6/1/05-00866

# Proposed Remedial Action Plan

## Site 12: Former Exchange Laundry/Dry Cleaning Facility

**Naval Amphibious Base Little Creek**
**Virginia Beach, Virginia**

**June 2005**

## 1 Introduction

This **Proposed Remedial Action Plan (PRAP)** identifies the Preferred Alternative for addressing groundwater contamination at **Site** 12, the former Exchange Laundry/ Dry Cleaning Facility, at Naval Amphibious Base (NAB) Little Creek, Virginia Beach, Virginia. The Preferred Alternative is groundwater treatment through in-situ chemical/bio-augmentation technology, and post injection monitoring of the natural degradation of chlorinated volatile organic compounds (cVOCs). **Land use controls (LUCs)** will be maintained until site conditions achieve unlimited exposure and unrestricted use. This Plan provides the rationale for this preference.

This document is issued jointly by the United States Navy (Navy), the lead agency for site activities, and the **United States Environmental Protection Agency (EPA)** Region III in consultation with the **Virginia Department of Environmental Quality (VDEQ)**, the support agency. The Navy is issuing this Proposed Remedial Action Plan to fulfill public participation responsibilities as required under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)** and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**.

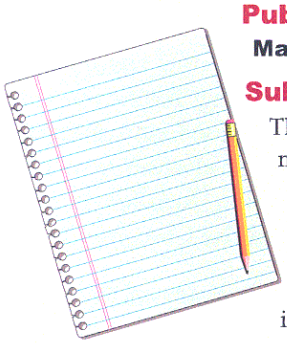
This PRAP summarizes the remedial alternatives evaluated for Site 12. Additional information that can be found in the Final Supplemental **Remedial Investigation (RI)** (October 2000), the Revised **Final Feasibility Study (FS)** (September 2004), and other documents contained in the **Administrative Record** file and **Information Repository** for NAB Little Creek. A glossary of key terms used in this PRAP is attached, and are identified in bold print the first time they appear.

The Navy and EPA, in consultation with the VDEQ, will make the final decision on the remedial approach for Site 12 after reviewing and considering all information submitted during the 30-day **public comment period**. The Preferred Alternative may be modified or another **remedial action** may be selected based on new information and/or public comments received. Therefore, public participation is encouraged.

## 2 Site Background

NAB Little Creek was commissioned July 30, 1945 to train landing craft personnel for operational assignments. During the last 60 years, NAB Little Creek has expanded in both area and the complexity of its mission. NAB Little

## Mark Your Calendar for the Public Comment Period



### Public Comment Period

**May 2 – June 2, 2005**

### Submit Written Comments

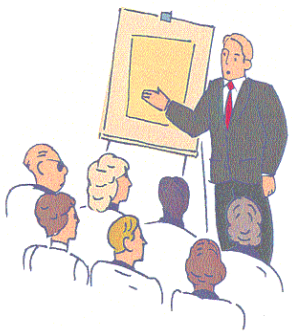
The Navy will accept written comments on the Proposed Remedial Action Plan during the public comment period. To submit comments or obtain further information, please refer to the insert page.

### Attend the Public Meeting

**May 9, 2005**

Time - 7:00 pm
Place - Shelton Park Elementary School
1700 Shelton Road
Virginia Beach, VA 23455

The Navy will hold a public meeting to explain the Proposed Remedial Action Plan. Verbal and written comments will be accepted at this meeting.



### Location of Information Repository

**Virginia Beach Central Library**
4100 Virginia Beach Boulevard
Virginia Beach, VA, 23452
Phone: 757.431.3001

Creek personnel provide logistic facilities and support services to 27 homeported ships and more than 80 tenant commands.

NAB Little Creek is located in the northwest corner of Virginia Beach, Virginia, along the Chesapeake Bay's southern shore. The base's western border abuts the City of Norfolk, Virginia (Figure 1). The area surrounding this 2,215 acre base is low-lying and relatively flat. The base is bounded on the north by the Chesapeake Bay; on the west by residential communities and several marinas; on the south by Shore Drive, Lake Whitehurst, Little Creek Reservoir/Lake Smith, Norfolk International Airport Industrial Park, and residential development; and on the east by Lake Bradford. In May 1999, NAB Little Creek was placed on USEPA's **National Priorities List (NPL)**.

