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FINAL RECORD OF DECISION SOILS OPERABLE UNIT 2 (OU 2) PARADISE CREEK DISPOSAL AREA NSY NORFOLK PORTSMOUTH VA

03/01/2010

NAVFAC MID ATLANTIC

Final

Record of Decision (Soil)
Operable Unit 2: Paradise Creek Disposal Area

Norfolk Naval Shipyard
Portsmouth, Virginia

Prepared by

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

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Abbreviations and Acronyms

ABM	abrasive blast material
ARAR	applicable or relevant and appropriate requirement
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	chemical of potential concern
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
ESV	ecological screening value
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
GDN	geocomposite drainage net
HHRA	Human Health Risk Assessment
HI	hazard index
IAS	Initial Assessment Study
IC	institutional control
ICR	Incremental Lifetime Cancer Risk
ID	identification
IR	Installation Restoration
IRI	Interim Remedial Investigation
LUC	land use control
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NNSY	Norfolk Naval Shipyard
NPL	National Priorities List
NTCRA	Non-time-critical Removal Action

O&M	operation and maintenance
ORA	Oil Reclamation Area
OU2	operable unit
OWS	oil-water separator
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricants
RA	Remedial Action
RAA	remedial action alternative
RAO	remedial action objective
RAB	Restoration Advisory Board
RACG	remedial action cleanup goal
RBD	risk-based criteria
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbon
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VaWQS	Virginia Water Quality Standards
VaWQS	Virginia Water Quality Standards for Human Health
VDEQ	Virginia Department of Environmental Quality
VEPCO	Virginia Electric and Power Company
VOC	volatile organic compound

SECTION 1

Declaration

1.1 Site Name and Location

Operable Unit (OU) 2, Paradise Creek Disposal Area
Norfolk Naval Shipyard (NNSY), Portsmouth, Virginia
United States Environmental Protection Agency (USEPA) Identification (ID): VA1170024813

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the selected remedy and provides the rationale for addressing potential human health and ecological risks from exposure to soil and surface water for OU2, Paradise Creek Disposal Area and Associated Areas at NNSY. Groundwater is being investigated separately and will be addressed under a separate ROD. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, and to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on documentation maintained in the Administrative Record for this site.

The Department of the Navy (Navy), the lead agency, and USEPA Region III jointly issue this ROD. The Virginia Department of Environmental Quality (VDEQ) concurs with the selected remedy.

1.3 Assessment of the Site

OU2 is comprised of five sites: Sites 3, 4, 5, 6, and 7. Based on the results of previous investigations, chemicals in soil and waste in place at Sites 3, 4, 5, and 6 may result in potential human health risks. Therefore the response actions in this ROD for soil associated with Sites 3, 4, 5, and 6 are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances from the site into the environment.

No unacceptable risks associated with human or ecological exposure to surface water in Paradise Creek were identified. Additionally, potential unacceptable risks associated with receptor exposure to soil at Site 7 were mitigated through completion of a Non-Time-Critical Removal Action (NTCRA). No response action is necessary for Site 7 or surface water of Paradise Creek adjacent to OU2.

1.4 Description of the Selected Remedy

The selected remedy will be implemented to ensure the remedial action objectives (RAOs) are achieved. The site-specific RAOs for soil are the following:

- **Soil–**Prevent direct contact with contaminated soil posing unacceptable risk and reduce the potential for further erosion while being compatible with future actions that may be taken for groundwater at the site.

The selected remedy to address contaminated soil at OU2, Sites 3, 4, 5, and 6, is a containment presumptive remedy, the components of which are: construction of a soil cover with stabilization of the landfill side slopes, land use controls (LUCs) and maintenance to prevent human and ecological receptor exposure to contaminated soil and to ensure integrity of the cover. As a result of a previous NTCRA, no further action (NFA) for Site 7 is warranted. Contaminated sediment adjacent to OU2 is being addressed under a separate removal action. Groundwater impacted by OU2 activities also is being addressed separately. The soil cover is not intended to be a remedy for OU2 groundwater, and, if necessary, may be disturbed in the future as part of Remedial Action (RA) for groundwater.

LUCs will be enforced on the soil cover to ensure protectiveness from receptor exposure to contaminated soil and to maintain the integrity of the cover. Following the execution of this ROD, the Navy shall develop, and submit to USEPA and VDEQ, in accordance with the Federal Facilities Agreement (FFA), a remedial design for the LUCs. LUCs and maintenance actions, including periodic inspections and reporting, shall be provided as part of the Remedial Design. Implementing these activities will ensure that residential development, or any other land use that is inconsistent with the specific RAO and selected remedy will not be allowed on the site and that the soil cover will be properly maintained.

1.5 Statutory Determinations

The selected remedy is protective of human health and the environment because application of a soil cover reduces the potential for human exposure to contaminated soil and potential migration of contaminants offsite and enforcement of LUCs will prohibit activities giving rise to unacceptable exposure to hazardous substances, pollutants, or contaminants.

The selected remedy complies with applicable or relevant and appropriate requirements (ARARs), is cost effective, utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and addresses all potential risks from exposure to soil and surface water at OU2. The selected remedy does not satisfy the statutory preference of treatment as a principal element of the remedy because treatment of hazardous substances in a landfill is impracticable given the size of the site and uncertainty associated with the specific location of such waste within the landfill. Because the remedy will result in hazardous substances, pollutants, or contaminants remaining onsite in soil above levels that allow for unlimited use and unrestricted exposure a statutory review will be conducted within 5 years after initiation of the RA (and every 5 years thereafter), to ensure that the remedy is, or will be, effective in protection of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary (**Section 2**) of this ROD. Additional information for OU2 can be found in the Administrative Record for NNSY, located at the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Public Affairs Office, 9742 Maryland Avenue, Building A-81, Norfolk, Virginia 23511.

- Contaminants of concern (COCs) and their respective concentrations (**Section 2.5**)
- Potential risks associated with exposure to the soil COCs (**Section 2.7**)
- RAOs (**Section 2.8**)
- Potential land use that will be available at the site as a result of the selected remedy (**Section 2.6**)
- Estimated capital, annual operation and maintenance (O&M), and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (**Section 2.9**)
- How source materials constituting principal threats will be addressed (**Section 2.11**)
- Key factors leading to the selection of the remedy (**Section 2.12**)

1.7 Authorizing Signatures

The Navy and USEPA selected this remedy with the concurrence of VDEQ.

Concur and recommend for immediate implementation:

_____ _____

W.C. Kiestler
Captain, U.S. Navy
Commander, Norfolk Naval Shipyard
Portsmouth, VA

Date

_____ _____

Kathryn A. Hodgkiss, Acting Director
Hazardous Site Cleanup Division
USEPA Region III

Date

SECTION 2

Decision Summary

2.1 Site Name, Location, and Description

This ROD addresses soil and surface water at OU2, Paradise Creek Disposal Area, at NNSY in Portsmouth, Virginia. The Navy is the lead agency under CERCLA and provides funding for site cleanups. NNSY (USEPA ID# VA1170024813) was placed on USEPA's National Priorities List (NPL) on July 22, 1999. NNSY was included under the Federal Facilities section of the NPL in which federal agencies are considered responsible for conducting response actions at the facilities under their jurisdiction. An FFA between USEPA Region III and NNSY was finalized in September 2004 (USEPA/Navy, 2004). USEPA oversees the Navy's management and cleanup of the Installation Restoration (IR) Program sites and solid waste management units (SWMUs) at NNSY.

NNSY is located along the Southern Branch of the Elizabeth River in Portsmouth, Virginia (**Figure 2-1**). The NNSY is the oldest continuously operated shipyard in the United States, with origins dating back to 1767 when it was a merchant shipyard under British rule.

After World War II, NNSY became primarily an overhaul and repair facility. NNSY has remained such to this day. The facility's current mission is to provide logistic support for assigned ships and service craft; perform authorized work in connection with construction, conversion, overhaul, repair, alteration, dry docking, and outfitting of ships and other watercraft; perform manufacturing, research, development, and test work; and provide services and material to other activities and units.

The present shipyard and the nearby Navy-owned noncontiguous areas include the following (**Figure 2-1**):

- Main Shipyard
- Southgate Annex
- Scott Center Annex
- Paradise Creek Disposal Area
- New Gosport

OU2, Paradise Creek Disposal Area, encompasses approximately 91 acres and lies adjacent to Paradise Creek at the southern boundary of NNSY (**Figure 2-2**). OU2 is bounded to the northwest, across Victory Boulevard, by a refuse-derived fuel processing plant operated by the Southeastern Public Service Authority; to the east by a former wood treatment facility (owned by Atlantic Wood Industries, Inc. and currently on the USEPA Region III NPL), the Portsmouth School Board vehicle maintenance and refueling yard, and the Vane Brothers Marine Terminal property (formerly used for petroleum bulk-storage); and to the south and southwest by Paradise Creek, a tributary to the Southern Branch of the Elizabeth River (**Figure 2-2**). Land use on the opposite bank of Paradise Creek (the south bank) is also industrial.

Site 3 lies adjacent to the north bank of Paradise Creek on the southern edge of NNSY. The area to the south and east of the divide (access road) is referred to as the Eastern Landfill, while the area to the north and west of the divide is referred to as the Western Landfill (**Figure 2-2**). Sites 4, 5, and 6, are located within the boundaries of Site 3. The individual sites are overlapping with no defined areas of contamination that can be attributed to one site rather than another. Site 3 is comprised of hydraulic fill. Norfolk Dredging Company performed the filling operations in 1941 using dredge material from the Southern Branch of the Elizabeth River.

Sites 4 and 6, which were located in the northern portion of the Western Landfill, were used as chemical storage and disposal areas. Site 5, which was also located in the northern portion of the Western Landfill, is a former oil reclamation area. Soil boring logs from within the Site 4 boundary collected during a 1996 site characterization report for Site 5 (OHM, 1997) indicated most surface material to a depth of 5 to 8 feet below ground surface (bgs) consisted of fill material including brick fragments, wood chips, crushed rock fragments, and construction debris, mixed with silts and sands. Site 7, located between the southern corners of the Eastern and Western landfills and Paradise Creek, was a chemical waste storage area that has been addressed by a NTCRA completed in 2006. Buried waste materials, debris, and contaminated soils were excavated from Site 7, which was backfilled with clean fill to establish tidal wetlands planted with native species. Specific information on the sites comprising OU2 is provided below.

Site 3

From 1954 through 1983, Site 3 reportedly served as a disposal area for dredge fill, abrasive blast material (ABM), paint residues, sanitary wastes, solvents, and other industrial residues. According to the Initial Assessment Study (IAS) (Water and Air Research, 1983), the average rates of disposal of the primary wastes were estimated as follows:

- Salvage waste, including fluorescent tubes, mercury-contaminated rags, and construction/ demolition debris: 1,200 tons per month
- Sandblasting grit: 1,500 tons per month
- Oil-fired power plant fly ash: 180 tons per month
- Coal-fired power plant fly ash: 1,800 tons per month
- Salvage waste, fuel-boiler-plant bottom ash: 1,700 tons per month up through 1977, 400 tons per month after 1977
- Asbestos waste: 320 cubic yards per month

Building 431, formerly located on the eastern side of the Western Area, was an incinerator used for burning liquid and solid waste until the late 1960s.

According to the NNSY Landfill Management Plan (Talbot and Associates, 1983), solid waste disposal operations continued until approximately 1983, when the landfill's permit expired. An application for a state permit to vertically expand both the Eastern and Western landfills was denied. Between 1983 and 1985, an unspecified final cover material was applied to the Eastern Landfill. A letter from the Commonwealth of Virginia Department of

Waste Management to the Environmental Programs Division of NNSY indicated the closure procedure for the facility had been accomplished and the site was deemed to be properly closed (Commonwealth of Virginia, 1989). VDEQ presently considers the Eastern and Western landfills closed.

Site 4

Site 4, Liquid Waste Holding Ponds, is an area north of the Western Landfill that consists of five former chemical waste holding ponds constructed between 1963 and 1972 on top of and within the fill material comprised of brick fragments, wood chips, crushed rock fragments, and construction debris, mixed with silts and sands (as noted by boring logs from the site). These ponds received liquid wastes between 1963 and 1980. According to the historical information provided in the Remedial Investigation (RI) (CH2M HILL, 2002), four of the five ponds were lined with either a clay liner or asphalt. As documented by Navy records, the types of waste held in the ponds at Site 4 included cyanides, acids, degreasers, solvents, alkali, and other materials. When the ponds were full, the liquids were pumped into tanker trucks for offsite disposal. Prior to covering the pits with soil in 1981 (1 foot of clay and 6 inches of topsoil), remaining liquids were pumped out and disposed of offsite (NNSY, 1981). Site 4 was not operated within a regulatory program and, as such, the covering/ closure of the holding ponds was not completed in accordance with any specific regulations.

Site 5

Site 5, Oil Reclamation Area (ORA), is an area north of the Western Landfill used to store and consolidate used petroleum, oil, and lubricants (POL) from 1963 to the early 2000s before contract sale to Craney Island for reclamation. Two underground storage tanks (USTs) were used at the site for this purpose. The first tank was a 10,000-gallon tank in use from 1968 until the early 1980s. Because of suspected leaks, this tank was replaced in the 1980s by a new used-oil storage system. Navy record drawings indicate that the initial UST was abandoned in place by filling it with sand and capping the pipes. The new system consisted of a second 10,000-gallon UST, four bermed concrete pads used as staging areas for drums and tanker trucks, and an in-ground concrete oil-water separator (OWS) used to treat oily water collected in the four staging areas. An underground sewer pipe ran from floor drains in the four bermed staging areas to the OWS. A diversion box was installed on this line to manually divert oily water to the OWS and clean water to a 72-inch diameter storm sewer beneath the access road dividing the landfill areas. Treated water from the OWS was discharged through an underground pipe to the sanitary sewer. POL storage or handling no longer is conducted at the site. A concrete area adjacent to the east side of Site 5 was reportedly used in the mid-1980s for storing containers of waste material (including oil, hydraulic fluid, and Freon) in 55-gallon drums (NUS Corporation, 1986). All former oil-handling structures (e.g., sumps, pipes) have been abandoned and taken out of service.

