,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,1-Dichloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	548	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
1,1-Dichloroethene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	173	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
1,2,4-Trichlorobenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,270	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dibromo-3-chloropropane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
1,2-Dibromoethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	300	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichlorobenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	2,190	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,2-Dichloropropane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	38,800	-- / --	0.00003	NO	--	--	NO	--	-- / --	--	NO
1,3-Dichlorobenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,000	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
1,4-Dichlorobenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,280	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
2-Butanone	2.80 - 2.80	0 / 1	--	--	--	1.40	--	--	1.40	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
2-Hexanone	2.80 - 2.80	0 / 1	--	--	--	1.40	--	--	1.40	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO

TABLE G-16
Ecological Screening Statistics - Site 32 Subsurface Soil
Site Investigation Report - Site 32
Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
4-Methyl-2-pentanone	2.80 - 2.80	0 / 1	--	--	--	1.40	--	--	1.40	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Acetone	14.0 - 14.0	0 / 1	--	--	--	7.00	--	--	7.00	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Benzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,140	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Bromodichloromethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Bromoform	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	300	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Bromomethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbon disulfide	5.60 - 5.60	0 / 1	--	--	--	2.80	--	--	2.80	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Carbon tetrachloride	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	3,400	-- / --	0.0003	NO	--	--	NO	--	-- / --	--	NO
Chlorobenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	2,400	-- / --	0.0005	NO	--	--	NO	--	-- / --	--	NO
Chloroethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Chloroform	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,844	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Chloromethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
cis-1,2-Dichloroethene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	447	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
cis-1,3-Dichloropropene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Cyclohexane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	6,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Dibromochloromethane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Dichlorodifluoromethane (Freon-12)	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Ethylbenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,815	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Isopropylbenzene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
m- and p-Xylene	2.20 - 2.20	0 / 1	--	--	--	1.10	--	--	1.10	1,300	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Methyl acetate	5.60 - 5.60	0 / 1	--	--	--	2.80	--	--	2.80	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Methylcyclohexane	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Methylene chloride	5.60 - 5.60	0 / 1	--	--	--	2.80	--	--	2.80	1,250	-- / --	0.004	NO	--	--	NO	--	-- / --	--	NO
Methyl-tert-butyl ether (MTBE)	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
o-Xylene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	1,300	-- / --	0.001	NO	--	--	NO	--	-- / --	--	NO
Styrene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	64,000	-- / --	0.00002	NO	--	--	NO	--	-- / --	--	NO
Tetrachloroethene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	179	-- / --	0.01	NO	--	--	NO	--	-- / --	--	NO
Toluene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	40,000	-- / --	0.00003	NO	--	--	NO	--	-- / --	--	NO
trans-1,2-Dichloroethene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	447	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
trans-1,3-Dichloropropene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	5,000	-- / --	0.0002	NO	--	--	NO	--	-- / --	--	NO
Trichloroethene	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	500	-- / --	0.002	NO	--	--	NO	--	-- / --	--	NO
Trichlorofluoromethane (Freon-11)	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	NSV	-- / --	NSV	NO	--	--	NO	--	-- / --	--	NO
Vinyl chloride	1.10 - 1.10	0 / 1	--	--	--	0.55	--	--	0.55	412	-- / --	0.003	NO	--	--	NO	--	-- / --	--	NO

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling Screening Value
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

TABLE G-17

Ecological Screening Statistics - Site 32 Groundwater

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL (Norm)	Geometric Mean	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	95% UCL Hazard Quotient	Mean Hazard Quotient	Step 3A COPC?	Background 95% UTL	Frequency of UTL Exceedance	Maximum Ratio to UTL	COPC for Risk Evaluation?
Inorganics (UG/L)																				
Cadmium	4.00 - 4.00	0 / 5	--	--	--	2.00	0.0	2.00	2.00	0.27	-- / --	14.8	**YES**	7.41	7.41	NO[3]	0.605	-- / --	6.61	NO[3]
Mercury	0.069 - 0.069	0 / 5	--	--	--	0.035	0.0	0.035	0.035	0.91	-- / --	0.08	NO	0.04	0.04	NO	--	-- / --	--	NO
Silver	0.12 - 0.12	0 / 5	--	--	--	0.060	0.0	0.060	0.060	0.36	-- / --	0.33	NO	0.17	0.17	NO	--	-- / --	--	NO
Dissolved Metals (UG/L)																				
Cadmium	4.00 - 4.00	0 / 5	--	--	--	2.00	0.0	2.00	2.00	0.25	-- / --	16.0	**YES**	8.00	8.00	NO[3]	0.177	-- / --	22.6	NO[3]
Mercury	0.069 - 0.069	0 / 5	--	--	--	0.035	0.0	0.035	0.035	0.77	-- / --	0.09	NO	0.04	0.04	NO	--	-- / --	--	NO
Silver	0.12 - 0.12	0 / 5	--	--	--	0.060	0.0	0.060	0.060	0.36	-- / --	0.33	NO	0.17	0.17	NO	--	-- / --	--	NO

1 - Count of detected samples exceeding or equaling Screening Value

2 - Shaded cells indicate hazard quotient based on reporting limits

3 - See uncertainty section

TABLE G-18

Eco-SSL Values for Birds and Mammals (Bioaccumualtive Chemicals)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Bird	Mammal	Units	Reference
Metals				
Arsenic	43.0	46.0	mg/kg	USEPA 2005b
Cadmium	0.77	0.36	mg/kg	USEPA 2005e
Chromium	26.0	34.0	mg/kg	USEPA 2008a
Copper	28.0	49.0	mg/kg	USEPA 2007a
Lead	11.0	56.0	mg/kg	USEPA 2005g
Nickel	210	130	mg/kg	USEPA 2007c
Selenium	1.20	0.63	mg/kg	USEPA 2007d
Silver	4.20	14.0	mg/kg	USEPA 2006a
Zinc	46.0	79.0	mg/kg	USEPA 2007e
Organics				
4,4'-DDT (and metabolites)	0.093	0.021	mg/kg	USEPA 2007f
Dieldrin	0.022	0.0049	mg/kg	USEPA 2007g
Pentachlorophenol	2.10	2.80	mg/kg	USEPA 2007h
PAHs - LMW	--	100	mg/kg	USEPA 2007i
PAHs - HMW	--	1.10	mg/kg	USEPA 2007i

TABLE G-19

Screening Statistics - Surface Soil - Mammal/Bird Eco-SSLs

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	95% UCL (Norm)	Arithmetic Mean	Mammal Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	95% UCL Hazard Quotient	Mean Hazard Quotient	Bird Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	95% UCL Hazard Quotient	Mean Hazard Quotient
Inorganics (MG/KG)															
Arsenic	-- - --	1 / 1	3.80	--	3.80	46.0	0 / 1	0.08	--	0.08	43.0	0 / 1	0.09	--	0.09
Cadmium	6.95 - 7.34	6 / 8	0.39	2.15	1.14	0.36	2 / 8	1.09	--	--	0.77	0 / 8	0.51	--	--
Chromium	-- - --	1 / 1	16.0	--	16.0	34.0	0 / 1	0.47	--	0.47	26.0	0 / 1	0.62	--	0.62
Copper	-- - --	1 / 1	11.4	--	11.4	49.0	0 / 1	0.23	--	0.23	28.0	0 / 1	0.41	--	0.41
Lead	-- - --	1 / 1	18.4	--	18.4	56.0	0 / 1	0.33	--	0.33	11.0	1 / 1	1.67	--	1.67
Nickel	-- - --	1 / 1	8.51	--	8.51	130	0 / 1	0.07	--	0.07	210	0 / 1	0.04	--	0.04
Selenium[1]	4.26 - 4.26	0 / 1	--	--	2.13	0.63	0 / 1	6.76	--	3.38	1.20	0 / 1	3.55	--	1.78
Silver	0.15 - 0.16	4 / 8	0.20	0.14	0.11	14.0	0 / 8	0.01	0.01	0.01	4.20	0 / 8	0.05	0.03	0.03
Zinc	-- - --	1 / 1	40.4	--	40.4	79.0	0 / 1	0.51	--	0.51	46.0	0 / 1	0.88	--	0.88
Pesticides (UG/KG)															
4,4'-DDD	-- - --	1 / 1	1.20	--	1.20	21.0	0 / 1	0.06	--	0.06	93.0	0 / 1	0.01	--	0.01
4,4'-DDE	-- - --	1 / 1	11.0	--	11.0	21.0	0 / 1	0.52	--	0.52	93.0	0 / 1	0.12	--	0.12
4,4'-DDT	-- - --	1 / 1	2.80	--	2.80	21.0	0 / 1	0.13	--	0.13	93.0	0 / 1	0.03	--	0.03
Dieldrin[1]	1.20 - 1.20	0 / 1	--	--	0.60	4.90	0 / 1	0.24	--	0.12	22.0	0 / 1	0.05	--	0.03
Semivolatile Organic Compounds (UG/KG)															
PAH (HMW)[1]	135 - 135	0 / 1	--	--	67.5	1,100	0 / 1	0.12	--	0.06	--	-- - --	--	--	--
PAH (LMW)[1]	180 - 180	0 / 1	--	--	90.0	100,000	0 / 1	0.002	--	0.001	--	-- - --	--	--	--
Pentachlorophenol[1]	360 - 360	0 / 1	--	--	180	2,800	0 / 1	0.13	--	0.06	2,100	0 / 1	0.17	--	0.09