## 2.1 Site Description and Background

Site 12, the Exchange Laundry/ Dry Cleaning Facility, was located in Building 3323, near the intersection of Third and B Streets, in the eastern portion of NAB Little Creek (Figure 2). In earlier investigations, Site 12 was also referred to as Solid Waste Management Unit (SWMU) 77 and the Naval Exchange (NEX) laundry.

The NEX (Building 3323) operated from 1973 until it was demolished in 1987 for the construction of the existing commissary (Building 3445). An estimate of 1,320 gallons of waste, including tetrachloroethene (PCE), a chlorinated volatile organic compound (cVOC), soap, sizing, and dyes from Site 12 was reportedly dumped into a storm sewer. Of this total, approximately 200 gallons were estimated to be PCE sludge. When the new commissary was constructed, a passive subsurface venting system was installed under the commissary floor to prevent the possibility of vapors from the cVOCs in shallow groundwater from entering into the new building. Site 12 is currently covered by buildings, a self-serve car wash, and asphalt or concrete.

Prior to construction of the commissary in 1992, a catch basin, storm water conveyance system, and a Northern Outfall emptied into a freshwater drainage canal located approximately 100 feet to the west of Site 12. The storm water conveyance system was removed and the area was regraded during construction of the commissary. The Southern Outfall is still in existence receiving storm water drainage from a relatively small area near the southwest corner of the commissary and does not receive groundwater discharge from Site 12. The Southern Outfall consists of a 12-inch galvanized iron pipe that discharges to the canal approximately 3 feet below ground surface. The 20 feet wide and 8 feet deep drainage canal has relatively steep sides and typically contains between 1 and 3 feet of water. The canal flows southward, from Lake Bradford to Little Creek Cove. The water level in the canal is controlled by a weir at Little Creek Cove that prevents the tides in the cove from backing up into Lake Bradford. During most times of the year, except during heavy rains, the canal is stagnant with no perceptible flow. The canal was dredged in 1999 to remove an abundance of sediment and debris that had accumulated.

Shallow **groundwater** (Columbia Aquifer) at the site ranges seasonally between 6 and 8 feet below ground surface and flows toward the west. Sanitary sewer pipes intersect Site 12 groundwater. The sanitary sewer line in this vicinity is located below the water table on the west side of the site. The sanitary sewer line is in poor condition allowing shallow groundwater to flow into the cracked sewer line, thus controlling groundwater flow at the site. A clay confining unit separates the underlying Yorktown Aquifer from the Columbia Aquifer. Groundwater flow in the Yorktown Aquifer is north, toward the Chesapeake Bay.