Site 6

Site 6, Former Liquid Waste Disposal Area, is an area north of the western portion of Site 3 where spent ABM was disposed of between the mid-1960s and 1977. Liquids such as acetone and alcohol were placed over top of the ABM and allowed to evaporate (White, 1998). Information about any completed closeout or cleanup activities that are specific to

Site 6 is limited. The 1983 IAS indicated the exact location of the site could not be determined.

Site 7

Site 7, Former Liquid Waste Holding Area, is an approximately 1-acre area between the southeastern corner of the Western Landfill, the southwestern corner of the Eastern Landfill, and Paradise Creek. The site was reportedly used between the late 1950s and early 1970s. The composition and quantity of wastes placed in Site 7 is unknown; however, according to the IAS, it is believed that the same types of waste placed at Sites 4 and 6 were also placed at Site 7. Documents reviewed to prepare the IAS indicated this area also received waste acetylene sludge (calcium hydroxide) generated at other areas of the NNSY (for example, at Site 9, located within the South Gate Annex). Waste and waste contaminated soil was removed via NTCRA in 2006. Currently the site is a tidal wetland.

2.2 Site History and Enforcement Activities

OU2 has been characterized under numerous investigations and studies since 1983. Preliminary environmental studies conducted at OU2 as part of the base-wide effort include the IAS and the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (NUS Corporation, 1986). Site-specific investigations conducted before NNSY was placed on the NPL in July 1999 consist of an Interim Remedial Investigation (IRI) (International Technology Corporation, 1989), an RI/Feasibility Study (FS) (FWEI, 1995), and Site Characterization and Conceptual Design (OHM, 1997). Detailed information from previous investigations conducted at OU2 is available in the Administrative Record for NNSY or by contacting the NAVFAC Public Affairs Office.

2.2.1 Previous Investigations

A summary of the post-NPL investigation efforts is provided below. **Figure 2-3** illustrates soil, and surface water sample collections locations which were part of previous investigation efforts.

Phase II Remedial Investigation

The *Final Phase II Remedial Investigation Report Operable Unit 2 – Paradise Creek Disposal Area and Associated Areas, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, 2002) presents the findings of soil, soil gas, and surface water sampling, and identifies the extent of contamination of these media. The Phase II RI was completed to fill data gaps identified prior to the NNSY NPL listing in the Phase I RI (FWEI, 1995) needing to be addressed to define the nature and extent of contamination, as well as to complete the risk assessments. The RI identified metals and polynuclear aromatic hydrocarbons (PAHs) in soil, potentially indicating a site release. Human health and ecological risks were quantitatively assessed. Based on the results of the Human Health Risk Assessment (HHRA), PAHs and metals in soil were determined to be present at levels posing potential unacceptable risk requiring RA. Development of a FS was recommended to address these contaminated media. Detailed results of the HHRA and Ecological Risk Assessment (ERA) are presented in **Section 2.7**.

Draft OU2 Feasibility Study

The *Draft Feasibility Study Operable Unit 2, Paradise Creek Disposal Area and Associated Areas* (CH2M HILL, 2000) was prepared to document the engineering analyses and evaluations used to develop remedial action alternatives (RAAs) for OU2. The draft FS was used by the Navy and regulatory agencies to identify a cost-effective remedial alternative that complied with the requirements of the NCP.

Four alternatives were developed for the draft FS and were evaluated based on criteria set forth in the NCP. The recommended alternative was Alternative 4, Soil Cover with Institutional Controls (ICs). This alternative specifically included construction of a soil cover, installation of stormwater controls, and ICs. A parallel objective was to stabilize steep slopes of the landfill that may fail in the future.

In order to further evaluate potential contamination in marsh sediments adjacent to OU2, the draft FS was not finalized.

Waste Delineation Investigation

The *Final Waste Delineation Investigation for OU1, Site 2/Scott Center Landfill and OU2, Site 7/ Paradise Creek Disposal Area, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, 2003) presented the results of a waste delineation conducted at OU2, Site 7. This investigation was completed to provide the Navy with additional information regarding the extent and characterization of the waste present at Site 7, particularly calcium hydroxide. Based on the results of this investigation an Engineering Evaluation/Cost Analysis (EE/CA) was recommended to evaluate removal alternatives to address the calcium hydroxide at Site 7.

Engineering Evaluation/Cost Analysis

The *Final Engineering Evaluation/Cost Analysis for Operable Unit 2, Paradise Creek Disposal Area, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, 2004a) was completed to identify, evaluate, and compare a range of alternatives for the NTCRA at OU2. The EE/CA addressed three distinct areas of OU2 as part of the NTCRA and was divided into separate work elements. The following removal alternatives were recommended:

- **Work Element A (Eastern and Western Landfill Areas)—**Installation of additional soil cover over the existing landfill cover to promote drainage and mitigate potential risk from exposure to surface soil, installation of a passive landfill gas system, side slope stabilization, and implementation of post-closure O&M requirements as well as institutional controls.
- **Work Element B (Marsh Sediment Remediation Area)—**Excavation of contaminated sediments and the construction of an enhanced wetlands environment. Wetland enhancement and utilization of phytoremediation were also evaluated in the EE/CA as components of site restoration.
- **Work Element C (Site 7)—**Excavation of waste, waste-contaminated soils, and all other buried wastes; and installation of a stormwater Best Management Practice for a wetland.

Paradise Creek Design Basis Report

The *Final Design Basis Report for Paradise Creek Landfill Cover, Norfolk Naval Shipyard, Portsmouth, Virginia* (JV I, 2004) was prepared to present specific design information for the response actions to be implemented as described in the EE/CA at the Paradise Creek Disposal Area. The report used USEPA's presumptive landfill remedy approach and the recommended alternative presented in the initial draft FS completed in 2000. This report discussed the soil cover design, hydrological/hydraulic features, and other design features, including construction phasing, erosion and sediment control, debris and hot spot removal, roadway design, and marsh area and wetland construction.

This report proposed a phased approach to accommodate construction sequencing of the work elements A and C described in the 2004 EE/CA. Additional data was necessary to design work element B, therefore this element was satisfied through a later addition of a Phase IV. Design phases satisfying work elements A and C are described as follows:

- **Phase I—**Preparatory work, including demolition, waste excavation activities within Site 7, installation of access roads, and installation of drainage structures and other features required to support subsequent phases of the project. Phase I also included the construction of a tidal salt marsh wetland planted with native species in the vicinity of Site 7.
- **Phase II—**Grading, cover installation, and final restoration activities for the Site 3 Eastern Landfill area.
- **Phase III—**Grading, cover installation, and final restoration activities for the Site 3 Western Landfill area and Sites 4, 5, and 6. Phase III provided for the improvement of a small salt marsh wetland at the toe of the slope along the southwestern edge of the Western Landfill area.

Each phase of work was developed as a separate design package, including phase-specific drawings, specifications, and construction quality assurance plans.

Non-time-critical Removal Action – Site 7

A NTCRA was initially planned to implement all three phases of construction activities. However, only Phase I (site preparatory work and excavation/restoration of Site 7) was completed in accordance with the design. Waste and waste-contaminated soils at Site 7 were excavated and tidal wetlands constructed as part of site restoration. Phases II and III of the design were not initiated under the NTCRA. The removal action activities which achieved the cleanup goals for Site 7 are documented in the *Closeout Report Operable Unit #2 - Paradise Creek Disposal Area Removal Action - Phase 1 Norfolk Naval Shipyard Portsmouth, VA* (FSSI, 2007).

Phase IV Marsh Sediment Remediation

A fourth phase (Phase IV) of construction was developed for the Paradise Creek Disposal Area to address the Marsh Sediment Remediation Area adjacent to the Eastern Landfill. This area was identified in the 2000 draft FS as requiring further investigation, investigated during the Paradise Creek ERA, and addressed in the 2004 final EE/CA as Work Element B.

The recommended alternative for this work element in the EE/CA was to excavate and achieve remedial action cleanup goals (RACGs) in sediment.

The *Final Technical Memorandum, Findings of Phase I Paradise Creek Marsh Sediment Sampling Adjacent to Scott Center Landfill (OU1) and Paradise Creek Disposal Area (OU2) and Remedial Action Considerations*, *Norfolk Naval Shipyard, Portsmouth, Virginia*, (CH2M HILL, 2004b) presented the results of the Paradise Creek marsh sediment sampling adjacent to OU2. Results of the sampling, in conjunction with existing sediment data, provided adequate information to effectively identify the lateral extent of marsh sediment with contaminant concentrations exceeding RACGs and requiring RA consideration.

Pre-confirmation sampling was completed to determine the depth(s) to which marsh sediment excavation at OU2 would occur and confirm that RACGs would be achieved during the construction process. Results from the sampling event are presented in the *Technical Memorandum*, *Results of Pre-Removal Vertical Confirmatory Sampling of Operable Unit 2, Site 3 (Paradise Creek Disposal Area) Phase IV Construction, Marsh Sediment Remediation Area, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, 2005). Sample results indicated the excavation depth needed to restore the site as an improved quality wetland habitat was greater than the depths of RACG exceedances in sediment.

Marsh sediments are being addressed by a separate removal action. Closeout documentation for the removal action will demonstrate that removal action objectives were achieved.

Focused Feasibility Study

A final Focused Feasibility Study (FFS) was completed in March 2009 to address soil and sediment contamination at OU2; groundwater contamination will be addressed separately after additional investigations (CH2M HILL, 2009b). The FFS included the soil cover and side slope stabilization measures to address soil contamination, and provided for the stabilization of the potentially unstable side slopes on the landfill and incorporation of stormwater management features within the soil cover. The sediment alternatives were also evaluated in the FFS; however, because the pre-confirmation sampling had been completed to define the lateral and vertical extent of the affected area and because the sediment remediation area is small in comparison to the soil cover, the remediation of the sediment was planned as a common component to the construction activities for each of the soil alternatives. The sediment removal now will be conducted as a removal action concurrent to the landfill soil remedy.

Alternatives evaluated in the 2009 FFS for soil are:

- **Alternative 1—**No Action
- **Alternative 2—**Soil Cover with Side Slope Stabilization (including excavation and removal of contaminated sediment and enhancement of wetlands environment)
- **Alternative 3—**RCRA Subtitle D Landfill Cap with Side Slope Stabilization (including excavation and removal of contaminated sediment and enhancement of wetlands environment)

2.3 Community Participation

The NNSY Restoration Advisory Board (RAB) was formed in 1994. RAB meetings are routinely held to provide an information exchange among community members, USEPA, VDEQ, and the Navy. These meetings are open to the public and are held approximately every 6 months. RAB meetings provide opportunity for public comment and input on all remedies considered and the assumptions used, including the assumptions about reasonably anticipated future land use. A community relations program is being conducted through the IR Program process, and public input is considered a key element in the decision making process. During the course of investigations at OU2, the RAB has been apprised of all environmental activities related to the site.

In accordance with Sections 113 and 117 of CERCLA, the Navy conducted a public comment period from March 16 through May 1, 2009, for the *Proposed Plan for OU2, Paradise Creek Disposal Area Soil and Sediment, Norfolk Naval Shipyard, Portsmouth, Virginia* (CH2M HILL, 2009a). A public meeting to present the Proposed Plan for OU2 was held on March 31, 2009, at the Portsmouth Main Branch Library in Portsmouth, Virginia. Public notice of the meeting and availability of documents were placed in *The Virginian Pilot* newspaper on March 14, 2009.

The public information repositories for OU2, Paradise Creek Disposal Area and Associated Areas documents, including those in the Administrative Record used in the remedy selection process for OU2, are maintained in the following locations:

Public Affairs Office, NAVFAC Mid-Atlantic
9742 Maryland Avenue, Building A-81
Norfolk, Virginia 23511
Phone (757) 445-8732 ext. 3096

Portsmouth Public Library
601 Court Street
Portsmouth, Virginia 23704
Phone (757) 393-8501

No comments were submitted by the public during the public comment period. There were no attendees at the public meeting.

2.4 Scope and Role of Response Action

As noted earlier, NNSY was placed on USEPA's NPL in July 1999 (USEPA ID# VA1170024813). As a result of the NPL listing and pursuant to CERCLA, the Navy, USEPA, and VDEQ entered into an FFA (USEPA/Navy, 2004) to ensure that the environmental impacts associated with past and present activities at the NNSY are thoroughly investigated and appropriate RAs are taken, as necessary, to protect public health, welfare, and the environment. The NNSY FFA identifies and categorizes every area that has been identified as having, or suspected to have had, a release of a hazardous substance. The FFA also establishes a procedural framework and schedule for developing, implementing, and

monitoring appropriate response actions at the NNSY in accordance with CERCLA, as amended, and the NCP.

A list of all OUs and IR Program sites can be found in the current version of the Site Management Plan (CH2M HILL, 2008). The SMP contains the location, description, COCs, and cleanup status of each site at NNSY, including OU2. The following OUs and IR sites have been investigated in accordance with the CERCLA process and have resulted in RODs:

- **OU 1 (IR Site 2: the Scott Center Landfill)** has been completed with a NFA ROD, signed October 2005 (Navy, 2005).
- **OU 4 (IR Site 17: Building 195—Plating Shop)** was completed in August 2006 with the ROD calling for LUCs to prevent future residential development of the site (Navy, 2006).
- **IR Site 10 (1927 Landfill)** was completed in October 2008 with the ROD calling for LUCs to prevent future residential development of the site (Navy, 2008).