Shaded cells indicate HQ > 1

1 - HQs based upon reporting limits

TABLE G-20

Hazard Quotients for Terrestrial Food Web Exposures - Screening (Maximum)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

	Meadow Vole			Short-tailed Shrew			Red Fox			American Robin			Mourning Dove			Red-tailed Hawk		
Chemical	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																		
Cadmium	5.97E-02	1.89E-02	5.97E-03	6.10E-01	1.93E-01	6.10E-02	3.80E-02	1.20E-02	3.80E-03	2.07E-01	9.25E-02	4.14E-02	5.07E-02	2.27E-02	1.01E-02	1.55E-02	6.92E-03	3.09E-03
Lead	4.20E-02	3.05E-02	2.22E-02	2.83E-01	2.06E-01	1.50E-01	4.80E-02	3.49E-02	2.53E-02	1.86E-01	8.31E-02	3.72E-02	2.70E-01	1.91E-01	1.35E-01	4.90E-02	2.19E-02	9.80E-03
Mercury	8.73E-01	3.91E-01	1.75E-01	**1.85E+01**	**8.28E+00**	**3.70E+00**	6.23E-02	4.86E-02	3.78E-02	7.90E-01	5.05E-01	3.23E-01	7.75E-02	5.48E-02	3.87E-02	3.95E-03	2.52E-03	1.61E-03
Selenium	**1.32E+00**	**1.03E+00**	8.01E-01	**2.04E+00**	**1.59E+00**	**1.24E+00**	3.18E-01	2.48E-01	1.93E-01	5.04E-01	2.73E-01	1.48E-01	**1.79E+00**	**1.26E+00**	8.94E-01	1.07E-01	5.79E-02	3.13E-02
Polychlorinated Biphenyls																		
Aroclor-1016	6.46E-03	2.89E-03	1.29E-03	2.56E-02	1.14E-02	5.11E-03	5.56E-04	3.52E-04	2.22E-04	5.00E-03	2.24E-03	1.00E-03	4.73E-03	2.12E-03	9.47E-04	1.66E-03	7.44E-04	3.33E-04
Aroclor-1221	1.39E-02	6.20E-03	2.77E-03	2.61E-02	1.17E-02	5.21E-03	7.33E-03	3.28E-03	1.47E-03	5.00E-03	2.24E-03	1.00E-03	1.01E-02	4.52E-03	2.02E-03	2.18E-03	9.75E-04	4.36E-04
Aroclor-1232	9.81E-03	4.39E-03	1.96E-03	2.58E-02	1.15E-02	5.16E-03	6.36E-03	2.84E-03	1.27E-03	5.00E-03	2.24E-03	1.00E-03	7.16E-03	3.20E-03	1.43E-03	1.90E-03	8.48E-04	3.79E-04
Aroclor-1242	6.46E-03	2.89E-03	1.29E-03	2.56E-02	1.14E-02	5.11E-03	5.56E-03	2.49E-03	1.11E-03	5.00E-03	2.24E-03	1.00E-03	4.73E-03	2.12E-03	9.47E-04	1.66E-03	7.44E-04	3.33E-04
Aroclor-1248	4.04E-03	1.81E-03	8.08E-04	2.54E-02	1.14E-02	5.08E-03	4.99E-03	2.23E-03	9.98E-04	5.00E-03	2.24E-03	1.00E-03	2.99E-03	1.34E-03	5.98E-04	1.50E-03	6.69E-04	2.99E-04
Aroclor-1254	3.25E-03	1.46E-03	6.51E-04	2.53E-02	1.13E-02	5.07E-03	4.80E-03	2.15E-03	9.60E-04	5.00E-03	2.24E-03	1.00E-03	2.42E-03	1.08E-03	4.84E-04	1.44E-03	6.44E-04	2.88E-04
Aroclor-1260	1.29E-03	5.76E-04	2.58E-04	1.02E-02	4.57E-03	2.04E-03	1.95E-03	8.71E-04	3.90E-04	1.97E-03	8.82E-04	3.94E-04	9.95E-04	4.45E-04	1.99E-04	5.80E-04	2.59E-04	1.16E-04
Aroclor-1268	1.29E-03	5.76E-04	2.58E-04	1.02E-02	4.57E-03	2.04E-03	1.95E-03	8.71E-04	3.90E-04	1.97E-03	8.82E-04	3.94E-04	9.95E-04	4.45E-04	1.99E-04	5.80E-04	2.59E-04	1.16E-04
Pesticides																		
Aldrin	1.38E-04	6.19E-05	2.77E-05	2.43E-03	1.08E-03	4.85E-04	4.12E-04	1.84E-04	8.24E-05	4.40E-03	1.97E-03	8.80E-04	6.21E-04	2.78E-04	1.24E-04	1.09E-03	4.86E-04	2.17E-04
alpha-BHC	1.32E-04	9.33E-05	6.60E-05	1.10E-04	7.77E-05	5.50E-05	4.80E-05	3.39E-05	2.40E-05	1.71E-04	8.58E-05	4.29E-05	7.21E-04	3.60E-04	1.80E-04	1.20E-04	6.03E-05	3.01E-05
alpha-Chlordane	7.08E-06	5.01E-06	3.54E-06	1.27E-04	9.00E-05	6.37E-05	2.15E-05	1.52E-05	1.08E-05	1.74E-04	7.79E-05	3.48E-05	4.15E-05	1.85E-05	8.29E-06	4.27E-05	1.91E-05	8.55E-06
beta-BHC	1.31E-04	9.25E-05	6.54E-05	1.10E-04	7.77E-05	5.49E-05	4.77E-05	3.37E-05	2.38E-05	1.71E-04	8.58E-05	4.29E-05	7.14E-04	3.57E-04	1.79E-04	1.20E-04	5.99E-05	3.00E-05
delta-BHC	1.01E-04	7.11E-05	5.03E-05	1.08E-04	7.62E-05	5.39E-05	4.05E-05	2.86E-05	2.02E-05	1.71E-04	8.58E-05	4.29E-05	5.50E-04	2.75E-04	1.38E-04	1.02E-04	5.09E-05	2.55E-05
Endosulfan I	1.37E-03	6.13E-04	2.74E-04	1.17E-03	5.23E-04	2.34E-04	5.03E-04	2.25E-04	1.01E-04	9.65E-06	4.32E-06	1.93E-06	3.95E-05	1.77E-05	7.90E-06	6.66E-06	2.98E-06	1.33E-06
Endosulfan II	7.36E-04	3.29E-04	1.47E-04	1.13E-03	5.04E-04	2.25E-04	3.51E-04	1.57E-04	7.02E-05	9.65E-06	4.32E-06	1.93E-06	2.13E-05	9.52E-06	4.26E-06	4.67E-06	2.09E-06	9.34E-07
Endrin	4.09E-04	1.83E-04	8.18E-05	2.88E-03	1.29E-03	5.76E-04	5.45E-04	2.44E-04	1.09E-04	1.62E-02	7.22E-03	3.23E-03	4.44E-04	1.99E-04	8.89E-05	4.44E-03	1.98E-03	8.87E-04
gamma-BHC (Lindane)	3.61E-05	1.61E-05	7.21E-06	4.70E-04	2.10E-04	9.40E-05	8.09E-05	3.62E-05	1.62E-05	6.14E-04	2.74E-04	1.23E-04	1.08E-04	4.83E-05	2.16E-05	1.51E-04	6.77E-05	3.03E-05
gamma-Chlordane	7.08E-06	5.01E-06	3.54E-06	1.27E-04	9.00E-05	6.37E-05	2.15E-05	1.52E-05	1.08E-05	1.74E-04	7.79E-05	3.48E-05	4.15E-05	1.85E-05	8.29E-06	4.27E-05	1.91E-05	8.55E-06
Heptachlor	1.55E-04	6.95E-05	3.11E-05	2.22E-03	9.91E-04	4.43E-04	3.84E-04	1.72E-04	7.67E-05	1.02E-03	4.56E-04	2.04E-04	1.87E-04	8.37E-05	3.74E-05	2.57E-04	1.15E-04	5.14E-05
Heptachlor epoxide	4.74E-04	2.12E-04	9.48E-05	7.13E-03	3.19E-03	1.43E-03	1.21E-03	5.43E-04	2.43E-04	3.36E-03	1.50E-03	6.72E-04	5.10E-04	2.28E-04	1.02E-04	8.24E-04	3.68E-04	1.65E-04
Methoxychlor	1.69E-05	1.20E-05	8.46E-06	4.16E-05	2.94E-05	2.08E-05	1.06E-05	7.49E-06	5.30E-06	2.72E-07	1.22E-07	5.44E-08	3.69E-07	1.65E-07	7.38E-08	1.06E-07	4.76E-08	2.13E-08
Toxaphene	1.19E-04	5.31E-05	2.37E-05	4.12E-04	1.84E-04	8.24E-05	9.39E-05	4.20E-05	1.88E-05	1.93E-03	8.64E-04	3.86E-04	1.85E-03	8.26E-04	3.70E-04	6.70E-04	3.00E-04	1.34E-04
Volatile and Semivolatile Organics																		
1,1,2,2-Tetrachloroethane	1.63E-06	7.30E-07	3.26E-07	2.24E-06	1.00E-06	4.47E-07	7.35E-07	3.29E-07	1.47E-07	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	3.27E-06	2.31E-06	1.64E-06	2.11E-06	1.49E-06	1.06E-06	1.10E-06	7.77E-07	5.49E-07	6.97E-07	3.12E-07	1.39E-07	4.17E-06	1.87E-06	8.35E-07	6.34E-07	2.83E-07	1.27E-07
1,2-Dichlorobenzene	3.45E-06	1.54E-06	6.91E-07	2.12E-06	9.48E-07	4.24E-07	1.13E-06	5.07E-07	2.27E-07	1.20E-06	5.37E-07	2.40E-07	7.07E-06	3.16E-06	1.41E-06	1.07E-06	4.76E-07	2.13E-07
1,3-Dichlorobenzene	3.24E-06	1.45E-06	6.48E-07	2.10E-06	9.41E-07	4.21E-07	1.08E-06	4.84E-07	2.16E-07	1.20E-06	5.37E-07	2.40E-07	6.63E-06	2.97E-06	1.33E-06	1.02E-06	4.55E-07	2.03E-07
1,4-Dichlorobenzene	9.96E-06	5.75E-06	3.32E-06	6.06E-06	3.50E-06	2.02E-06	3.26E-06	1.88E-06	1.09E-06	1.20E-06	5.37E-07	2.40E-07	7.13E-06	3.19E-06	1.43E-06	1.07E-06	4.79E-07	2.14E-07
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	1.82E-03	1.29E-03	9.09E-04	1.30E-02	9.21E-03	6.51E-03	2.49E-03	1.76E-03	1.24E-03	1.42E-01	6.34E-02	2.83E-02	6.00E-02	2.68E-02	1.20E-02	4.00E-02	1.79E-02	8.01E-03
Hexachlorobutadiene	4.28E-03	1.35E-03	4.28E-04	8.37E-03	2.65E-03	8.37E-04	2.33E-03	7.38E-04	2.33E-04	2.85E-03	1.27E-03	5.70E-04	4.87E-03	2.18E-03	9.75E-04	1.22E-03	5.47E-04	2.45E-04
Hexachlorocyclopentadiene	6.94E-05	3.10E-05	1.39E-05	2.20E-04	9.85E-05	4.40E-05	5.15E-05	2.30E-05	1.03E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	1.76E-04	7.87E-05	3.52E-05	1.74E-04	7.76E-05	3.47E-05	6.84E-05	3.06E-05	1.37E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA

Shaded cells indicate HQ > 1

NA - TRV not available

TABLE G-21

Summary of Meadow Vole Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Cadmium	0.39	Regression	3.94E+00	Regresso	3.73E-01	0	4.60E-02	0.77	2.43	7.70	5.97E-02	1.89E-02	5.97E-03
Lead	18.4	Regression	8.43E+00	Regresso	1.36E+00	0	1.97E-01	4.70	6.47	8.90	4.20E-02	3.05E-02	2.22E-02
Mercury	0.24	20.63	5.03E+00	Regresso	1.71E-01	0	2.79E-02	0.032	0.072	0.16	8.73E-01	3.91E-01	1.75E-01
Selenium	4.26	Regression	2.68E+00	Regresso	2.51E+00	0	2.64E-01	0.20	0.26	0.33	**1.32E+00**	**1.03E+00**	8.01E-01
Polychlorinated Biphenyls													
Aroclor-1016	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	8.78E-04	0.136	0.30	0.68	6.46E-03	2.89E-03	1.29E-03
Aroclor-1221	0.0240	Regression	2.56E-02	0.749	1.80E-02	0	1.89E-03	0.136	0.30	0.68	1.39E-02	6.20E-03	2.77E-03
Aroclor-1232	0.0240	Regression	2.56E-02	0.515	1.24E-02	0	1.33E-03	0.136	0.30	0.68	9.81E-03	4.39E-03	1.96E-03
Aroclor-1242	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	8.78E-04	0.136	0.30	0.68	6.46E-03	2.89E-03	1.29E-03
Aroclor-1248	0.0240	Regression	2.56E-02	0.184	4.42E-03	0	5.49E-04	0.136	0.30	0.68	4.04E-03	1.81E-03	8.08E-04
Aroclor-1254	0.0240	Regression	2.56E-02	0.139	3.34E-03	0	4.43E-04	0.136	0.30	0.68	3.25E-03	1.46E-03	6.51E-04
Aroclor-1260	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	1.75E-04	0.136	0.30	0.68	1.29E-03	5.76E-04	2.58E-04
Aroclor-1268	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	1.75E-04	0.136	0.30	0.68	1.29E-03	5.76E-04	2.58E-04
Pesticides													
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	0	2.77E-05	0.20	0.45	1.00	1.38E-04	6.19E-05	2.77E-05
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	0	2.11E-04	1.60	2.26	3.20	1.32E-04	9.33E-05	6.60E-05
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	3.24E-05	4.58	6.48	9.16	7.08E-06	5.01E-06	3.54E-06
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	0	2.09E-04	1.60	2.26	3.20	1.31E-04	9.25E-05	6.54E-05
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	0	1.61E-04	1.60	2.26	3.20	1.01E-04	7.11E-05	5.03E-05
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	0	2.05E-04	0.15	0.34	0.75	1.37E-03	6.13E-04	2.74E-04
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	0	1.10E-04	0.15	0.34	0.75	7.36E-04	3.29E-04	1.47E-04
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	0	7.53E-05	0.18	0.41	0.92	4.09E-04	1.83E-04	8.18E-05
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	0	2.89E-04	8.00	17.9	40.0	3.61E-05	1.61E-05	7.21E-06
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	3.24E-05	4.58	6.48	9.16	7.08E-06	5.01E-06	3.54E-06
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	0	3.11E-05	0.20	0.45	1.00	1.55E-04	6.95E-05	3.11E-05
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	0	9.48E-05	0.20	0.45	1.00	4.74E-04	2.12E-04	9.48E-05
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	0	6.77E-05	4.00	5.66	8.00	1.69E-05	1.20E-05	8.46E-06
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	0	9.50E-04	8.00	17.9	40.0	1.19E-04	5.31E-05	2.37E-05
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	0	1.24E-04	76.0	170	380	1.63E-06	7.30E-07	3.26E-07
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	0	1.73E-04	53.0	75.0	106	3.27E-06	2.31E-06	1.64E-06
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	0	2.96E-04	85.7	192	429	3.45E-06	1.54E-06	6.91E-07

TABLE G-21

Summary of Meadow Vole Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	0	2.78E-04	85.7	192	429	3.24E-06	1.45E-06	6.48E-07
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	0	2.99E-04	30.0	52.0	90.0	9.96E-06	5.75E-06	3.32E-06
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	0	7.25E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	0	7.57E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	0	3.64E-03	2.00	2.83	4.00	1.82E-03	1.29E-03	9.09E-04
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	0	8.55E-03	2.00	6.32	20.0	4.28E-03	1.35E-03	4.28E-04
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	0	5.20E-03	75.0	168	375	6.94E-05	3.10E-05	1.39E-05
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	0	1.76E-02	100	224	500	1.76E-04	7.87E-05	3.52E-05