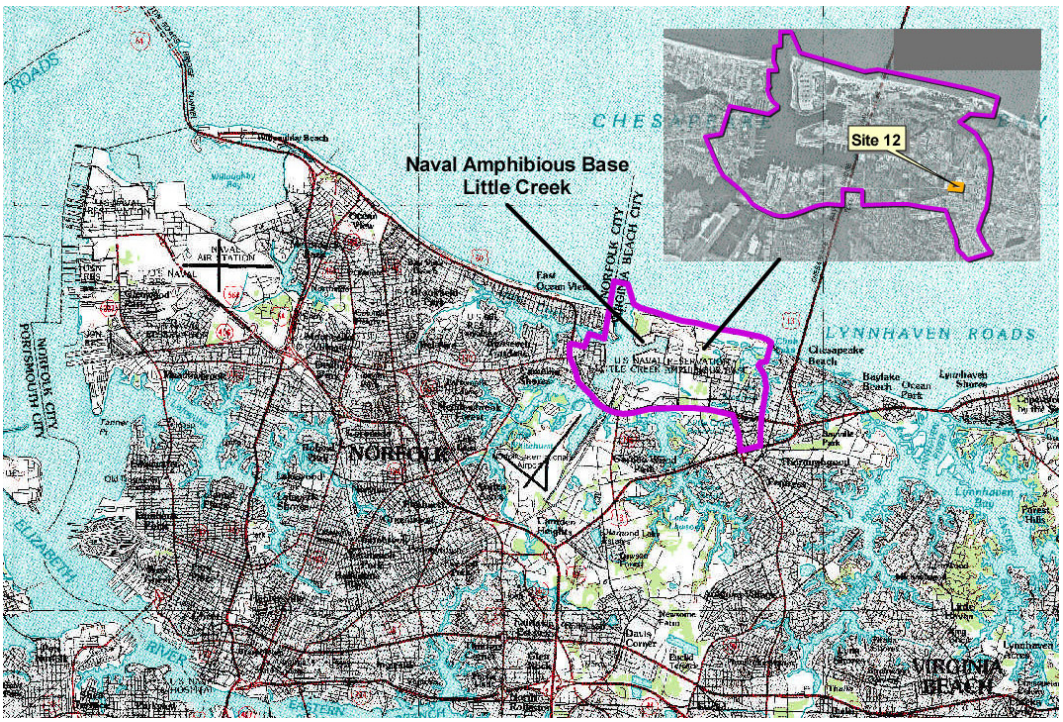



*Figure 1 - Base Location Map*

## 2.2 Summary of Previous Investigations

Site 12 was characterized under numerous investigations and studies between 1984 and the present. The following is a chronological listing of those studies.

### Initial Assessment Study 1984

An Initial Assessment Study (IAS) was conducted to identify potential areas of concern at NAB Little Creek through a review of waste generation, handling, and disposal practices. The review involved historical records, aerial photographs, field inspections, and interviews with NAB Little Creek personnel. Site 12 was recommended for additional study. The scope of work for the Round I Verification Study (RVS) came from recommendations made in the IAS.

### Round I Verification Study 1986

The RVS at NAB Little Creek was completed in 1986. The purpose of the study was to verify the presence and/or absence of contamination at the sites recommended in the IAS for additional study. The scope of the RVS activities was established by the recommendations presented in the IAS. Contamination was detected in groundwater at Site 12.

### RCRA Facility Assessment 1989

A RCRA Facility Assessment (RFA) was conducted to identify potential areas of concern at NAB Little Creek. The RFA consisted of a records review and interviews. Prior sampling indicated elevated levels of chlorinated VOC in surface water and sediment in the canal adjacent to SWMU 77 (Site 12). The RFA recommended further study under the Navy's **Installation Restoration Program (IRP)**.

### Interim Remedial Investigation 1991

The Interim Remedial Investigation (IRI) was conducted in 1991 to determine whether further characterization activities or remedial action was warranted at Site 12. The objectives of this investigation were to conduct a second round of sampling following the RVS. The data were used to develop recommended response actions, a human health assessment, and site specific recommendations concerning additional characterization.

### Environmental Assessment for Site 12

A two-phase environmental assessment of Site 12 was conducted in 1990 and 1991. Phase I entailed the drilling, installation, and sampling of eight monitoring wells, the collection of a soil sample from each monitoring well boring, and the collection of three sediment samples along the drainage canal west of Site 12. Phase II was to verify the Phase I findings and provide a more detailed delineation of the extent of groundwater contamination at Site 12. The specific activities completed for Phase II included the drilling, installation, and sampling of two additional monitoring wells, collection of a second round of samples from the eight existing wells, and the establishment of vertical well elevation data in order to determine the direction of groundwater flow.

### Site Characterization Investigation 1992

A Site Characterization Investigation was conducted in 1992 for the new commissary building construction