Two OUs have been addressed to date by removal actions:

- **OU 3 (IR Site 9: the former Acetylene Waste Lagoon)** was addressed by an NTCRA completed in November 2003.
- **OU 5 (Site 1: the former New Gosport Landfill)** was addressed by an NTCRA completed in June 2001.

One IR was investigated and closed out without a ROD:

- **IR Site 15 (Past Pier-Side Industrial Operations)** was investigated under the site screening process with a No Action determination following completion of the Preliminary Assessment report in December 2006.

Additionally, the NNSY FFA includes a list of 154 sites for which NFA under CERCLA is required (USEPA/Navy, 2004).

The OU2 RA described in this ROD is intended to address all potential risks to human health and the environment associated with waste and waste-contaminated soils at Sites 3, 4, 5, and 6. Site 7 has been excavated and restored as tidal wetlands pursuant to an NTCRA. Marsh sediment is being addressed by a separate removal action.

2.5 Site Characteristics

2.5.1 Site Overview

OU2, Paradise Creek Disposal Area, encompasses approximately 91 acres and lies adjacent to Paradise Creek at the southern boundary of NNSY (**Figure 2-2**). OU2 consists of five individual sites (Sites 3, 4, 5, 6, and 7). The recommendations for these sites in the 1983 IAS stated that these sites were best investigated as a single unit because of their close proximity to one another. Available records indicate a variety of waste including solvents, ABM, and waste POL were disposed of throughout OU2 as described in Section 2.1. Disposal activities have ceased at the site and groundwater is still under investigation.

Currently, access to OU2 is controlled with fencing. There are limited surface features (concrete pads) associated with the former use of Site 5 as an ORA. There are no readily visible indications of the former locations of Sites 4 and 6. Locations are estimated based upon historical site maps and aerial photographs. The perimeter of the Site 3 Eastern Landfill has steep side slopes and is heavily vegetated with trees and scrub brush with evidence of landfill debris present at the ground surface.

Land surface elevations throughout much of the site range from sea level to approximately 10 feet above mean sea level (msl). However, local elevations (i.e., throughout most of Site 3) can be 15 feet to greater than 20 feet above msl because of landfilling activities. Most of the high areas of the site, including the landfill slopes and berms, are man-made. The subsurface soil at OU2 is generally characterized by artificial fill and debris material which replaced, or was emplaced onto, natural geologic surface material throughout most of the investigation areas. The conceptual site model is presented as **Figure 2-4**.

All surface water drains either naturally or by the shipyard stormwater system to the tidal Paradise Creek. With the exception of the marshy terrace below the southeast corner of the Eastern Landfill area of Site 3, no significant standing water bodies exist within the site investigation areas to which site surface water might drain and be stored permanently. However, marshes in the buffer between Site 3 and Paradise Creek may temporarily store surface water drained from the sites. This temporarily stored surface water either percolates into the groundwater system and/or slowly drains into the main channel of Paradise Creek via overland flow or groundwater base flow.

Groundwater associated with OU2 was characterized during the RI (CH2M HILL, 2002). Groundwater at this site is not currently used or anticipated to be used as a drinking water supply or for any other purpose. Groundwater associated with OU2 is considered one hydrogeologic unit and continues to be investigated. A separate ROD for OU2 groundwater will be issued.

2.5.2 Nature and Extent of Contamination

The conclusions provided below regarding contaminants in soil at OU2 are presented in greater detail in the Phase II RI (CH2M HILL, 2002). The Phase II RI sampling and data analysis, evaluation, and assessments for OU2 were conducted separately for "Site 3" (consisting of Sites 3, 4, 6, and 7, which were associated with waste disposal and/or chemical holding and storage) and Site 5 (which was used primarily for the handling and temporary storage of oil products). Human health and ecological risk screenings were conducted as part of the respective risk assessments. The following comparison criteria were used to evaluate surface soil, subsurface soil, and surface water in the RI:

- *Surface soil* results were compared against Region III USEPA Biological Technical Assistance Group (BTAG) Flora Criteria and Fauna Criteria for soil, Region III USEPA Risk-based Concentrations (RBCs) for residential soil), and Alternate Ecological Screening Values negotiated with the State of Virginia and USEPA by the Navy.
- *Subsurface soil* results were compared against Region III USEPA BTAG Flora and Fauna Criteria for soil, Region III USEPA RBCs for residential soil), and Alternate Ecological Screening Values negotiated with the State of Virginia and USEPA by the Navy.

- *Surface water* results were compared against Region III USEPA BTAG Flora and Fauna Criteria for surface water, Region III USEPA RBCs for tap water, Virginia Water Quality Standards (VaWQS) for Chronic Effects for saltwater (VaWQS Aquatic Saltwater Chronic), VaWQS Human Health Standards (VaWQS-HH) for general surface water, and Alternate Ecological Screening Values (ESVs) negotiated with the State of Virginia and USEPA by the Navy.

The following conclusions regarding contaminant nature and extent in soil have been derived from the data collected at OU2:

- The surface soil contains elevated concentrations (i.e., above background levels) of metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc) and of various PAHs and polychlorinated biphenyls (PCBs). All of the elevated metals and several PAHs and pesticides also exceeded screening criteria in several samples. Several phenols also exceeded screening criteria. No volatile organic compounds (VOCs) were detected above screening criteria.
- Surface soil contamination was detected, particularly in the following locations:
  - Along the southern border of Site 4 (PAHs and phenols)
  - In drainage ditches that collect runoff from Site 4, Site 5, and the remainder of the Western Landfill (PAHs and phenols)
  - Along the northern part of the Virginia Electric and Power Company (VEPCO) right-of-way[1] between Site 3 and the Atlantic Wood Industries, Inc. facility (PAHs, phenols, and arsenic), in the drainage ditch running along the southern side of the VEPCO right-of-way (pesticides), and in the eastern part of the Western Landfill on the embankment leading down to the VEPCO right-of-way (PAHs and phenols)
  - In the western and central parts of the Western Landfill (pesticides, PCBs, and metals)
  - In the northwest corner of the Eastern Landfill (metals)
  - Near the crossing of the landfill access road and the VEPCO right-of-way (PAHs)
  - Where the VEPCO right-of-way meets Paradise Creek (PAHs)
  - On the south side of Site 7, within the bermed area (PAHs and pesticides)
  - At Site 5, PAHs, PCBs, and several metals were detected at concentrations above screening criteria.
- The fill material and subsurface soil contained VOCs, PAHs, PCBs, and metals that exceeded screening criteria. Maximum concentrations of most analytes in the subsurface soil were higher than in the surface soil. In general, the highest concentrations and most exceedances were detected in samples from depths greater than 2 to 3 feet bgs. No

[1] The access road between the landfills was referred to as the "VEPCO right of way" in the RI. Since that time, the Navy has acquired the property and has constructed a new access road on what was previously termed the right-of-way.

background data were collected for subsurface soil; concentrations of PAHs and several metals exceeded background results for surface soil. Exceedances of criteria were detected in many locations on the site, particularly in the western part of the Western Landfill (VOCs, PAHs, and PCBs), in and near Site 4 (VOCs, PAHs, phenols, PCBs, and metals), Site 7 (metals), the southeast corner of the Eastern Landfill (VOCs, PAHs, and metals) (removed in 2005-2006 NTCRA), and Site 6 (PAHs and metals). In Site 5 subsurface soil, total petroleum hydrocarbons (TPHs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected at elevated levels near the former location of UST 2 and in the vicinity of the OWS on the south side of the site. Several PAHs, PCBs, and several metals were also detected above screening levels in subsurface soil.

- The landfill gas studies completed in 1998 and 2003 at OU2 concluded that landfill gas is being generated from both the Eastern and Western Landfills and recommended that a passive venting system be installed within the cover and perimeter gas probes be installed for periodic monitoring at OU2 as part of a future system that may be constructed.

2.5.3 Contaminant Fate and Transport

The primary fate and contaminant migration pathways for COCs at OU2 that appear to be present at the site are listed below (CH2M HILL, 2002). The list also indicates whether the data show that migration is probable, possible, unlikely, or nonexistent for the major classifications of contaminants found in soil at OU2:

- Soil to Paradise Creek surface water:
  - VOCs—possible migration
  - Semivolatile organic compounds (SVOCs), pesticides, and PCBs—unlikely migration
  - Metals—possible migration
- Soil to Paradise Creek sediment:
  - VOCs—no migration
  - SVOCs, pesticides, and PCBs—possible migration
  - Metals (particularly copper, lead, and zinc)—possible migration
- Soil to groundwater:
  - VOCs—probable migration, particularly in the vicinity of Site 4
  - SVOCs (including phenols), pesticides, and PCBs—probable migration
  - Metals (particularly arsenic, barium, cadmium, nickel, vanadium, and zinc)—probable migration

Fate and transport pathways for groundwater are not addressed in this document; the medium is currently under investigation. Marsh sediment is being addressed with a removal action. Documentation of sediment removal and associated activities will also be provided separately.

2.6 Current and Potential Future Site and Resource Uses

Currently, access to OU2 is controlled with fencing. There is no current land use by the facility. The future land use will be limited to open space through the implementation of LUCs to prevent unacceptable exposure of contaminants in soil to receptors. Access to the site will be controlled by fencing and restricted except for inspection, monitoring, or maintenance activities. The adjacent and surrounding land use is primarily industrial for both Navy and non-Navy entities and is anticipated to remain so for the foreseeable future. Surface water features are not used for any use within the vicinity of OU2, nor is the future use of these features planned. Site groundwater is currently under investigation and will be addressed in a separate ROD.

2.7 Summary of Risks

Detailed results of the HHRA and ERA are presented in the OU2 RI/HHRA (CH2M HILL, 2002) and the Paradise Creek ERA (CH2M HILL, 2001), which are available in the Administrative Record file. Potential human health risks were associated with exposure to soil (combined surface and subsurface soil).

Based on the primary fate and migration pathways, the human health and ecological exposure pathway models were developed to evaluate site risks in the HHRA and ERA and are included in **Appendix A**. Additionally, a summary of human health and ecological risk assessment results based on exposure scenarios and pathways is provided in **Appendix A**.

Risks associated with groundwater will be addressed separately in a ROD for OU2 groundwater. Marsh sediment is being addressed by a removal action that is also separate from this ROD.

2.7.1 Human Health Risk Summary

An HHRA was conducted to evaluate potential human health risks associated with current receptors (industrial worker) and hypothetical future receptors (industrial worker, construction worker, adult or child residents, and adult and child recreational users) under different exposure scenarios (ingestion, dermal contact, and inhalation of soil if no RA were implemented for the soil (**Table 2-1**). The risk for Sites 3, 4, 6, and 7 was evaluated as a single site, referred to only as "Site 3." Site 5, which was used primarily for the handling and storage of petroleum, was addressed separately. Additionally, potential human health risks associated with current and hypothetical future receptors (adult and child recreational users and fishers) under various exposure scenarios (ingestion of biota and dermal contact with surface water) were evaluated for Paradise Creek. Health risks are based on a conservative estimate of the potential cancer risk or the potential to cause other health effects not related to cancer (non-cancer risk or hazard index [HI]). The NCP, at 40 Code of Federal Regulations (CFR) Section 300.430 (e)(2)(i)(A), defines an acceptable non-cancer hazard as an HI of less than 1 or a cancer risk range of 10^{-4} to 10^{-6}. **Table 2-2** provides a summary of the pathways and exposure scenarios for OU2.

The risk assessment incorporated the general methodology described in *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A* (USEPA, 1989) and

Part D (USEPA, 1998), and *USEPA Region III Technical Guidance Manuals for Risk Assessment* (USEPA, 1992; 1993; 1995). This risk assessment followed USEPA's procedure for interim deliverables (USEPA, 1998). Tables were submitted to the USEPA for review as interim deliverables, prior to completion of the risk assessment. The interim deliverable tables for each site were provided as an Appendix to the RI/HHRA.

Sites 3, 4, and 6

Based on the HHRA completed in the 2002 RI, there are no non-cancer hazards or cancer risks that exceed USEPA's acceptable levels for an industrial worker or future adult recreational user exposed to soil at Sites 3, 4, and 6 as evaluated as a combined data set in the 2002 RI.

Under a reasonable maximum exposure analysis, ingestion of and/or dermal contact with soil by a future adult or child resident, future construction worker, and future child recreational user would result in a non-cancer hazard and/or cancer risk above USEPA's acceptable levels. The unacceptable risks and hazards associated with exposure to soil (evaluated as a combined data set for Sites 3, 4, and 6) are summarized in **Table 2-3**.

Pre-NPL investigations at OU2 provided for separate risk evaluations for soil for Sites 3, 4, and 6. In the RI/Risk Assessment/FS Report (FWEI, 1995), the risks associated with soil were:

- Site 3: resident child HI = 12.2, incremental lifetime cancer risk (ICR) = 1.2E-4, adult resident HI=2.75, ICR =1.8E-4, lifetime resident ICR = 2.9E-4, worker adult ICR = 4.6E-5
- Site 4: resident child HI = 7.1
- Site 6: resident child HI = 5.6
- Site 6: resident adult ICR = 2.1E-6

The 1995 RI data were superseded by the 2002 RI/HHRA in which the risk evaluation assessed Sites 3, 4, and 6 as a single, combined data set. Review of these data support the determination to assess sample results from each as a single site due to the similarity in detected constituents, concentrations and hazards and risks associated with Sites 3, 4, and 6 during previous investigations. As shown in **Table 2-3** and the bullets above, the conclusions of the risk evaluations performed either as a single site, or separately, are similar.

Additionally, data from Sites 4 and 6 do not indicate that past liquid waste disposal activities have resulted in hazards or risks which are dissimilar to those posed by the former landfill activities in Site 3.

Site 5

Based on the HHRA, there are no non-cancer hazards or cancer risks that exceed USEPA's acceptable levels for an industrial worker, future construction worker, future resident, or future recreational user exposed to Site 5 soil. Although the reasonable maximum exposure cumulative non-cancer hazard for a future child resident (HI = 2.5) from exposure to soil exceeds USEPA's target threshold of 1, no individual compounds or target organs

contribute a risk greater than 1. Therefore, there are no unacceptable risks or hazards for the future child resident from exposure to soil at Site 5.