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)

FIR = 0.00310 = Food ingestion rate (kg/day dry weight)

FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)

PDFi = 0.020 = Proportion of diet composed of food item (soil invertebrates)

FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)

PDFi = 0.956 = Proportion of diet composed of food item (terrestrial plants)

SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)

PDS = 0.024 = Proportion of diet composed of soil

WIR = 0.0133 = Water ingestion rate (L/day)

WC = Chemical-specific = Concentration of chemical in water (mg/L)

BW = 0.0300 = Body weight (kg)

TABLE G-22

Summary of Short-Tailed Shrew Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Cadmium	0.39	Regressior	3.94E+00	Regresson	3.73E-01	0	4.69E-01	0.77	2.43	7.70	6.10E-01	1.93E-01	6.10E-02
Lead	18.4	Regressior	8.43E+00	Regresson	1.36E+00	0	1.33E+00	4.70	6.47	8.90	2.83E-01	2.06E-01	1.50E-01
Mercury	0.24	20.63	5.03E+00	Regresson	1.71E-01	0	5.92E-01	0.032	0.072	0.16	**1.85E+01**	**8.28E+00**	**3.70E+00**
Selenium	4.26	Regressior	2.68E+00	Regresson	2.51E+00	0	4.08E-01	0.20	0.26	0.33	**2.04E+00**	**1.59E+00**	**1.24E+00**
Polychlorinated Biphenyls													
Aroclor-1016	0.0240	Regressior	2.56E-02	0.323	7.75E-03	0	3.48E-03	0.136	0.30	0.68	2.56E-02	1.14E-02	5.11E-03
Aroclor-1221	0.0240	Regressior	2.56E-02	0.749	1.80E-02	0	3.54E-03	0.136	0.30	0.68	2.61E-02	1.17E-02	5.21E-03
Aroclor-1232	0.0240	Regressior	2.56E-02	0.515	1.24E-02	0	3.51E-03	0.136	0.30	0.68	2.58E-02	1.15E-02	5.16E-03
Aroclor-1242	0.0240	Regressior	2.56E-02	0.323	7.75E-03	0	3.48E-03	0.136	0.30	0.68	2.56E-02	1.14E-02	5.11E-03
Aroclor-1248	0.0240	Regressior	2.56E-02	0.184	4.42E-03	0	3.45E-03	0.136	0.30	0.68	2.54E-02	1.14E-02	5.08E-03
Aroclor-1254	0.0240	Regressior	2.56E-02	0.139	3.34E-03	0	3.45E-03	0.136	0.30	0.68	2.53E-02	1.13E-02	5.07E-03
Aroclor-1260	0.0120	Regressior	9.96E-03	0.105	1.26E-03	0	1.39E-03	0.136	0.30	0.68	1.02E-02	4.57E-03	2.04E-03
Aroclor-1268	0.0120	Regressior	9.96E-03	0.105	1.26E-03	0	1.39E-03	0.136	0.30	0.68	1.02E-02	4.57E-03	2.04E-03
Pesticides													
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	0	4.85E-04	0.20	0.45	1.00	2.43E-03	1.08E-03	4.85E-04
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	0	1.76E-04	1.60	2.26	3.20	1.10E-04	7.77E-05	5.50E-05
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	5.83E-04	4.58	6.48	9.16	1.27E-04	9.00E-05	6.37E-05
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	0	1.76E-04	1.60	2.26	3.20	1.10E-04	7.77E-05	5.49E-05
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	0	1.73E-04	1.60	2.26	3.20	1.08E-04	7.62E-05	5.39E-05
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	0	1.76E-04	0.15	0.34	0.75	1.17E-03	5.23E-04	2.34E-04
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	0	1.69E-04	0.15	0.34	0.75	1.13E-03	5.04E-04	2.25E-04
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	0	5.30E-04	0.18	0.41	0.92	2.88E-03	1.29E-03	5.76E-04
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	0	3.76E-03	8.00	17.9	40.0	4.70E-04	2.10E-04	9.40E-05
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	5.83E-04	4.58	6.48	9.16	1.27E-04	9.00E-05	6.37E-05
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	0	4.43E-04	0.20	0.45	1.00	2.22E-03	9.91E-04	4.43E-04
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	0	1.43E-03	0.20	0.45	1.00	7.13E-03	3.19E-03	1.43E-03
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	0	1.66E-04	4.00	5.66	8.00	4.16E-05	2.94E-05	2.08E-05
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	0	3.30E-03	8.00	17.9	40.0	4.12E-04	1.84E-04	8.24E-05
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	0	1.70E-04	76.0	170	380	2.24E-06	1.00E-06	4.47E-07
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	0	1.12E-04	53.0	75.0	106	2.11E-06	1.49E-06	1.06E-06
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	0	1.82E-04	85.7	192	429	2.12E-06	9.48E-07	4.24E-07
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	0	1.80E-04	85.7	192	429	2.10E-06	9.41E-07	4.21E-07

TABLE G-22

Summary of Short-Tailed Shrew Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	0	1.82E-04	30.0	52.0	90.0	6.06E-06	3.50E-06	2.02E-06
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	0	1.67E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	0	1.67E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	0	2.61E-02	2.00	2.83	4.00	1.30E-02	9.21E-03	6.51E-03
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	0	1.67E-02	2.00	6.32	20.0	8.37E-03	2.65E-03	8.37E-04
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	0	1.65E-02	75.0	168	375	2.20E-04	9.85E-05	4.40E-05
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	0	1.74E-02	100	224	500	1.74E-04	7.76E-05	3.47E-05

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0019 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.823 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.047 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.130 = Proportion of diet composed of soil
WIR = 0.0048 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0133 = Body weight (kg)