Site 7

As a result of the completion of the NTCRA which consisted of complete removal of contamination at Site 7 and creation of a tidal wetland, no unacceptable risks remain (FSSI, 2007).

Paradise Creek

Based on the HHRA, there are no non-cancer hazards or cancer risks that exceed USEPA's acceptable levels for a future adult or child recreational user exposed to surface water in Paradise Creek. Although ingestion of biota by current/future adult and child fishers would result in a non-cancer hazard and/or cancer risk above USEPA's acceptable levels, this risk is not believed to be site-related. A number of other potential sources along Paradise Creek, upstream, downstream, and between the NNSY sites, may affect the quality of Paradise Creek surface water and biota. Without a background comparison, the chemicals of potential concern (COPCs) were based on all constituents detected in Paradise Creek at concentrations that exceeded screening levels. This process may have resulted in additional constituents selected as COPCs that were quantitatively evaluated and an overestimation of true risks associated with activities at the NNSY sites, specifically overestimation of the site-related risks associated with biota. Similar concentrations of arsenic, the primary risk driver in biota, were found in biota samples collected throughout the stream, which makes it uncertain whether arsenic is a result of site-related sources or if it is naturally occurring. Other known uses of arsenic are in insecticides, wood preservatives, pigments and glazes, and leather tanning.

2.7.2 Ecological Risk Summary

A Baseline Ecological Risk Assessment (BERA) was completed to evaluate potential risks to ecological receptors in Paradise Creek and adjacent Navy landfills from chemicals originating from three landfills (Scott Center, Paradise Creek, and New Gosport) associated with NNSY. In addition to the evaluation of Paradise Creek, the ERA further evaluated ecological risks in adjacent upland areas (soil on the landfills) based on consideration of the presumptive remedies proposed for the Scott Center Landfill and Paradise Creek Landfill and removal actions completed during 2001 at the New Gosport Landfill. The ERA concluded that the proposed soil cover over the Paradise Creek landfill areas would eliminate the identified potential risk.

Results of the ERA related to sediment are being addressed separately from this ROD.

2.7.3 Basis for Action

Based on the results of the HHRA and ERA, metals, PAHs, and waste in place are present in soil at levels resulting in unacceptable human health risks. Therefore, a response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 Remedial Action Objectives

The Navy, USEPA, and VDEQ concluded that RA was necessary to protect human health, welfare, and the environment from landfill contents remaining in place and actual or threatened releases of hazardous substances in soil.

The OU2 site-specific RAO for soil is provided below.

Soil

Prevent direct contact with contaminated soil posing unacceptable risk and reduce the potential for further erosion while being compatible with future actions that may be taken for groundwater at the site.

2.9 Description of Alternatives

The FFS was streamlined by developing site-wide alternatives based on expectations inherent in the NCP for landfill sites and by focusing on alternatives successfully implemented at similar CERCLA sites. The presumptive remedy (containment via cover or cap) was developed in accordance with USEPA's guidance document for application of the presumptive remedy process to municipal landfills (*Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites* [USEPA, 1991]). The presumptive remedy approach eliminates the technology screening step from the feasibility study process (*Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* [USEPA, 1996]). Consistent with this guidance, containment alternatives were developed for soil and buried waste associated with OU2. Remedial alternatives developed and evaluated to meet the RAOs for soil at OU2 are detailed in the FFS and presented in **Table 2-4**.

The following alternatives for soil were retained for detailed evaluation and comparative analysis:

- **Alternative 1—**No Action
- **Alternative 2—**Soil Cover with Side Slope Stabilization
- **Alternative 3—**RCRA Subtitle D Landfill Cap with Side Slope Stabilization

Except for the No Action Alternative, each alternative is protective of human health and the environment and complies with ARARs. The No Action Alternative does not protect human health and the environment, but is presented as a baseline for comparison in accordance with the NCP at 40 CFR 300.430(e)(6).

During the initial closure of the landfill (Site 3 Eastern and Western Landfills) in the 1980s, cover soil (6 to 18 inches) was placed over the landfill. Likewise, the Site 4 pits were covered with soil (1 foot of clay and 6 inches of topsoil) in 1981, after remaining liquids had been pumped out and disposed of offsite (NNSY, 1981). An unspecified amount of fill was observed being placed on the northern portion of the Site 3 Western Landfill (Sites 4 and 6) in 1987 (A. T. Kearney, Inc., 1987), although the exact location and thickness of the fill is unknown. To reduce the total amount of cover material needed, this soil was counted towards minimum cover requirements.

For Alternative 2, a minimum of 12 additional inches of soil cover shall be placed over the existing landfill cover system, including 6 inches of topsoil. Anywhere the existing cover is disturbed by grading or excavation, the cover requires there always be a minimum of 24 inches of clean soil cover, including 6 inches of topsoil.

For Alternative 3, the minimum requirements are:

- Barrier Layer, 18 inches thick with a maximum hydraulic conductivity of 1×10^{-5} centimeters per second
- Drainage Layer, a geocomposite drainage net (GDN) that will serve to direct water away from the barrier layer to lessen the potential for the water to reach the waste.
- Vegetative Support Layer, an 18-inch thick layer of soil serving to store moisture and support overlying vegetation as well as a protective layer for the underlying drainage and barrier layers; and,
- Topsoil Layer, the upper 6 inches of the final cover system to consisting of topsoil or similar materials capable of sustaining the vegetative cover.

Because OU2 is a landfill, monitoring and assessment of landfill gas is necessary at least quarterly for a year after the landfill cover is completed, at which time the monitoring data will be assessed to determine if additional action is needed. If gas monitoring results indicate the presence of concentrations of methane in excess of the compliance levels (80 percent of the lower explosive limit for methane) at the facility boundary, a remediation plan for the methane gas releases will be developed and implemented. Details of the gas monitoring program will be provided in a post-closure care plan for the site that will outline operation, maintenance, and monitoring for the landfill cover. A passive gas-venting system is necessary to provide a means for any generated gas to be released to prevent building up within the subsurface, as well as probes to serve as monitoring points. Likewise, a groundwater monitoring program will be required. The response action for groundwater and the associated groundwater monitoring program will be developed separately from this ROD during the FS phase for groundwater at OU2. LUCs will be implemented to prevent exposure to soil and groundwater until site conditions allow for unlimited use and unrestricted exposure.

While no human health risk was identified for soil related to Site 5, inclusion of this area within the overall soil cover is necessary to provide for stormwater management features promoting runoff from the surface of the cover.

The distinguishing features of the alternatives are cost and implementation requirements. In addition to capital, O&M, and present-worth costs, an inflation rate of 7 percent was used to account for future costs associated with long-term O&M (assumed for 30 years). An order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost for each remedial alternative is presented in **Table 2-4**.

2.10 Summary of Comparative Analysis of Alternatives

Each remedial alternative for OU2 was evaluated against the nine criteria listed below, as required by the NCP at 40 CFR 300.430 (e)(9)(iii). The OU2 FFS provides a more detailed comparative analysis of alternatives than is presented in this ROD. Soil Alternative 1 (No Action) does not achieve the threshold criteria of overall protection of human health and the environment and compliance with ARARs or meet the RAOs and was not evaluated further. A comparison of soil alternatives 2 and 3 is presented in **Table 2-4** and described in Section 2.10.1**.**

- **Overall Protection of Human Health and the Environment**—addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.
- **Compliance with ARARs**—Section 121(d) of CERCLA and the NCP at 40 CFR Section 300.430(f)(1)(ii)(B) require that RAs at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4).
- **Long-term Effectiveness and Permanence**—refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment**—refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.
- **Short-term Effectiveness**—addresses the period of time needed to implement the remedy and reduce any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.
- **Implementability**—addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.
- **Cost**—refers to the estimated capital and annual O&M costs, as well as present-worth cost. Present-worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
- **State Acceptance**—considers whether the state agrees with the analyses and recommendations.

- **Community Acceptance**—considers whether the local community agrees with the analyses and selected remedy.

2.10.1 Threshold Criteria

Overall Protection of Human Health and the Environment

Alternatives 2 and 3 are protective of human health and the environment because each provides for a clean soil cover over the existing landfill to prevent exposure to waste and waste-contaminated soil as well as stabilization measures to prevent future side slope failures that could expose buried waste. Potentially unacceptable risk exposures will be managed through the implementation and enforcement of LUCs.

Compliance with ARARs

The ARARs include any federal or state environmental or facility-siting standards, requirements, criteria, or limitations that are legally applicable or relevant and appropriate to a CERCLA site or action. Both Alternatives 2 and 3 will comply with ARARs (**Appendix B**).

2.10.2 Primary Balancing Criteria

Long-term Effectiveness and Permanence

Alternatives 2 and 3 are equally effective and permanent in the long term. Implementation of the engineering design features during construction for either a soil cover or an engineering cap provides long-term protectiveness. The implementation and enforcement of LUCs protect against unacceptable exposures. Periodic inspection and maintenance (as necessary) ensures effectiveness, and, if conducted regularly provides for similar (indefinite) life expectancies for either alternative.

Reduction in Toxicity, Mobility, or Volume through Treatment

Neither Alternative 2 nor 3 reduce the toxicity or volume of waste or waste-contaminated soil because construction of a cover or cap is a containment technology. Furthermore, alternatives including treatment of landfill contents would be impracticable because landfills cover many acres of land and include hazardous substances co-mingled homogeneously with other materials. The mobility of contaminants in soil and buried waste is reduced with the placement of clean soil fill or an engineered cap but not through treatment or recycling. While groundwater will be addressed separately, placement of a soil cover or an engineered cap with stormwater management features will help to reduce future constituent migration to groundwater.

Short-term Effectiveness

The short-term effectiveness for both Alternatives 2 and 3 involves the introduction of increased truck traffic in the surrounding community to import clean fill for the engineered cap to the site. Due to the increased cap thickness for Alternative 3, more fill material must be imported to the site, which will increase traffic in the surrounding community, and takes longer to construct than Alternative 2. Because the duration of Alternative 2 is shorter than the duration of Alternative 3, it poses less risk to workers (risk associated with both soil

exposure as well as risks associated with construction activities). Construction practices will be implemented for erosion control as well as prevent the migration of dust.

Implementability

Both Alternatives 2 and 3 for soil are relatively straightforward to implement using standard construction methods and equipment, although Alternative 2 does not have a hydraulic conductivity requirement that calls for engineering testing and measurements during construction to ensure that specified requirements are met and would therefore be easier to implement. Alternative 2 requires importing less fill to the site than Alternative 3 and could therefore be constructed in a shorter timeframe. The LUCs are readily implementable and enforceable for each alternative.

Cost

Alternative 2 is projected to cost approximately $10 million, versus approximately $17 million to implement Alternative 3. Alternative 2 is less costly because less material must be imported to the site and less testing would be necessary during construction. O&M costs for both alternatives are estimated to be the same over time because the same requirements would be necessary for each.

2.10.3 Modifying Criteria

State Acceptance

The Commonwealth of Virginia was involved throughout the CERCLA process and in the selection of the remedy for OU2. VDEQ, as the designated state support agency in Virginia, has reviewed this ROD and has given concurrence on the selected remedy.

Community Acceptance

No written comments, concerns, or questions were received by the Navy, USEPA, or VDEQ during the public comment period from March 16, 2009 through May 1, 2009. A public meeting was held on March 31, 2009, to present the Proposed Plan for OU2 and answer questions on the Proposed Plan. There was no public attendance at the public meeting.

2.11 Principal Threat Wastes

The NCP establishes an expectation that USEPA will use treatment to minimize the unacceptable risk posed by a site whenever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment if exposure to them should occur. There are no known principal threat wastes present at OU2 associated with soil; however, the potential for principal threat wastes exists within the buried landfill materials. Groundwater is currently under investigation and will be addressed in a separate ROD.

2.12 Selected Remedy

The selected remedy for contaminated soil at OU2 is soil cover with side slope stabilization with LUCs.

2.12.1 Summary of the Rationale for the Selected Remedy

The Navy and USEPA, in partnership with the VDEQ, selected Alternative 2, soil cover with side slope stabilization with LUCs as the remedial alternative. Constructing a soil cover across the site, combined with side slope stabilization, is the most cost-effective alternative. Aside from additional quantity of construction materials and cost, Alternative 3 presents few differences from Alternative 2. The infiltration modeling performed within the FFS indicated that Alternative 2 had a cap efficiency of 74 percent versus an efficiency of 81 percent for Alternative 3, which were deemed to be comparable values when the alternatives were evaluated against all other criteria. The Navy is responsible for implementing, maintaining, reporting on, and enforcing LUCs to ensure that future site activities provide for acceptable use and associated exposure. A conceptual understanding of the selected remedy is provided as **Figure 2-5**.

Based on information currently available, the Navy believes that the selected remedy meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The Navy expects the selected remedy to satisfy the statutory requirements of CERCLA Section 121 (b):

- Protection of human health and the environment
- Compliance with ARARs
- Cost-effectiveness
- Utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable

The selected remedy does not satisfy the statutory preference for treatment as a principal element of the remedy because of the uncertainty in the location and presence of hazardous substances in the landfill that could potentially be treated.

2.12.2 Description of the Selected Remedy

Alternative 2 consists of installing a soil cover over the landfill contents, side slope stabilization, and implementation of LUCs. Alternative 2 for soil is considered a presumptive remedy as a containment alternative and is detailed in the FFS (CH2M HILL, 2009b). The major components consist of the following:

- Passive gas venting and monitoring system installation
- Side slope stabilization
- Soil cover installation
- Drainage controls installation
- Vegetation establishment and restoration
- LUCs implementation

- Long-term site maintenance and monitoring (as appropriate)

In addition to the ARARs identified in Appendix B, the Navy will comply with the following executive orders:

- **Executive Order 11988, Floodplain Management,** which requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists.
- **Executive Order 11990, Protection of Wetlands,** which requires federal agencies conducting certain activities to avoid or minimize, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands if a practicable alternative exists.

Requirements for the landfill areas will include the implementation of a LUC remedial design, restricted site access, as well as periodic site inspections. Restrictions will be written to restrict future use of the site in a remedial design that defines the LUCs. Restrictions will notify the Navy, its contractors, and any future potential purchaser that the land was used for waste disposal and that land use must be restricted to prevent exposure to contamination beneath the cover and to ensure the integrity of the waste containment system.

Access to the site will be controlled. The existing chain link security fence will be extended to encompass the site perimeter. Fence gates will be locked and access to keys will be restricted. Signs will be posted along the site perimeter to deter unauthorized entry.

The Navy shall prepare and submit to EPA for review and approval the LUC remedial design which shall include the comprehensive list of LUCs to be implemented at the site, as well as implementation and maintenance actions, including periodic inspections. The following components will be included:

- The Navy will notify USEPA and VDEQ 6 months in advance of any anticipated transfer, out of Navy custody and control, of real property subject to LUCs. If 6 months advance notice is not reasonably possible, as much advance notice will be given as is reasonably possible, but in any event not less than 60 days.
- The Navy will notify USEPA and VDEQ as soon as practicable, presumptively within 10 days, of the discovery of activity at OU2 inconsistent with the LUC objectives stated above, and then promptly investigate and take appropriate corrective action. Such notice will also outline the steps to be taken to complete the following:
  - Evaluate the effectiveness of LUCs
  - Develop appropriate corrective action
  - Assess lessons learned and prevent recurrence
- The Navy will maintain a comprehensive list of LUCs with associated boundaries and expected durations.

The soil cover is not intended to be a remedy for OU2 groundwater, and, if necessary, may be disturbed in the future as part of Remedial Action (RA) for groundwater. Although not

discussed in this ROD, a groundwater monitoring program will be required. Five-year site reviews will be required by the NCP because contamination would remain onsite. Details for future groundwater response actions, use restrictions, and long-term monitoring programs will be addressed separately from this ROD.

Following implementation of the selected remedy, the Navy will prepare a maintenance program and any other monitoring plans and procedure appropriate for the site.

2.12.3 Expected Outcome of the Selected Remedy

Current land use, which is restricted except to conduct site inspection, monitoring, or maintenance, is expected to continue at OU2, with no other use planned for the foreseeable future. Site access is restricted and physical controls (soil cover) prevent exposure to site contaminants. Once LUCs are implemented, exposure will be controlled until such time that additional actions are completed that allow for unlimited use and unrestricted exposure. The maintenance action plan for OU2 will be implemented to ensure the long-term effectiveness of the soil cover remedy.

Site 7 does not require further action; the removal action completed in 2006 eliminated potential risk in all media.

2.13 Statutory Determinations

The selected remedy must satisfy the statutory requirements of CERCLA Section 121; the evaluation of how the selected remedy for OU2 satisfies these requirements is presented below.

2.13.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment through the installation of physical barriers (soil cover) to prevent unacceptable exposure to contaminated soil at OU2. The LUCs will prevent exposure in both the short and long terms and will afford an effective level of protection.

2.13.2 Compliance with ARARs

The selected remedy will meet all identified ARARs, as described in **Appendix B**.

2.13.3 Cost-Effectiveness

The selected remedy is cost-effective and represents a reasonable value for the size of the site. The cost is proportional to its overall effectiveness. The overall effectiveness was evaluated by assessing the threshold, primary balancing, and modifying criteria. The total present-worth cost of the selected remedy in this ROD is estimated to be $10,200,000.

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

The Navy, in partnership with USEPA and VDEQ, concluded that the selected remedy represents the maximum extent to which permanent solutions can be implemented in a practicable manner for OU2 soil and sediment. The treatment of landfill contents would be impracticable because the landfill covers many acres of land and may include hazardous substances co-mingled homogeneously with other materials. Removal of marsh sediment with site restoration is a permanent solution.

2.13.5 Preference for Treatment as a Principal Element

The use of a treatment or disposal alternative for soil is not cost-effective or practicable for this site.

2.13.6 Five-Year Review Requirement

The Navy will maintain the soil cover and implement LUCs, as well as conduct a statutory remedy review within 5 years after initiating RA, and every 5 years thereafter, to ensure the soil cover continues to provide adequate protection of human health and the environment.

2.14 Documentation of Significant Changes

No significant changes to the remedy have been made since the time it was presented as the selected remedy in the Proposed Plan. No comments were received during the public comment period or during the public meeting. Therefore, no significant changes were made to the preferred RAA identified in the Proposed Plan.

TABLE 2-1
Exposure Pathways for OU2[1]

Media	Exposure Route	Future						Current		
		Resident		Recreation		Industrial	Construction	Industrial	Recreation	
		Adult	Child	Adult	Child	Worker	Worker	Worker	Adult	Child
Surface Soil	Ingestion							X[2]		
	Dermal							X[2]		
	Inhalation									
Surface and Subsurface Soil	Ingestion	X	X	X	X	X	X			
	Dermal	X	X	X	X	X	X			
	Inhalation	X	X			X	X			

X Quantitative evaluation.

[1] The human health risk assessment evaluated OU2 as Sites 3, 4, 6, and 7 as a single site, referred to only as "Site 3." Site 7 has been removed and restored as tidal wetlands since the HHRA was conducted.

[2] Current and future scenario are the same.

TABLE 2-2
Summary Table for All Pathways and Exposure Scenarios for OU2[1]

	Exposure Pathways						Total Risk for Pathways	Total HI for Pathways	Percent Contribution by Pathway					
	Inhalation		Ingestion		Dermal				Inhalation		Ingestion		Dermal	
	Risk	HI	Risk	HI	Risk	HI			% Risk	% HI	% Risk	% HI	% Risk	% HI
Surface Soil														
Current Industrial Worker	--	--	1.9E-06	1.7E-01	2.1E-06	5.3E-01	4.1E-06	7.1E-01	--	--	47.9%	24.6%	52.1%	75.4%
Surface and Subsurface Soil														
Future Industrial Worker	2.4E-08	5.4E-05	2.1E-05	1.2E-01	1.8E-06	3.9E-01	2.3E-05	5.2E-01	--	--	91.9%	23.9%	8.0%	76.1%
Future Residential Child	--	3.1E-03	--	1.6E+01	--	3.7E+00	--	1.9E+01	--	--	--	80.8%	--	19.2%
Future Residential Adult	--	1.1E-03	--	1.7E+00	--	1.7E+00	--	3.3E+00	--	--	--	50.1%	--	49.8%
Future Residential Age-Adjusted	7.8E-07	--	9.0E-04	--	1.5E-05	--	9.2E-04	--	--	--	98.3%	--	1.6%	--
Future Construction Worker	9.3E-09	5.3E-05	3.9E-05	5.5E+00	2.6E-07	8.9E-01	3.9E-05	6.3E+00			99.3%	86.0%	0.7%	14.0%
Future Recreational Child	--	--	9.4E-05	2.3E+00	6.0E-07	5.5E-01	9.5E-05	2.9E+00	--	--	99.4%	80.7%	0.6%	19.3%
Future Recreational Adult	--	--	4.0E-05	2.5E-01	1.1E-06	2.5E-01	4.1E-05	5.0E-01	--	--	97.4%	49.6%	2.6%	50.4%

Risk = carcinogenic risk as determined by the risk calculations in Appendix N the Phase II Remedial Investigation Report (CH2M HILL, 2002). Cells highlighted in yellow indicate unacceptable risk for the exposure pathway.

HI = Hazard index as determined by the risk calculation in Appendix N of the Phase II Remedial Investigation Report (CH2M HILL, 2002).

[1] The human health risk assessment evaluated OU2 as Sites 3, 4, 6, and 7 as a single site, referred to only as "Site 3." Site 7 has been clean up and restored as tidal wetlands pursuant to an NTCRA.

[2] Risks associated with groundwater will be addressed separately from this ROD.

TABLE 2-3
Summary of Unacceptable RME Cancer Risks and Non-cancer Hazards Associated with Contact with Soils

Receptor	Cancer Risks			Non-Cancer Risks		
	Exposure Route	Cancer Risk	COCs with Cancer Risks $>10^{-4}$	Exposure Route	Hazard Index	COCs with HI > 1
OU2						
Future Resident Adult	N/A	N/A	N/A	Ingestion/ Dermal	3.3E+00	None[2]
Future Resident Child	N/A	N/A	N/A	Ingestion/ Dermal	1.9E+01	Antimony, Copper, Chromium, Iron, Zinc
Future Resident Child/Adult	Ingestion/ Dermal	9.2E-04	Benzo(a)anthracene	N/A	N/A	N/A
Future Construction Worker	N/A	N/A	N/A	Ingestion/ Dermal	6.3E+00	Copper
Future Recreational Child	N/A	N/A	N/A	Ingestion/ Dermal	2.9E+00	Copper

(1) No unacceptable RME risks or hazards were identified at Site 5. The human health risk assessment evaluated Sites 3, 4, 6, and 7 as a single site, referred to only as “Site 3”. Site 7 has been cleaned up and restored as tidal wetlands as part of a NTCRA.

(2) There are no constituents that contribute a HI above 1; however, the HI for gastrointestinal effects is greater than 1 based primarily on ingestion/dermal contact of copper and iron.

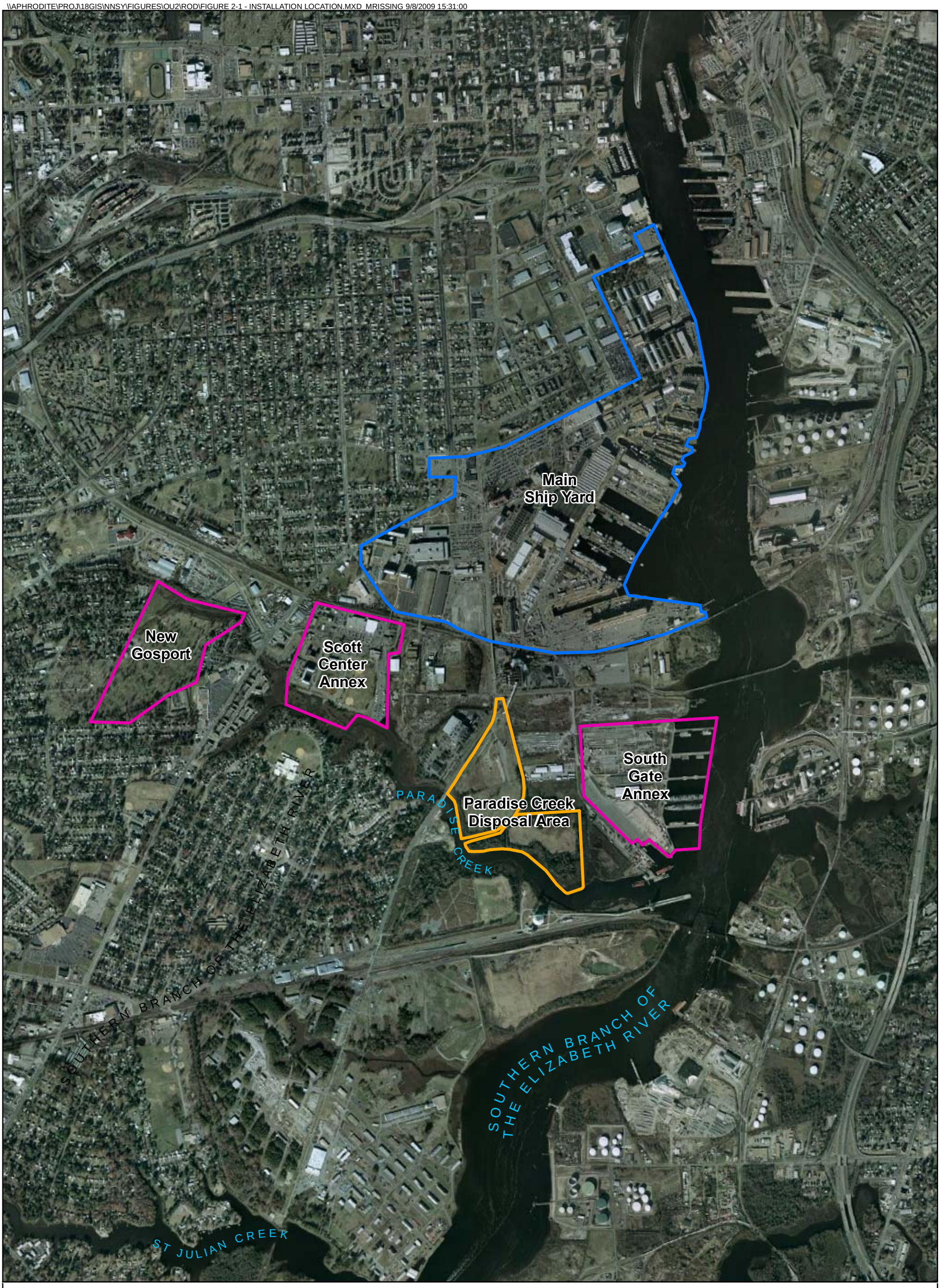
The RME exposure point concentrations (EPCs) were calculated as the 95 percent upper confidence limit (95% UCL) of the arithmetic mean concentration: antimony (54.1 mg/kg), chromium (158 mg/kg), copper (22,700 mg/kg), iron (46,600 mg/kg), zinc (23,700 mg/kg), benzo(a)anthracene (721 mg/kg).