TABLE G-23

Summary of Red Fox Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																	
Cadmium	0.39	Regression	3.94E+00	Regresson	3.73E-01	Regresson	1.83E-01	Regresson	9.18E-01	0	2.93E-02	0.77	2.43	7.70	3.80E-02	1.20E-02	3.80E-03
Lead	18.4	Regression	8.43E+00	Regresson	1.36E+00	Regresson	2.45E+00	Regresson	6.69E+00	0	2.25E-01	4.70	6.47	8.90	4.80E-02	3.49E-02	2.53E-02
Mercury	0.24	20.63	5.03E+00	Regresson	1.71E-01	0.192	4.68E-02	0.192	4.68E-02	0	9.35E-03	0.15	0.19	0.25	6.23E-02	4.86E-02	3.78E-02
Selenium	4.26	Regression	2.68E+00	Regresson	2.51E+00	Regresson	1.14E+00	Regresson	1.14E+00	0	6.36E-02	0.20	0.26	0.33	3.18E-01	2.48E-01	1.93E-01
Polychlorinated Biphenyls																	
Aroclor-1016	0.0240	Regression	2.56E-02	0.323	7.75E-03	See footnote	8.50E-03	See footnote	2.45E-02	0	7.62E-04	1.37	2.17	3.43	5.56E-04	3.52E-04	2.22E-04
Aroclor-1221	0.0240	Regression	2.56E-02	0.749	1.80E-02	See footnote	1.83E-02	See footnote	2.50E-02	0	1.00E-03	0.137	0.31	0.685	7.33E-03	3.28E-03	1.47E-03
Aroclor-1232	0.0240	Regression	2.56E-02	0.515	1.24E-02	See footnote	1.29E-02	See footnote	2.47E-02	0	8.71E-04	0.137	0.31	0.685	6.36E-03	2.84E-03	1.27E-03
Aroclor-1242	0.0240	Regression	2.56E-02	0.323	7.75E-03	See footnote	8.50E-03	See footnote	2.45E-02	0	7.62E-04	0.137	0.31	0.685	5.56E-03	2.49E-03	1.11E-03
Aroclor-1248	0.0240	Regression	2.56E-02	0.184	4.42E-03	See footnote	5.32E-03	See footnote	2.44E-02	0	6.83E-04	0.137	0.31	0.685	4.99E-03	2.23E-03	9.98E-04
Aroclor-1254	0.0240	Regression	2.56E-02	0.139	3.34E-03	See footnote	4.28E-03	See footnote	2.43E-02	0	6.58E-04	0.137	0.31	0.685	4.80E-03	2.15E-03	9.60E-04
Aroclor-1260	0.0120	Regression	9.96E-03	0.105	1.26E-03	See footnote	1.69E-03	See footnote	9.81E-03	0	2.67E-04	0.137	0.31	0.685	1.95E-03	8.71E-04	3.90E-04
Aroclor-1268	0.0120	Regression	9.96E-03	0.105	1.26E-03	See footnote	1.69E-03	See footnote	9.81E-03	0	2.67E-04	0.137	0.31	0.685	1.95E-03	8.71E-04	3.90E-04
Pesticides																	
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	See footnote	2.68E-04	See footnote	3.42E-03	0	8.24E-05	0.20	0.45	1.00	4.12E-04	1.84E-04	8.24E-05
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	See footnote	2.04E-03	See footnote	1.24E-03	0	7.68E-05	1.60	2.26	3.20	4.80E-05	3.39E-05	2.40E-05
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	See footnote	3.14E-04	See footnote	4.12E-03	0	9.86E-05	4.58	6.48	9.16	2.15E-05	1.52E-05	1.08E-05
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	See footnote	2.02E-03	See footnote	1.24E-03	0	7.63E-05	1.60	2.26	3.20	4.77E-05	3.37E-05	2.38E-05
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	See footnote	1.56E-03	See footnote	1.22E-03	0	6.47E-05	1.60	2.26	3.20	4.05E-05	2.86E-05	2.02E-05
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	See footnote	1.99E-03	See footnote	1.24E-03	0	7.54E-05	0.15	0.34	0.75	5.03E-04	2.25E-04	1.01E-04
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	See footnote	1.07E-03	See footnote	1.19E-03	0	5.26E-05	0.15	0.34	0.75	3.51E-04	1.57E-04	7.02E-05
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	See footnote	7.29E-04	See footnote	3.74E-03	0	1.00E-04	0.18	0.41	0.92	5.45E-04	2.44E-04	1.09E-04
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	See footnote	2.79E-03	See footnote	2.65E-02	0	6.47E-04	8.00	17.9	40.0	8.09E-05	3.62E-05	1.62E-05
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	See footnote	3.14E-04	See footnote	4.12E-03	0	9.86E-05	4.58	6.48	9.16	2.15E-05	1.52E-05	1.08E-05
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	See footnote	3.01E-04	See footnote	3.13E-03	0	7.67E-05	0.20	0.45	1.00	3.84E-04	1.72E-04	7.67E-05
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	See footnote	9.18E-04	See footnote	1.01E-02	0	2.43E-04	0.20	0.45	1.00	1.21E-03	5.43E-04	2.43E-04
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	See footnote	6.55E-04	See footnote	1.17E-03	0	4.24E-05	4.00	5.66	8.00	1.06E-05	7.49E-06	5.30E-06
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	See footnote	9.19E-03	See footnote	2.33E-02	0	7.51E-04	8.00	17.9	40.0	9.39E-05	4.20E-05	1.88E-05
Volatile/Semivolatile Organics																	
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	See footnote	1.20E-03	See footnote	1.20E-03	0	5.59E-05	76.0	170	380	7.35E-07	3.29E-07	1.47E-07
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	See footnote	1.68E-03	See footnote	7.89E-04	0	5.82E-05	53.0	75.0	106	1.10E-06	7.77E-07	5.49E-07
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	See footnote	2.87E-03	See footnote	1.28E-03	0	9.71E-05	85.7	192	429	1.13E-06	5.07E-07	2.27E-07
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	See footnote	2.69E-03	See footnote	1.27E-03	0	9.27E-05	85.7	192	429	1.08E-06	4.84E-07	2.16E-07
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	See footnote	2.89E-03	See footnote	1.28E-03	0	9.78E-05	30.0	52.0	90.0	3.26E-06	1.88E-06	1.09E-06
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	See footnote	7.02E-02	See footnote	1.18E-01	0	4.35E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	See footnote	7.33E-02	See footnote	1.18E-01	0	4.43E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	See footnote	3.52E-02	See footnote	1.84E-01	0	4.98E-03	2.00	2.83	4.00	2.49E-03	1.76E-03	1.24E-03
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	See footnote	8.28E-02	See footnote	1.18E-01	0	4.67E-03	2.00	6.32	20.0	2.33E-03	7.38E-04	2.33E-04

TABLE G-23

Summary of Red Fox Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	See footnote	5.04E-02	See footnote	1.17E-01	0	3.86E-03	75.0	168	375	5.15E-05	2.30E-05	1.03E-05
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	See footnote	1.70E-01	See footnote	1.22E-01	0	6.84E-03	100	224	500	6.84E-05	3.06E-05	1.37E-05

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)

FIR = 0.1476 = Food ingestion rate (kg/day dry weight)

FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)

PDFi = 0.028 = Proportion of diet composed of food item (soil invertebrates)

FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)

PDFi = 0.070 = Proportion of diet composed of food item (terrestrial plants)

FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis)

PDFi = 0.874 = Proportion of diet composed of food item (small mammals)

SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)

PDS = 0.028 = Proportion of diet composed of soil

WIR = 0.4115 = Water ingestion rate (L/day)

WC = Chemical-specific = Concentration of chemical in water (mg/L)

BW = 3.17 = Body weight (kg)

TABLE G-24

Summary of American Robin Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Cadmium	0.39	Regression	3.94E+00	Regresson	3.73E-01	0	3.04E-01	1.47	3.29	7.35	2.07E-01	9.25E-02	4.14E-02
Lead	18.4	Regression	8.43E+00	Regresson	1.36E+00	0	7.15E-01	3.85	8.61	19.3	1.86E-01	8.31E-02	3.72E-02
Mercury	0.24	20.63	5.03E+00	Regresson	1.71E-01	0	3.87E-01	0.49	0.77	1.20	7.90E-01	5.05E-01	3.23E-01
Selenium	4.26	Regression	2.68E+00	Regresson	2.51E+00	0	2.22E-01	0.44	0.81	1.50	5.04E-01	2.73E-01	1.48E-01
Polychlorinated Biphenyls													
Aroclor-1016	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1221	0.0240	Regression	2.56E-02	0.749	1.80E-02	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1232	0.0240	Regression	2.56E-02	0.515	1.24E-02	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1242	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1248	0.0240	Regression	2.56E-02	0.184	4.42E-03	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1254	0.0240	Regression	2.56E-02	0.139	3.34E-03	0	2.05E-03	0.41	0.92	2.05	5.00E-03	2.24E-03	1.00E-03
Aroclor-1260	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	8.09E-04	0.41	0.92	2.05	1.97E-03	8.82E-04	3.94E-04
Aroclor-1268	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	8.09E-04	0.41	0.92	2.05	1.97E-03	8.82E-04	3.94E-04
Pesticides													
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	0	3.08E-04	0.07	0.16	0.35	4.40E-03	1.97E-03	8.80E-04
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	0	9.65E-05	0.56	1.13	2.25	1.71E-04	8.58E-05	4.29E-05
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	3.73E-04	2.14	4.79	10.7	1.74E-04	7.79E-05	3.48E-05
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	0	9.65E-05	0.56	1.13	2.25	1.71E-04	8.58E-05	4.29E-05
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	0	9.65E-05	0.56	1.13	2.25	1.71E-04	8.58E-05	4.29E-05
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	0	9.65E-05	10.0	22.4	50.0	9.65E-06	4.32E-06	1.93E-06
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	0	9.65E-05	10.0	22.4	50.0	9.65E-06	4.32E-06	1.93E-06
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	0	3.36E-04	0.021	0.047	0.104	1.62E-02	7.22E-03	3.23E-03
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	0	2.45E-03	4.00	8.9	20.0	6.14E-04	2.74E-04	1.23E-04
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	3.73E-04	2.14	4.79	10.7	1.74E-04	7.79E-05	3.48E-05
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	0	2.81E-04	0.28	0.62	1.38	1.02E-03	4.56E-04	2.04E-04
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	0	9.25E-04	0.28	0.62	1.38	3.36E-03	1.50E-03	6.72E-04
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	0	9.65E-05	355	794	1,775	2.72E-07	1.22E-07	5.44E-08
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	0	1.93E-03	1.00	2.24	5.00	1.93E-03	8.64E-04	3.86E-04
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	0	9.65E-05	NA	NA	NA	NA	NA	NA

TABLE G-24

Summary of American Robin Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	0	5.60E-05	80.4	180	402	6.97E-07	3.12E-07	1.39E-07
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	0	9.65E-05	80.4	180	402	1.20E-06	5.37E-07	2.40E-07
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	0	9.65E-05	80.4	180	402	1.20E-06	5.37E-07	2.40E-07
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	0	9.65E-05	80.4	180	402	1.20E-06	5.37E-07	2.40E-07
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	0	9.65E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	0	9.65E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	0	1.60E-02	0.113	0.253	0.565	1.42E-01	6.34E-02	2.83E-02
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	0	9.65E-03	3.39	7.58	17.0	2.85E-03	1.27E-03	5.70E-04
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	0	9.65E-03	NA	NA	NA	NA	NA	NA
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	0	9.65E-03	NA	NA	NA	NA	NA	NA