TABLE 2-4
Descriptions of Alternatives for OU2 Soil

Alternative	Components	Details	Cost
1—No Action	Existing Soil Contamination	Not Applicable	Capital Cost $0 Annual O&M $0 Present Value $0 --- Timeframe > 70 years Present Value $0
2 – Soil Cover with Side Slope Stabilization and Sediment Excavation	• Soil Cover Installation • Side Slope Stabilization • Passive gas venting and monitoring • Drainage control • LUCs • Sediment excavation	• Install Soil Cover • Topsoil Layer • Vegetative Support Layer • Side slope stabilization to provide a slope of 3H:1V • Gas monitoring will occur before, during, and for 1 year after construction	Capital Cost $9,200,000 Annual O&M (Years 1-30)1 50,000 Total Cost $10,700,000 --- Timeframe 30 years Present Value $10,180,022
3 – Landfill Cap with Side Slope Stabilization and Sediment Excavation	• RCRA Subtitle D Soil Cap Installation • Side Slope Stabilization • Passive gas venting and monitoring • Drainage control • LUCs • Sediment Removal	• Install RCRA Subtitle D cap consisting of – Barrier Layer – Drainage layer – Topsoil Layer – Vegetative Support Layer • Side slope stabilization to provide a slope of 3H:1V • Gas monitoring will occur before, during, and for 1 year after construction.	Capital Cost $16,400,000 Annual O&M (Years 1-30)[1] $50,000 Total Cost $17,900,000 --- Timeframe 30 Years Present Value $17,380,022 Sediment removal 106,000 Revised Present Value $17,486,022 Timeframe > 70 years

Notes:
(1) Assumptions regarding the long-term monitoring and maintenance requirements are only estimates. Actual requirements for groundwater long-term monitoring are yet to be defined and will be documented in the groundwater FS. Maintenance activities will vary from year to year.

\\APHRODITE\PROJ\18GIS\NNSY\FIGURES\OU2\ROD\FIGURE 2-1 - INSTALLATION LOCATION.MXD MRISSING 9/8/2009 15:31:00



Legend
- Norfolk Naval Shipyard
- Navy Annexes
- OU2 Boundary

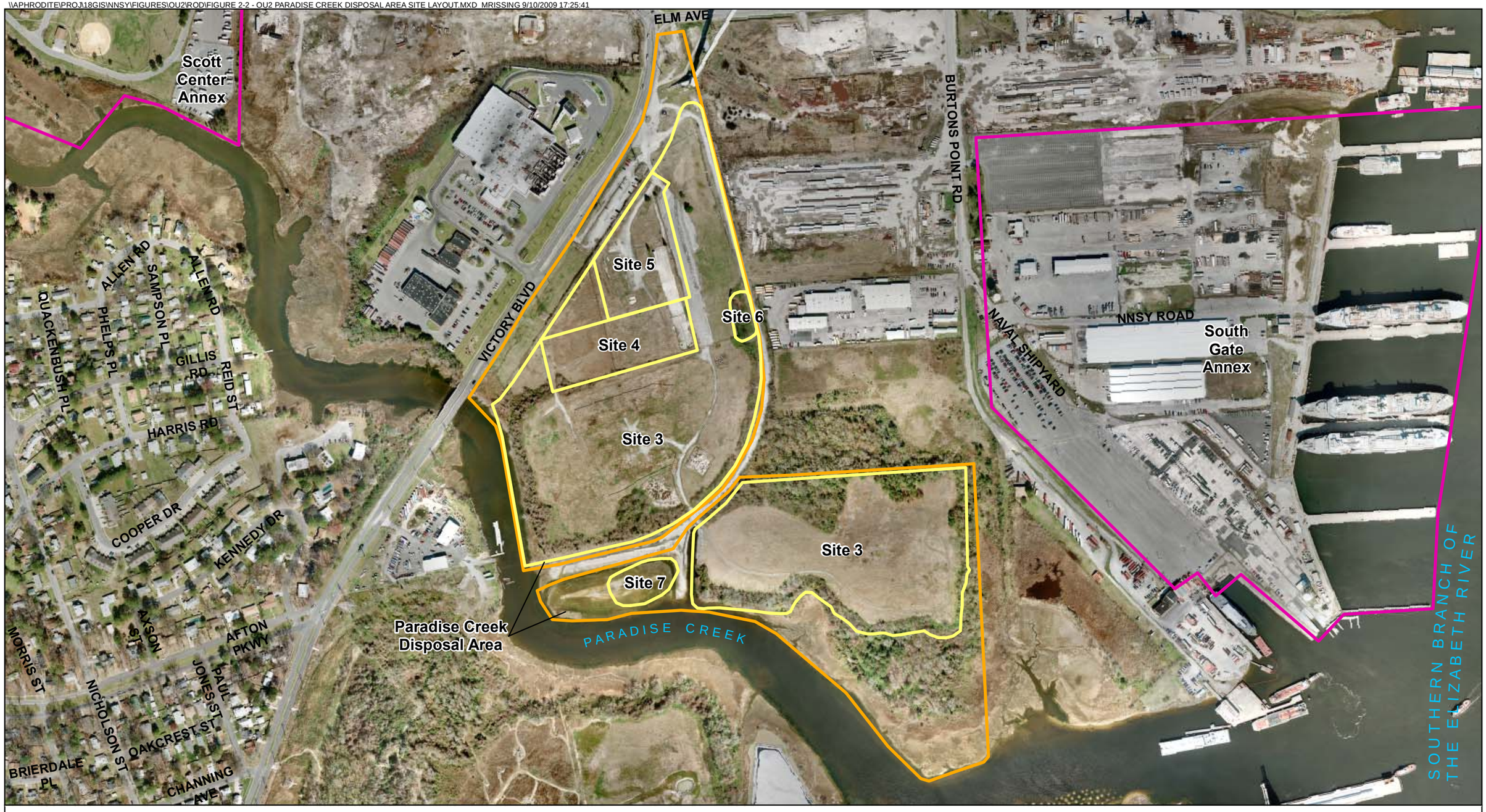
N

0 750 1,500 3,000
Feet

Figure 2-1
Installation Location
OU2 Record of Decision
Norfolk Naval Shipyard
Portsmouth, Virginia

CH2MHILL

\\APHRODITE\PROJ\18GIS\NNSY\FIGURES\OU2\ROD\FIGURE 2-2 - OU2 PARADISE CREEK DISPOSAL AREA SITE LAYOUT.MXD MRISSING 9/10/2009 17:25:41



Legend
- Site Boundary
- Navy Annexes
- OU2 Boundary

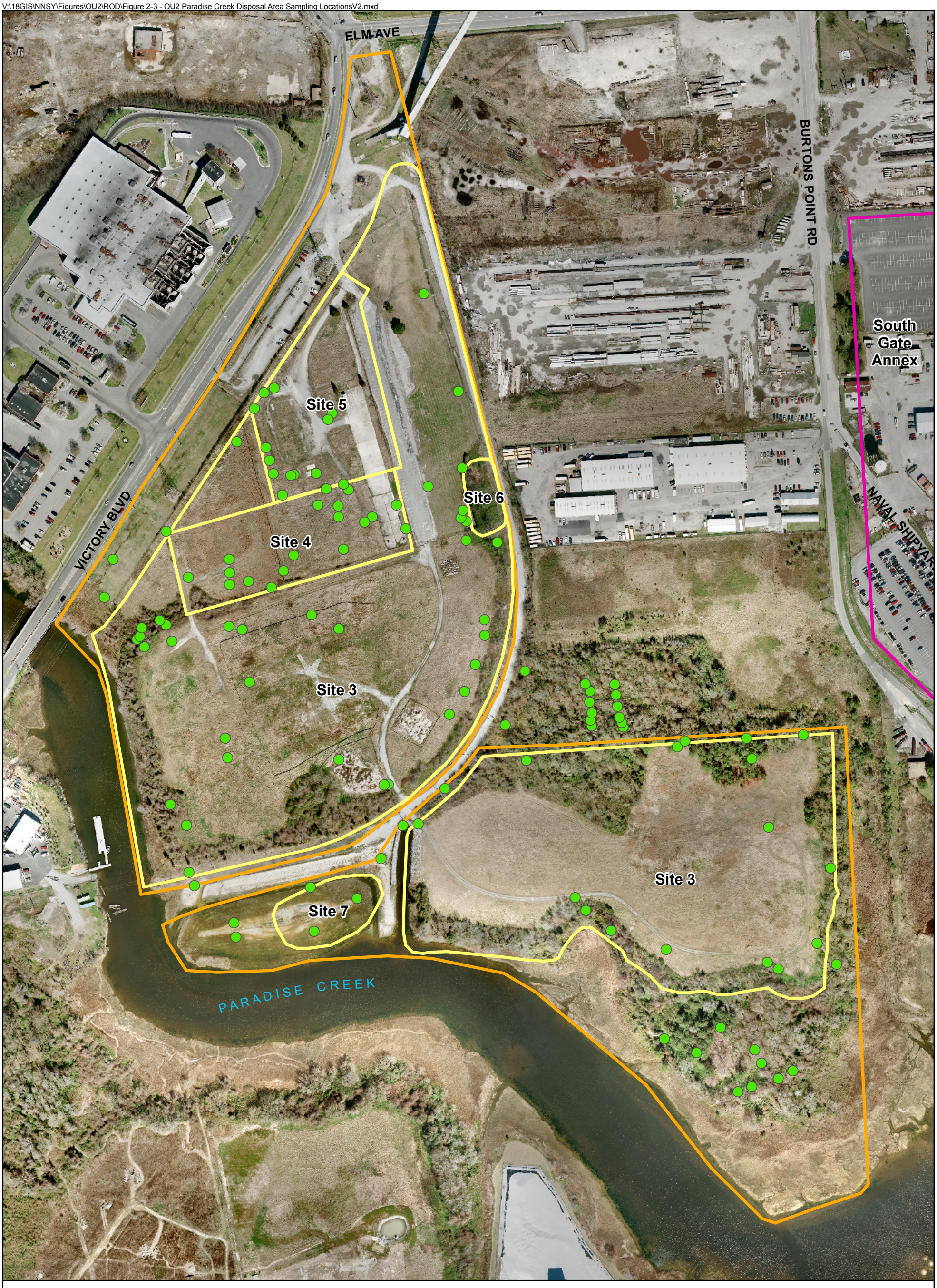
N

0 200 400 800 Feet

Figure 2-2
OU2 Paradise Creek Disposal Area Site Layout
OU2 Record of Decision
Norfolk Naval Shipyard
Portsmouth, Virginia

CH2MHILL

V:\18GIS\NNSY\Figures\OU2\ROD\Figure 2-3 - OU2 Paradise Creek Disposal Area Sampling LocationsV2.mxd



Legend
- Soil Sample Locations
- Site Boundary
- Navy Annexes
- OU2 Boundary

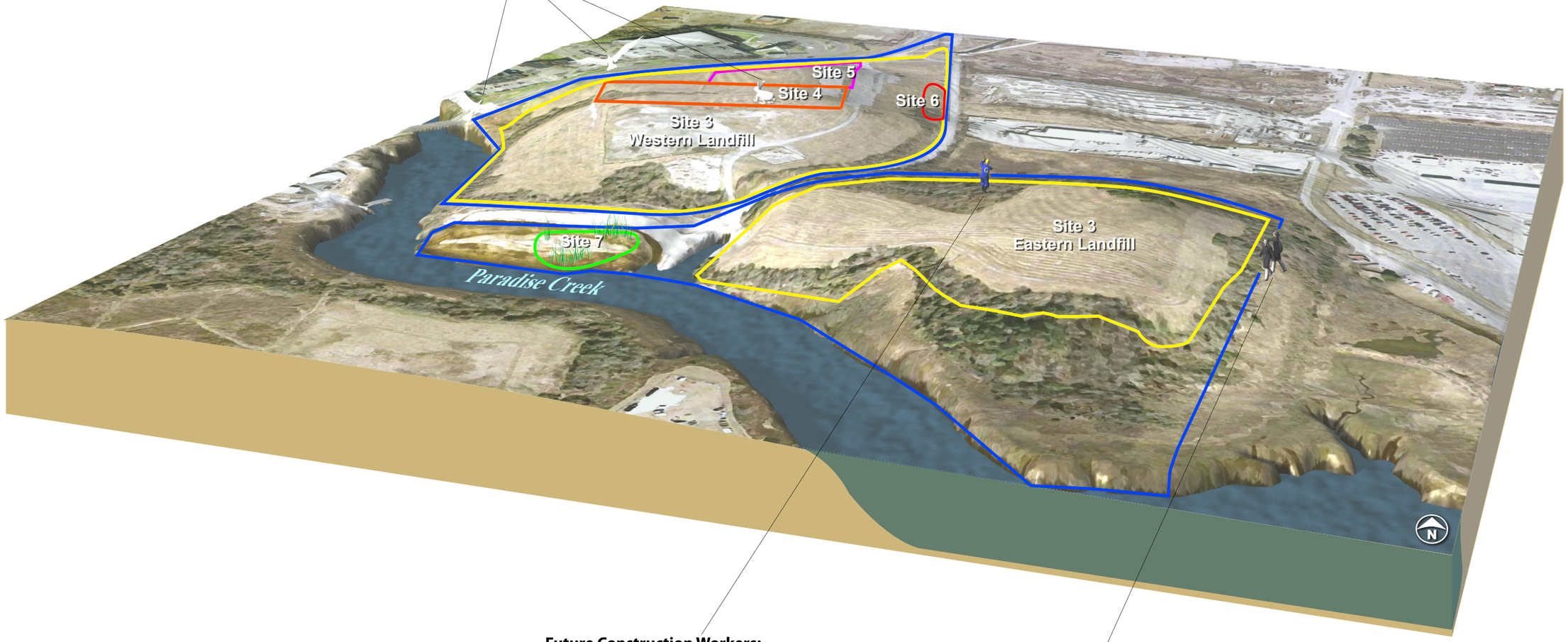
N

0 125 250 500 Feet

Figure 2-3
OU2 Paradise Creek Disposal Area Sampling Locations
OU2 Record of Decision
Norfolk Naval Shipyard
Portsmouth, Virginia