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0051 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.954 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil
WIR = 0.0129 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0635 = Body weight (kg)

TABLE G-25

Summary of Mourning Dove Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals													
Cadmium	0.39	Regression	3.94E+00	Regresson	3.73E-01	0	7.45E-02	1.47	3.29	7.35	5.07E-02	2.27E-02	1.01E-02
Lead	18.4	Regression	8.43E+00	Regresson	1.36E+00	0	4.40E-01	1.63	2.31	3.26	2.70E-01	1.91E-01	1.35E-01
Mercury	0.24	20.63	5.03E+00	Regresson	1.71E-01	0	3.49E-02	0.45	0.64	0.90	7.75E-02	5.48E-02	3.87E-02
Selenium	4.26	Regression	2.68E+00	Regresson	2.51E+00	0	5.18E-01	0.29	0.41	0.58	**1.79E+00**	**1.26E+00**	8.94E-01
Polychlorinated Biphenyls													
Aroclor-1016	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	1.70E-03	0.36	0.80	1.80	4.73E-03	2.12E-03	9.47E-04
Aroclor-1221	0.0240	Regression	2.56E-02	0.749	1.80E-02	0	3.64E-03	0.36	0.80	1.80	1.01E-02	4.52E-03	2.02E-03
Aroclor-1232	0.0240	Regression	2.56E-02	0.515	1.24E-02	0	2.58E-03	0.36	0.80	1.80	7.16E-03	3.20E-03	1.43E-03
Aroclor-1242	0.0240	Regression	2.56E-02	0.323	7.75E-03	0	1.70E-03	0.36	0.80	1.80	4.73E-03	2.12E-03	9.47E-04
Aroclor-1248	0.0240	Regression	2.56E-02	0.184	4.42E-03	0	1.08E-03	0.36	0.80	1.80	2.99E-03	1.34E-03	5.98E-04
Aroclor-1254	0.0240	Regression	2.56E-02	0.139	3.34E-03	0	8.71E-04	0.36	0.80	1.80	2.42E-03	1.08E-03	4.84E-04
Aroclor-1260	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	3.58E-04	0.36	0.80	1.80	9.95E-04	4.45E-04	1.99E-04
Aroclor-1268	0.0120	Regression	9.96E-03	0.105	1.26E-03	0	3.58E-04	0.36	0.80	1.80	9.95E-04	4.45E-04	1.99E-04
Pesticides													
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	0	4.36E-05	0.07	0.16	0.35	6.21E-04	2.78E-04	1.24E-04
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	0	4.06E-04	0.56	1.13	2.25	7.21E-04	3.60E-04	1.80E-04
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	4.93E-05	1.19	2.66	5.95	4.15E-05	1.85E-05	8.29E-06
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	0	4.02E-04	0.56	1.13	2.25	7.14E-04	3.57E-04	1.79E-04
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	0	3.09E-04	0.56	1.13	2.25	5.50E-04	2.75E-04	1.38E-04
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	0	3.95E-04	10.0	22.4	50.0	3.95E-05	1.77E-05	7.90E-06
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	0	2.13E-04	10.0	22.4	50.0	2.13E-05	9.52E-06	4.26E-06
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	0	1.33E-04	0.30	0.67	1.50	4.44E-04	1.99E-04	8.89E-05
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	0	4.32E-04	4.00	8.9	20.0	1.08E-04	4.83E-05	2.16E-05
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	0	4.93E-05	1.19	2.66	5.95	4.15E-05	1.85E-05	8.29E-06
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	0	5.15E-05	0.28	0.62	1.38	1.87E-04	8.37E-05	3.74E-05
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	0	1.40E-04	0.28	0.62	1.38	5.10E-04	2.28E-04	1.02E-04
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	0	1.31E-04	355	794	1,775	3.69E-07	1.65E-07	7.38E-08
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	0	1.85E-03	1.00	2.24	5.00	1.85E-03	8.26E-04	3.70E-04
Volatile/Semivolatile Organics													
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	0	2.39E-04	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	0	3.36E-04	80.4	180	402	4.17E-06	1.87E-06	8.35E-07
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	0	5.68E-04	80.4	180	402	7.07E-06	3.16E-06	1.41E-06

TABLE G-25

Summary of Mourning Dove Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Maximum Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	0	5.33E-04	80.4	180	402	6.63E-06	2.97E-06	1.33E-06
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	0	5.73E-04	80.4	180	402	7.13E-06	3.19E-06	1.43E-06
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	0	1.40E-02	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	0	1.46E-02	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	0	6.78E-03	0.113	0.253	0.565	6.00E-02	2.68E-02	1.20E-02
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	0	1.65E-02	3.39	7.58	17.0	4.87E-03	2.18E-03	9.75E-04
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	0	1.01E-02	NA	NA	NA	NA	NA	NA
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	0	3.39E-02	NA	NA	NA	NA	NA	NA

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0209 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.950 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.050 = Proportion of diet composed of soil
WIR = 0.0175 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.1050 = Body weight (kg)

TABLE G-26

Summary of Red-tailed Hawk Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Metals																	
Cadmium	0.39	Regression	3.94E+00	Regresson	3.73E-01	Regresson	1.83E-01	Regresson	9.18E-01	0	2.27E-02	1.47	3.29	7.35	1.55E-02	6.92E-03	3.09E-03
Lead	18.4	Regression	8.43E+00	Regresson	1.36E+00	Regresson	2.45E+00	Regresson	6.69E+00	0	1.89E-01	3.85	8.61	19.3	4.90E-02	2.19E-02	9.80E-03
Mercury	0.24	20.63	5.03E+00	Regresson	1.71E-01	0.192	4.68E-02	0.192	4.68E-02	0	1.93E-03	0.49	0.77	1.20	3.95E-03	2.52E-03	1.61E-03
Selenium	4.26	Regression	2.68E+00	Regresson	2.51E+00	Regresson	1.14E+00	Regresson	1.14E+00	0	4.70E-02	0.44	0.81	1.50	1.07E-01	5.79E-02	3.13E-02
Polychlorinated Biphenyls																	
Aroclor-1016	0.0240	Regression	2.56E-02	0.323	7.75E-03	See footnote	8.50E-03	See footnote	2.45E-02	0	6.82E-04	0.41	0.92	2.05	1.66E-03	7.44E-04	3.33E-04
Aroclor-1221	0.0240	Regression	2.56E-02	0.749	1.80E-02	See footnote	1.83E-02	See footnote	2.50E-02	0	8.94E-04	0.41	0.92	2.05	2.18E-03	9.75E-04	4.36E-04
Aroclor-1232	0.0240	Regression	2.56E-02	0.515	1.24E-02	See footnote	1.29E-02	See footnote	2.47E-02	0	7.78E-04	0.41	0.92	2.05	1.90E-03	8.48E-04	3.79E-04
Aroclor-1242	0.0240	Regression	2.56E-02	0.323	7.75E-03	See footnote	8.50E-03	See footnote	2.45E-02	0	6.82E-04	0.41	0.92	2.05	1.66E-03	7.44E-04	3.33E-04
Aroclor-1248	0.0240	Regression	2.56E-02	0.184	4.42E-03	See footnote	5.32E-03	See footnote	2.44E-02	0	6.13E-04	0.41	0.92	2.05	1.50E-03	6.69E-04	2.99E-04
Aroclor-1254	0.0240	Regression	2.56E-02	0.139	3.34E-03	See footnote	4.28E-03	See footnote	2.43E-02	0	5.91E-04	0.41	0.92	2.05	1.44E-03	6.44E-04	2.88E-04
Aroclor-1260	0.0120	Regression	9.96E-03	0.105	1.26E-03	See footnote	1.69E-03	See footnote	9.81E-03	0	2.38E-04	0.41	0.92	2.05	5.80E-04	2.59E-04	1.16E-04
Aroclor-1268	0.0120	Regression	9.96E-03	0.105	1.26E-03	See footnote	1.69E-03	See footnote	9.81E-03	0	2.38E-04	0.41	0.92	2.05	5.80E-04	2.59E-04	1.16E-04
Pesticides																	
Aldrin	0.0012	3.300	3.96E-03	0.139	1.67E-04	See footnote	2.68E-04	See footnote	3.42E-03	0	7.62E-05	0.07	0.16	0.35	1.09E-03	4.86E-04	2.17E-04
alpha-BHC	0.0012	1.000	1.20E-03	1.735	2.08E-03	See footnote	2.04E-03	See footnote	1.24E-03	0	6.78E-05	0.56	1.13	2.25	1.20E-04	6.03E-05	3.01E-05
alpha-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	See footnote	3.14E-04	See footnote	4.12E-03	0	9.15E-05	2.14	4.79	10.7	4.27E-05	1.91E-05	8.55E-06
beta-BHC	0.0012	1.000	1.20E-03	1.719	2.06E-03	See footnote	2.02E-03	See footnote	1.24E-03	0	6.74E-05	0.56	1.13	2.25	1.20E-04	5.99E-05	3.00E-05
delta-BHC	0.0012	1.000	1.20E-03	1.311	1.57E-03	See footnote	1.56E-03	See footnote	1.22E-03	0	5.73E-05	0.56	1.13	2.25	1.02E-04	5.09E-05	2.55E-05
Endosulfan I	0.0012	1.000	1.20E-03	1.687	2.02E-03	See footnote	1.99E-03	See footnote	1.24E-03	0	6.66E-05	10.0	22.4	50.0	6.66E-06	2.98E-06	1.33E-06
Endosulfan II	0.0012	1.000	1.20E-03	0.886	1.06E-03	See footnote	1.07E-03	See footnote	1.19E-03	0	4.67E-05	10.0	22.4	50.0	4.67E-06	2.09E-06	9.34E-07
Endrin	0.0012	3.600	4.32E-03	0.535	6.42E-04	See footnote	7.29E-04	See footnote	3.74E-03	0	9.23E-05	0.021	0.047	0.104	4.44E-03	1.98E-03	8.87E-04
gamma-BHC (Lindane)	0.0012	26.60	3.19E-02	1.852	2.22E-03	See footnote	2.79E-03	See footnote	2.65E-02	0	6.05E-04	4.00	8.9	20.0	1.51E-04	6.77E-05	3.03E-05
gamma-Chlordane	0.0012	4.000	4.80E-03	0.165	1.98E-04	See footnote	3.14E-04	See footnote	4.12E-03	0	9.15E-05	2.14	4.79	10.7	4.27E-05	1.91E-05	8.55E-06
Heptachlor	0.0012	3.000	3.60E-03	0.174	2.09E-04	See footnote	3.01E-04	See footnote	3.13E-03	0	7.08E-05	0.28	0.62	1.38	2.57E-04	1.15E-04	5.14E-05
Heptachlor epoxide	0.0012	10.00	1.20E-02	0.566	6.79E-04	See footnote	9.18E-04	See footnote	1.01E-02	0	2.27E-04	0.28	0.62	1.38	8.24E-04	3.68E-04	1.65E-04
Methoxychlor	0.0012	1.000	1.20E-03	0.525	6.30E-04	See footnote	6.55E-04	See footnote	1.17E-03	0	3.77E-05	355	794	1,775	1.06E-07	4.76E-08	2.13E-08
Toxaphene	0.0240	1.000	2.40E-02	0.355	8.51E-03	See footnote	9.19E-03	See footnote	2.33E-02	0	6.70E-04	1.00	2.24	5.00	6.70E-04	3.00E-04	1.34E-04
Volatile/Semivolatile Organics																	
1,1,2,2-Tetrachloroethane	0.0012	1.000	1.20E-03	1.000	1.20E-03	See footnote	1.20E-03	See footnote	1.20E-03	0	4.96E-05	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	0.0012	0.560	6.72E-04	1.426	1.71E-03	See footnote	1.68E-03	See footnote	7.89E-04	0	5.10E-05	80.4	180	402	6.34E-07	2.83E-07	1.27E-07
1,2-Dichlorobenzene	0.0012	1.000	1.20E-03	2.452	2.94E-03	See footnote	2.87E-03	See footnote	1.28E-03	0	8.56E-05	80.4	180	402	1.07E-06	4.76E-07	2.13E-07
1,3-Dichlorobenzene	0.0012	1.000	1.20E-03	2.296	2.76E-03	See footnote	2.69E-03	See footnote	1.27E-03	0	8.18E-05	80.4	180	402	1.02E-06	4.55E-07	2.03E-07
1,4-Dichlorobenzene	0.0012	1.000	1.20E-03	2.475	2.97E-03	See footnote	2.89E-03	See footnote	1.28E-03	0	8.62E-05	80.4	180	402	1.07E-06	4.79E-07	2.14E-07
4-Bromophenyl-phenylether	0.1200	1.000	1.20E-01	0.566	6.79E-02	See footnote	7.02E-02	See footnote	1.18E-01	0	3.88E-03	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	0.1200	1.000	1.20E-01	0.593	7.11E-02	See footnote	7.33E-02	See footnote	1.18E-01	0	3.94E-03	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.1200	1.690	2.03E-01	0.246	2.96E-02	See footnote	3.52E-02	See footnote	1.84E-01	0	4.52E-03	0.113	0.253	0.565	4.00E-02	1.79E-02	8.01E-03
Hexachlorobutadiene	0.1200	1.000	1.20E-01	0.675	8.11E-02	See footnote	8.28E-02	See footnote	1.18E-01	0	4.15E-03	3.39	7.58	17.0	1.22E-03	5.47E-04	2.45E-04

TABLE G-26

Summary of Red-tailed Hawk Exposure Doses - Screening (Step 2)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Maximum Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Hexachlorocyclopentadiene	0.1200	1.000	1.20E-01	0.393	4.71E-02	See footnote	5.04E-02	See footnote	1.17E-01	0	3.45E-03	NA	NA	NA	NA	NA	NA
Hexachloroethane	0.1200	1.000	1.20E-01	1.439	1.73E-01	See footnote	1.70E-01	See footnote	1.22E-01	0	6.05E-03	NA	NA	NA	NA	NA	NA

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0395 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (small mammals)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
WIR = 0.0680 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.957 = Body weight (kg)

TABLE G-27

Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Mean and 95% UCL)

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

	Meadow Vole			Short-tailed Shrew			Red Fox			American Robin			Mourning Dove			Red-tailed Hawk		
Chemical	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ	NOAEL HQ	MATC HQ	LOAEL HQ
Mean																		
Mercury	1.24E-01	5.57E-02	2.49E-02	2.04E-01	9.12E-02	4.08E-02	2.69E-03	2.10E-03	1.64E-03	7.53E-03	4.81E-03	3.08E-03	2.51E-02	1.77E-02	1.25E-02	2.77E-04	1.77E-04	1.13E-04
Selenium	2.93E-01	2.28E-01	1.78E-01	7.35E-01	5.72E-01	4.45E-01	1.44E-01	1.12E-01	8.76E-02	1.85E-01	1.00E-01	5.42E-02	5.83E-01	4.13E-01	2.92E-01	6.38E-02	3.45E-02	1.87E-02
95% UCL																		
Mercury	1.72E-01	7.71E-02	3.45E-02	3.59E-01	1.61E-01	7.18E-02	4.32E-03	3.37E-03	2.62E-03	1.34E-02	8.58E-03	5.48E-03	3.47E-02	2.46E-02	1.74E-02	4.94E-04	3.15E-04	2.02E-04

Shaded cells indicate HQ > 1

TABLE G-28

Summary of Meadow Vole Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean													
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0	3.98E-03	0.032	0.072	0.16	1.24E-01	5.57E-02	2.49E-02
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	0	5.87E-02	0.20	0.26	0.33	2.93E-01	2.28E-01	1.78E-01
95% UCL													
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0	5.52E-03	0.032	0.072	0.16	1.72E-01	7.71E-02	3.45E-02

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0021 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.020 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.956 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.024 = Proportion of diet composed of soil
WIR = 0.0090 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0428 = Body weight (kg)

TABLE G-29

Summary of Short-Tailed Shrew Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean													
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0	6.53E-03	0.032	0.072	0.16	2.04E-01	9.12E-02	4.08E-02
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	0	1.47E-01	0.20	0.26	0.33	7.35E-01	5.72E-01	4.45E-01
95% UCL													
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0	1.15E-02	0.032	0.072	0.16	3.59E-01	1.61E-01	7.18E-02

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0015 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.823 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.047 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.130 = Proportion of diet composed of soil
WIR = 0.0038 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0169 = Body weight (kg)