CH2MHILL

Eco-receptors:
Incidental ingestion would be from excavating through cover and ingesting soil at depth



Future Construction Workers:
Ingestion of and/or dermal contact with soil

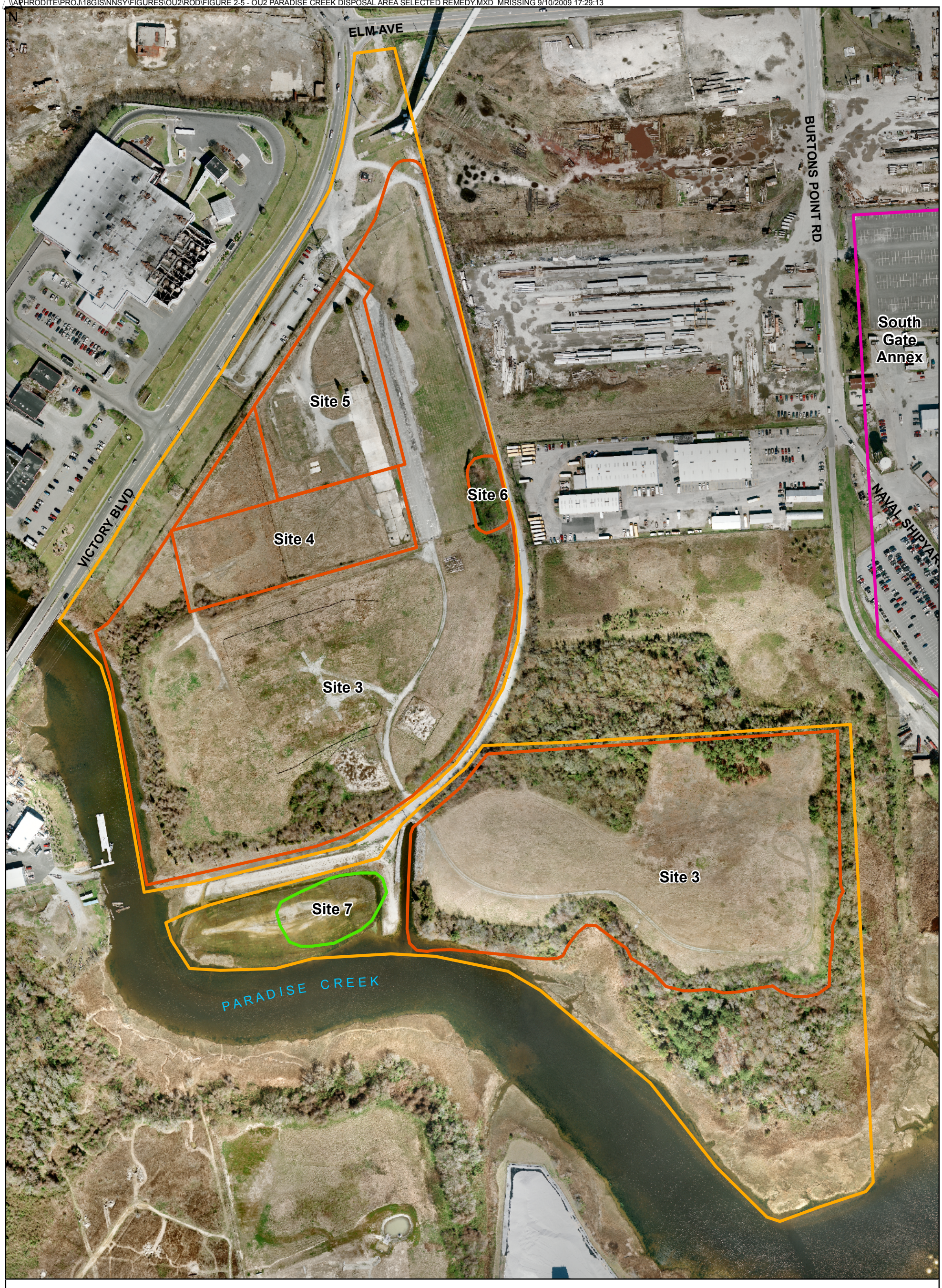
Future Adult/Child Resident and Future Child Recreation:
Ingestion of and/or dermal contact with soil

LEGEND

- Site 3 - Landfill
- Site 4 - Liquid Waste Holding Ponds
- Site 5 - Oil Reclamation Area
- Site 6 - Liquid Waste Disposal Area
- Site 7 - Liquid Waste Holding Area
- OU2 Site Boundary

FIGURE 4
OU2 Paradise Creek Disposal Area
Norfolk Naval Shipyard, Portsmouth, Virginia

\\APHRODITE\PROJ\18GIS\NNSY\FIGURES\OU2\ROD\FIGURE 2-5 - OU2 PARADISE CREEK DISPOSAL AREA SELECTED REMEDY.MXD MRISSING 9/10/2009 17:29:13



Legend
- Land Use Control Boundary
- No Further Action
- Navy Annexes
- OU2 Boundary

0 125 250 500 Feet

Figure 2-5
OU2 Paradise Creek Disposal Area Selected Remedy
OU2 Record of Decision
Norfolk Naval Shipyard
Portsmouth, Virginia

CH2MHILL

SECTION 3

Responsiveness Summary

No written comments, concerns, or questions were received by the Navy, USEPA, or VDEQ during the public comment period. No one from the public attended the public meeting held March 31, 2009. Navy, USEPA, and VDEQ representation were available to present the Proposed Plan for OU2 and answer questions regarding the Proposed Plan as well as any other documents in the information repository.

SECTION 4

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Appendix A
Exposure Pathway Models for Human Health and Ecological Risk Assessments

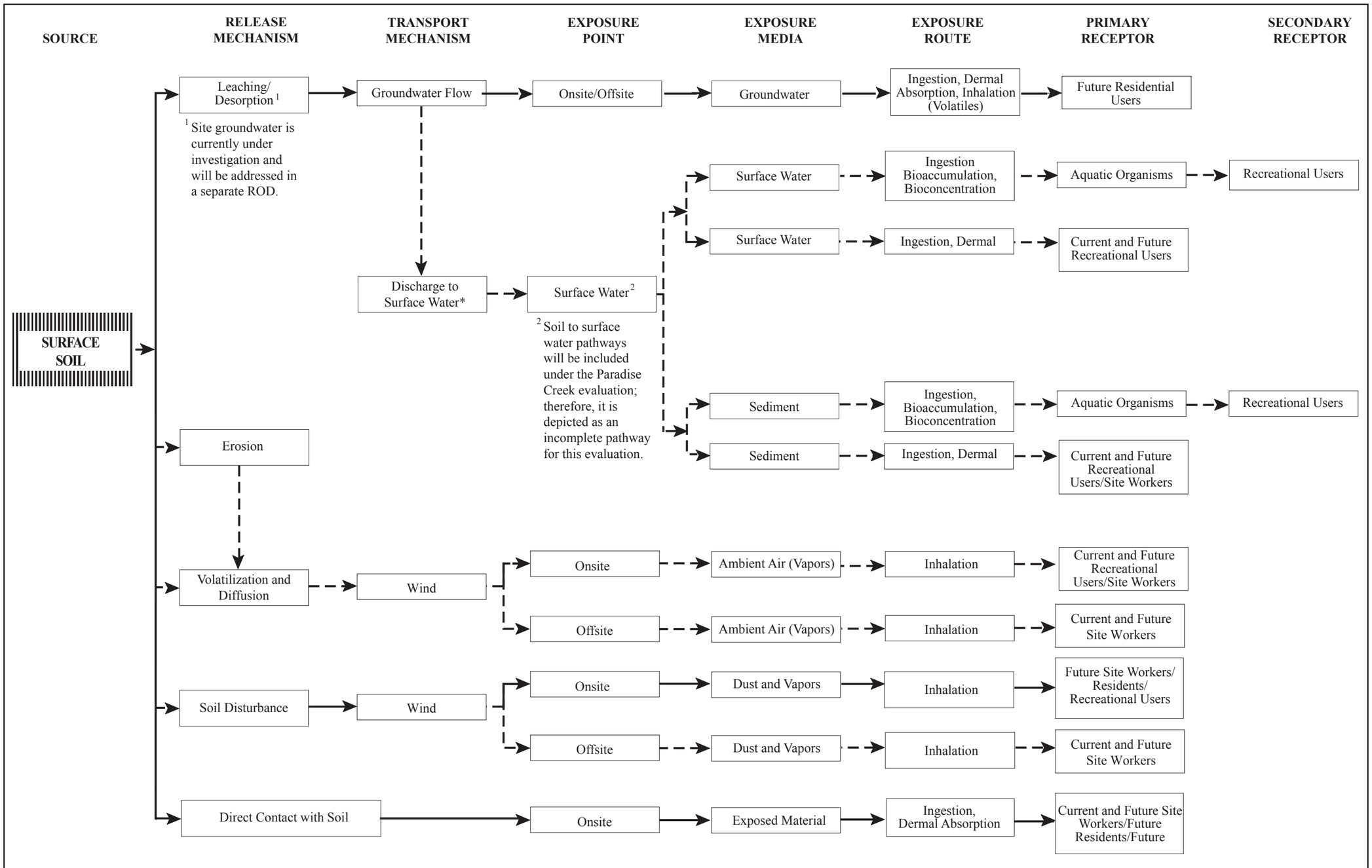
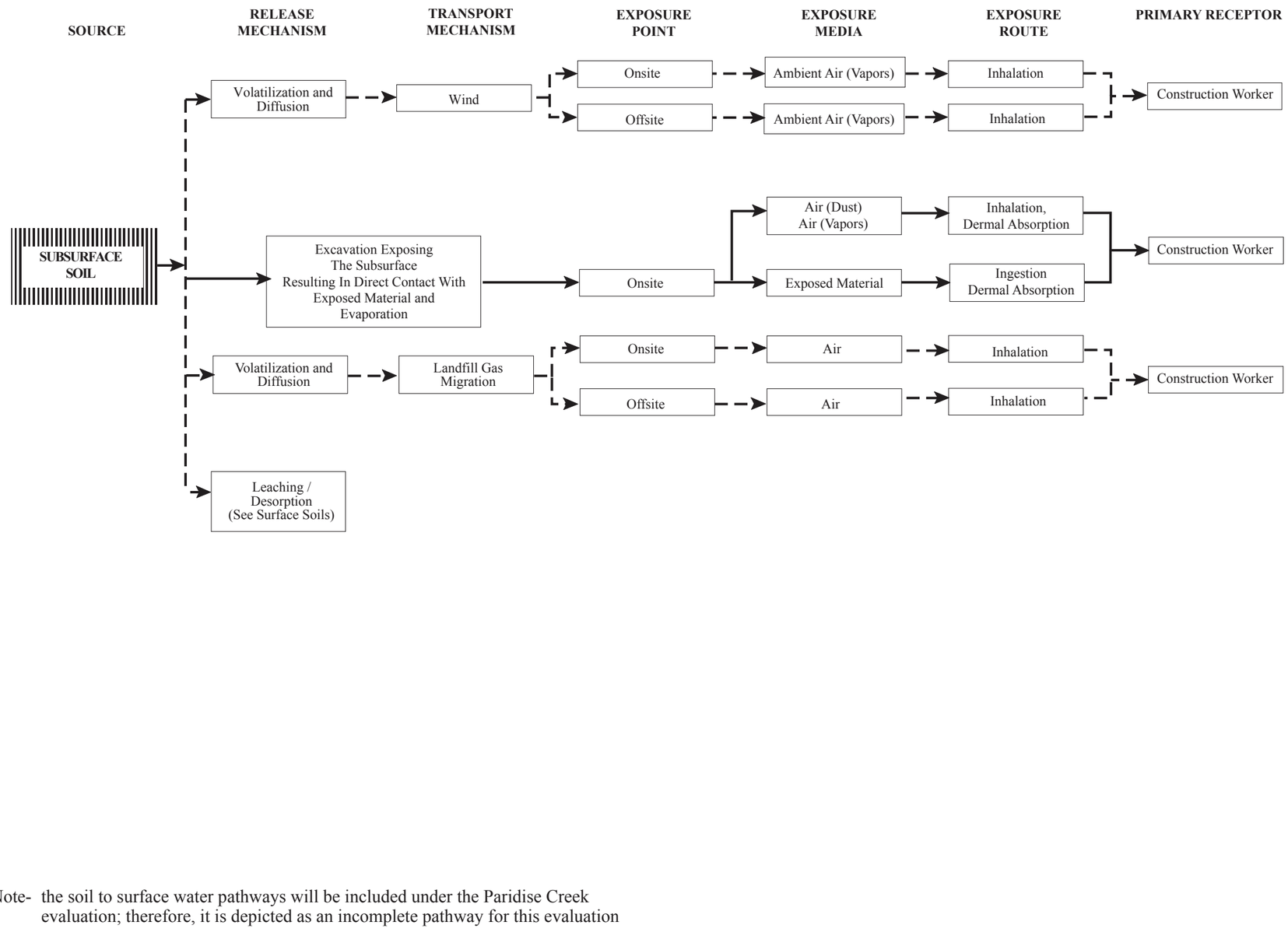


Figure A-1 (Sheet 1 of 2)
Potential Human Health Exposure Pathways
Site 3
Norfolk Naval Shipyard
Portsmouth, Virginia



*Note- the soil to surface water pathways will be included under the Paridise Creek evaluation; therefore, it is depicted as an incomplete pathway for this evaluation

Legend
——— Complete Pathway
– – – Incomplete Pathway

Figure A-1 (Sheet 2 of 2)
Potential Human Health Exposure Pathways
Site 3
Norfolk Naval Shipyard
Portsmouth, Virginia

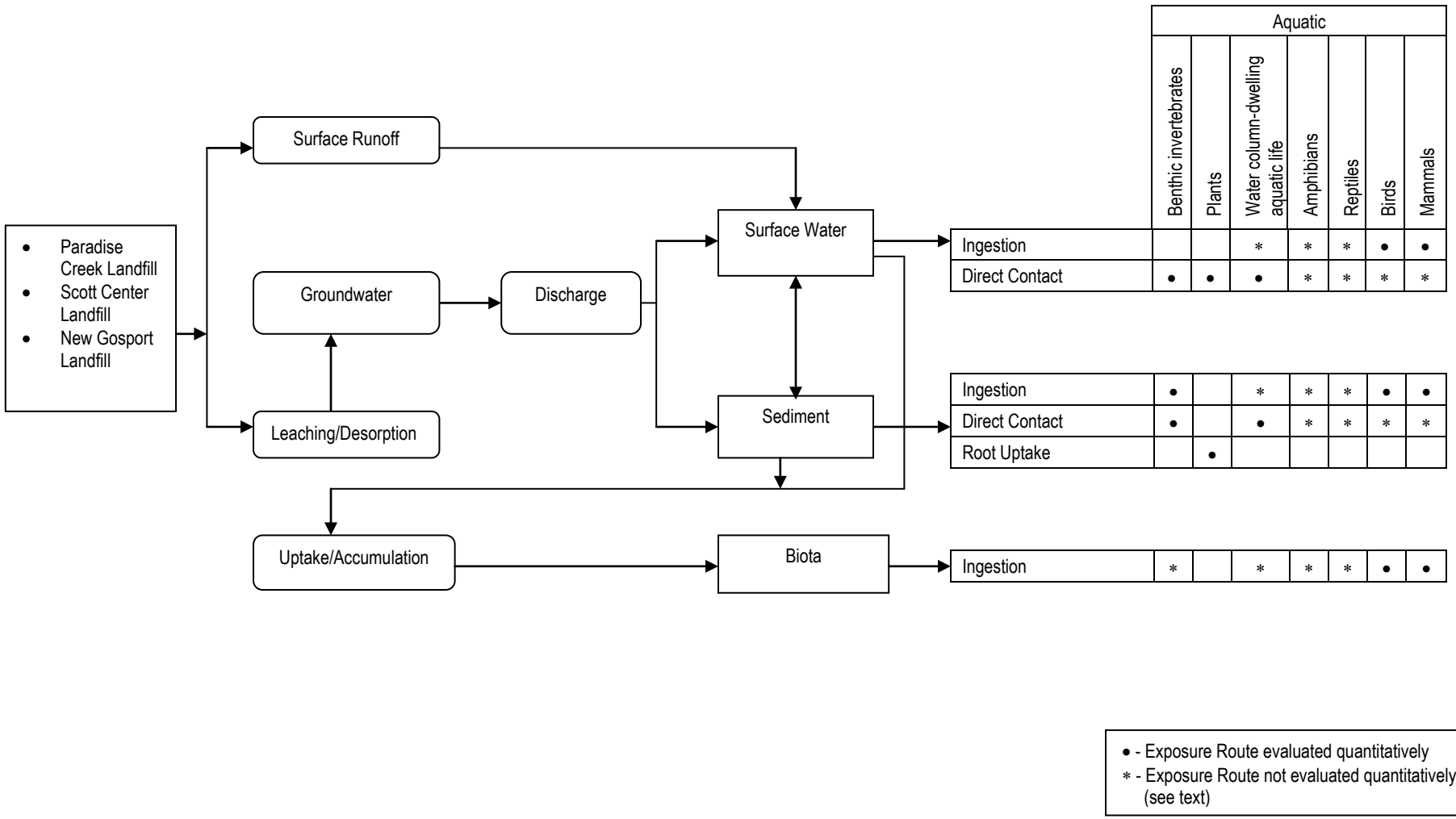


FIGURE A-2
Potential Ecological Exposure Pathways
Paradise Creek
Norfolk Naval Shipyard, Portsmouth, Virginia

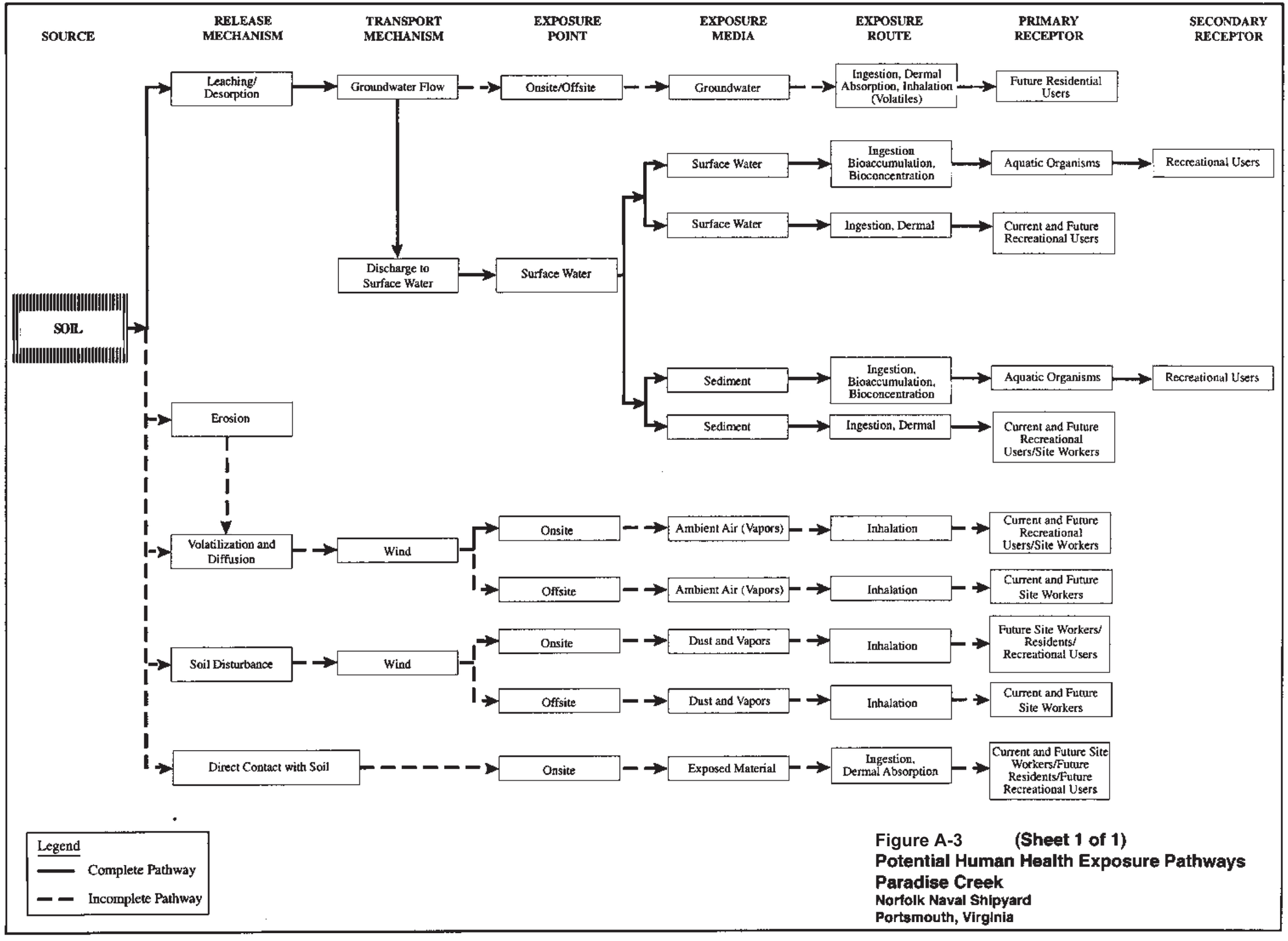


Figure A-3 (Sheet 1 of 1)
Potential Human Health Exposure Pathways
Paradise Creek
Norfolk Naval Shipyard
Portsmouth, Virginia

Appendix B
Applicable or Relevant and Appropriate Requirements (ARARs)

Attachment B

TABLE 1
Federal Chemical-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
There are no Federal Chemical-Specific ARARs for the Selected Remedy.					

TABLE 2
Virginia Chemical-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
There are no Virginia Chemical-Specific ARARs for the Selected Remedy.					

TABLE 3
Federal Location-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
***Clean Water Act* [33 USC §§ 1251-1387][a]**					
Wetlands	Avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	Existing wetland is filled in or permanently destroyed.	40 CFR 230.2, .10-.12, .20-.32, .41-.42, .53, .60-.77, .93, .94(a), .94(c), .95-.98 33 CFR 320.4, 328.2, 330.1(c), 330.4, 332.3, 332.4(a), 332.4(c), 332.5-8	Applicable	Wetlands are present at OU2. Any activities conducted in wetland areas will involve restoration/enhancement of wetlands.
***Coastal Zone Management Act* [16 USC §§ 1451-1464][a]**					
Coastal zone or area that will affect the coastal zone	Federal activities must be consistent with, to the maximum extent practicable, state coastal zone management programs.	Action causes an effect in state's coastal zone.	*Coastal Zone Management Act*; 16 USC 1456(c), 15 CFR 930.30 - .33, .36(a), .39(b-d)	Relevant and Appropriate	If construction activities at OU2 affect the state's coastal zone, the activities will be consistent to the maximum extent practicable with the State's enforceable policies.

Note:

a: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered potential ARARs.

TABLE 4
Virginia Location-Specific ARARs

Location	Requirement	Prerequisite	Citation	ARAR Determination	Comment
General Provisions Relating to Marine Resources Commission **[VA Code Ann. §§ 28.2-1300 to 1320 (1998)][a]**					
Wetlands	Compensation or mitigation for permanent loss of wetlands will be determined on a case-by-case basis.	Permanent loss of wetlands	*Wetlands Mitigation Compensation Policy, 4 VAC 20-390-10 to 50*	Applicable	Wetlands are present at OU2. Any construction activities conducted in wetlands will involve restoration to natural conditions. If permanent loss of wetlands occurs, compensation or mitigation will be determined based on this regulation.
State Water Control Law **[VA Code Ann. §§ 62.1-44.2 to 44.34:28 (2003)][a]**					
Wetlands	Activities performed in a wetland will comply with these requirements.	Activities will be performed in a wetland.	*Virginia Water Protection Permit Program*, 9 VAC 25-210-50	Applicable	Any wetland activities will be conducted in accordance with this regulation.

Note:

a: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered potential ARARs.

TABLE 5
Federal Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
***Clean Water Act* [33 USC §§ 1251-1387][a]**					
Discharge of dredge-and-fill	No discharge of dredged or fill material will be allowed unless appropriate and practicable steps are taken that minimize potential adverse impacts of the discharge on the aquatic ecosystem.	Discharges of dredged or fill material to surface waters, including wetlands.	40 CFR 230.2(b), .10-.12, .20-.32, .41-.42, .53, .60-.77 33 CFR 320.4, 328.2, 330.1(c), 330.4	Relevant and Appropriate	Construction operations that result in filling of adjacent wetlands will be conducted in accordance with these regulations.

Note:

a: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered potential ARARs.

TABLE 6
Virginia Action-Specific ARARs

Action	Requirement	Prerequisite	Citation	ARAR Determination	Comment
Stormwater Management Act **[VA Code Ann. §§ 10.1-562 – 573 (2005)]**[a]					
Construction activities that disturb one acre or more of land.	Procedures, requirements, and Best Management Practices to be followed in connection with construction activities.	Construction activities that disturb one acre or more of land.	*Stormwater Management Regulations,* 4VAC 50-60-10 to 80, 380.A&B., 420, 430, 1100 to 1140, 1160, 1170, 1182, 1186	Applicable	A site specific stormwater management plan will be developed for these construction activities. The Navy will follow the substantive, but not procedural requirements of the regulation.
Erosion and Sediment Control Law **[VA Code Ann. §§ 10.1-1300 to 1326 (1998)]**[a]					
Construction activities that disturb 10,000 sq ft or more of land.	Regulations for the effective control of soil erosion, sediment deposition and nonagricultural runoff which must be met in any control program to prevent the unreasonable degradation of properties, stream channels, waters and other natural resources.	Construction activities that disturb 10,000 sq ft or greater of land.	*Erosion and Sediment Control Regulations*, 4 VAC 50-30-40, 60.A	Applicable	An erosion and sediment control plan will be established to monitor and prevent erosion of the soil cover to adjacent water bodies during and after construction activities.
Virginia Waste Management Act **[VA Code Ann. §§ 10.1-1400 to 1457 (2004)]**[a]					
Waste/soil/water and Handling, Storage, treatment, and disposal of IDW	Wastes to be managed must be sampled for appropriate waste characterization, storage, and disposal requirements.	Management of wastes.	*Solid and Hazardous Waste Regulations 9 VAC 20-60-261 (incorporating 40 CFR Part 261) (hazardous waste identification)* *9 VAC 20-62-262 (incorporating 40 CFR Parts 262.11 and 262.34) (generator requirements)* *9 VAC 20-80-140, 150, 240.C*	Applicable	This remedy will generate water and potentially soil IDW which will be characterized for disposal. Based on site history, it is not anticipated that IDW will be characterized as hazardous waste.
Air Pollution Control Board **[VA Code Ann. §§ 10.1 -1300 to 1326 (1998)]**[a]					
Fugitive dust caused by construction activities	Reasonable precautions will be taken to prevent particulate matter from becoming airborne.	Fugitive dust emission from disturbance of soil, treatment of soil or water, or other pollutant management activities.	*Standard for Fugitive Dust/Emissions*, 9 VAC 5-50-90	Applicable	Fugitive dust caused by construction activities will be managed according to this requirement.

Note:

a: Statutes and policies, and their citations, are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statutes or policies as potential ARARs; specific potential ARARs are addressed in the table below each general heading; only pertinent substantive requirements of the specific citations are considered potential ARARs.