TABLE G-30

Summary of Red Fox Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean																	
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0.067	4.24E-03	0.067	4.24E-03	0	4.04E-04	0.15	0.19	0.25	2.69E-03	2.10E-03	1.64E-03
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	Regresson	8.77E-01	Regresson	8.77E-01	0	2.89E-02	0.20	0.26	0.33	1.44E-01	1.12E-01	8.76E-02
95% UCL																	
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0.067	7.56E-03	0.067	7.56E-03	0	6.48E-04	0.15	0.19	0.25	4.32E-03	3.37E-03	2.62E-03

Orange shaded cells indicate concentration based upon reporting limits

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.1231 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.028 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.070 = Proportion of diet composed of food item (terrestrial plants)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis)
PDFi = 0.874 = Proportion of diet composed of food item (small mammals)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.028 = Proportion of diet composed of soil
WIR = 0.3494 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 4.06 = Body weight (kg)

TABLE G-31

Summary of American Robin Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean													
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0	3.69E-03	0.49	0.77	1.20	7.53E-03	4.81E-03	3.08E-03
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	0	8.13E-02	0.44	0.81	1.50	1.85E-01	1.00E-01	5.42E-02
95% UCL													
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0	6.58E-03	0.49	0.77	1.20	1.34E-02	8.58E-03	5.48E-03

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0038 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.954 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil
WIR = 0.0106 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0773 = Body weight (kg)

TABLE G-32

Summary of Mourning Dove Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean													
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0	1.13E-02	0.45	0.64	0.90	2.51E-02	1.77E-02	1.25E-02
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	0	1.69E-01	0.29	0.41	0.58	5.83E-01	4.13E-01	2.92E-01
95% UCL													
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0	1.56E-02	0.45	0.64	0.90	3.47E-02	2.46E-02	1.74E-02

Orange shaded cells indicate concentration based upon reporting limits

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0176 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.950 = Proportion of diet composed of food item (terrestrial plants)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.050 = Proportion of diet composed of soil
WIR = 0.0148 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.1265 = Body weight (kg)

TABLE G-33

Summary of Red-tailed Hawk Exposure Doses - Baseline (Step 3A) - Arithmetic Mean and 95% UCL

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Herbivore Soil-Mammal BAF	Herbivore Small Mammal Concentration (mg/kg dw)	Insectivore Soil-Mammal BAF	Insectivore Small Mammal Concentration (mg/kg dw)	Mean Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	MATC TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	MATC HQ	LOAEL HQ
Mean																	
Mercury	0.063	1.186	7.50E-02	Regresson	8.22E-02	0.067	4.24E-03	0.067	4.24E-03	0	1.36E-04	0.49	0.77	1.20	2.77E-04	1.77E-04	1.13E-04
Selenium	2.13	Regression	1.61E+00	Regresson	1.17E+00	Regresson	8.77E-01	Regresson	8.77E-01	0	2.81E-02	0.44	0.81	1.50	6.38E-02	3.45E-02	1.87E-02
95% UCL																	
Mercury	0.113	1.186	1.34E-01	Regresson	1.13E-01	0.067	7.56E-03	0.067	7.56E-03	0	2.42E-04	0.49	0.77	1.20	4.94E-04	3.15E-04	2.02E-04

Orange shaded cells indicate concentration based upon reporting limits

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF of 1.0 was assumed

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.0360 = Food ingestion rate (kg/day dry weight)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (soil invertebrates)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis)
PDFi = 0.000 = Proportion of diet composed of food item (terrestrial plants)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis)
PDFi = 1.000 = Proportion of diet composed of food item (small mammals)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.000 = Proportion of diet composed of soil
WIR = 0.0639 = Water ingestion rate (L/day)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 1.126 = Body weight (kg)

TABLE G-34

Reporting Limit to Screening Value Comparison

Site Investigation Report - Site 32

Naval Weapons Station Yorktown, Yorktown, Virginia

Chemical	Units	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Mean Concentration	ESV	Minimum Ratio	Maximum Ratio	Mean Ratio
Surface Soil									
Selenium	MG/KG	0 / 1	4.26	4.26	2.13	0.52	8.19	8.19	4.10
Atrazine	UG/KG	0 / 1	120	120	60.0	11.9	10.1	10.1	5.04
Subsurface Soil									
Selenium	MG/KG	0 / 1	4.15	4.15	2.08	0.52	7.98	7.98	3.99
Atrazine	UG/KG	0 / 1	120	120	60.0	11.9	10.1	10.1	5.04
Groundwater									
Cadmium, total	UG/L	0 / 5	4.00	4.00	2.00	0.27	14.8	14.8	7.41
Cadmium, dissolved	UG/L	0 / 5	4.00	4.00	2.00	0.25	16.0	16.0	8.00

Shaded cells indicate ratio > 1

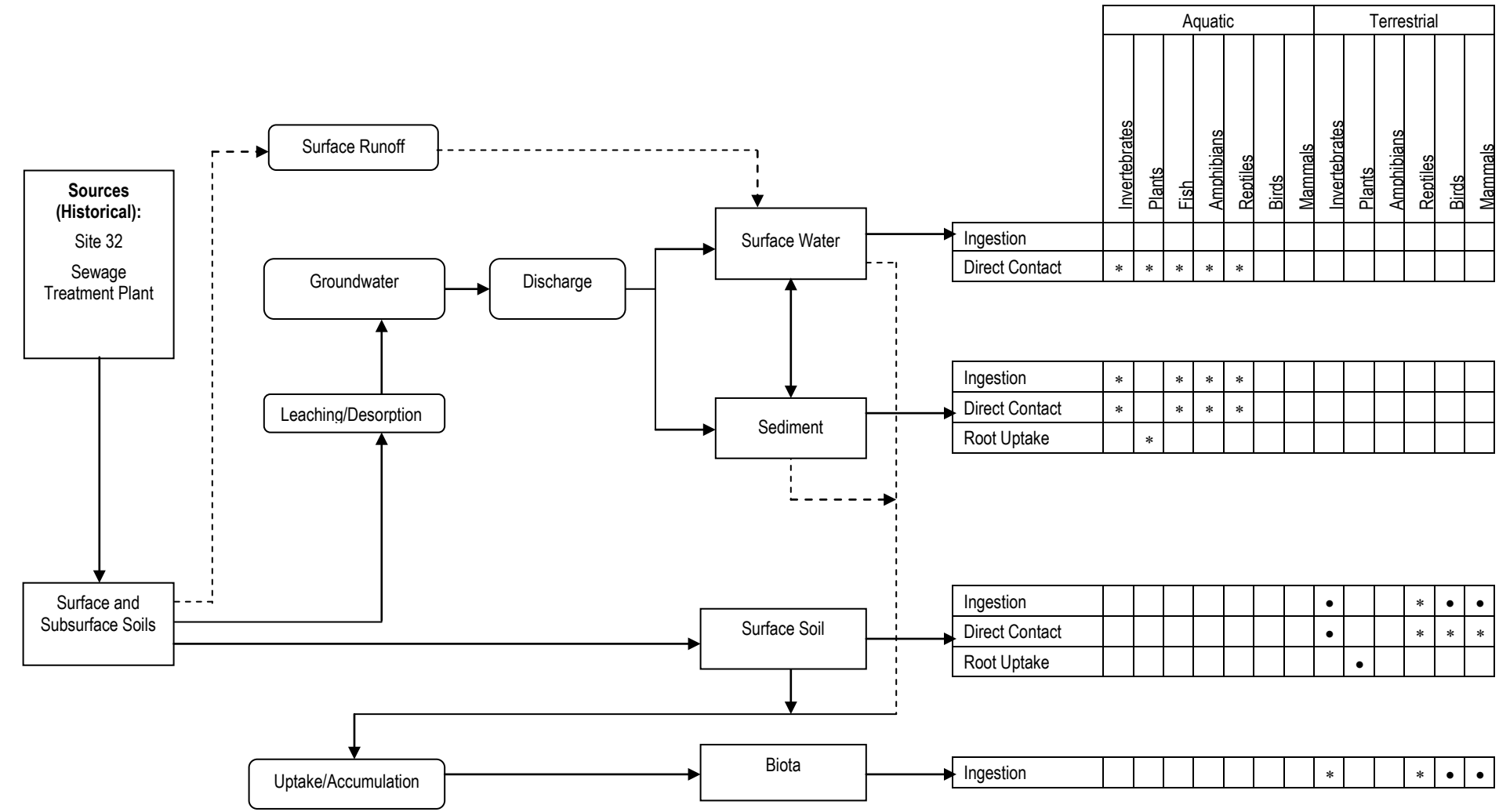

FIGURE G-1
ECOLOGICAL CONCEPTUAL MODEL – SITE 32
NAVAL WEAPONS STATION YORKTOWN
YORKTOWN, VIRGINIA