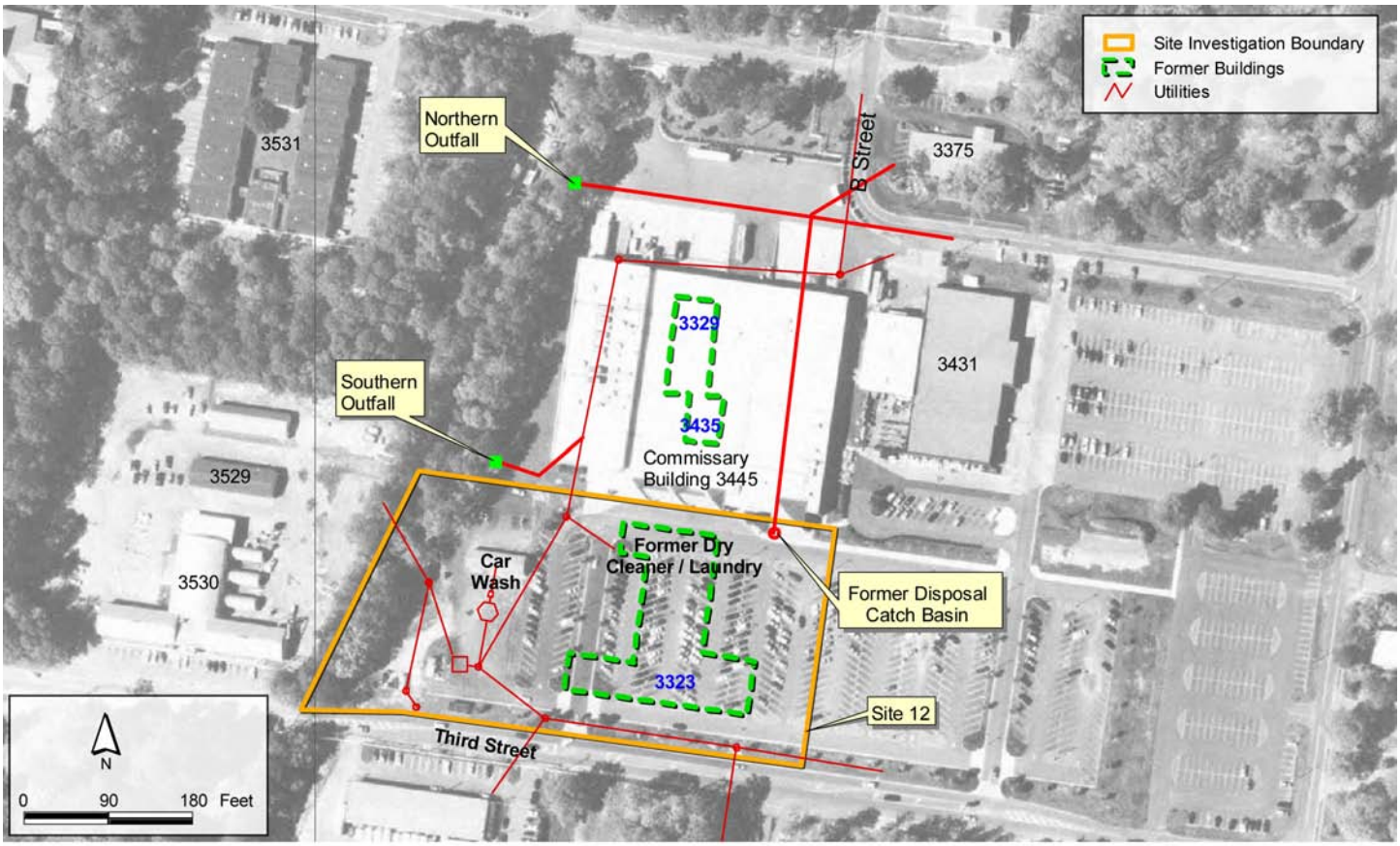



*Figure 2 - Site Location Map*

within Site 12. A subsurface investigation evaluated the lateral and vertical extent of potentially contaminated environmental media at the proposed building location. Soil and groundwater samples were analyzed to evaluate the nature of contamination. The Site Characterization Report recommended the installation of a passive soil-gas-reduction system with a liner to reduce the possibility of vapor migration into the proposed new building.

#### Remedial Investigation/Feasibility Study 1993

In 1993 a RI/FS of Site 12 was conducted to collect additional data to fully evaluate site conditions, determine potential risks, and develop and evaluate remedial action alternatives to mitigate any risks. The RI/FS recommended that additional hydrological characterization be conducted to evaluate treatment or containment options for Site 12 groundwater contamination. Additional groundwater sampling was also recommended.

#### Supplemental Remedial Investigation 2000

A Supplemental RI (SRI) was conducted in 2000 to obtain additional information on the horizontal and vertical extent of the chlorinated VOC plume, VOC source area, aquifer (shallow and deep) characteristics, and conduct a human health risk assessment (HHRA). The SRI concluded cVOCs contamination does not extend to the deeper Yorktown Aquifer, site-related contamination in the Columbia Aquifer is limited to PCE and its breakdown products, and there is a significant variation in chlorinated VOC concentration with depth in the Columbia Aquifer. No chlorinated VOCs were detected in the canal surface water during the SRI.

#### Ecological Risk Assessment (ERA) 2000 and 2003

A screening **ecological risk assessment** (SERA) for Site 12 was completed in 2000. The canal at Site 12 was dredged by the City of Virginia Beach following SRI sampling in 1999. A baseline ecological risk assessment (BERA) was completed in 2003 that concluded a complete exposure pathway to surface soil for ecological receptors does not exist and potential ecological risk is negligible in the canal due to the limited habitat (essentially a linear ditch), and that based upon site history, chemicals that may pose potential ecological risk (metals) are not related to Site 12.

#### Feasibility Study and Feasibility Study Addendum 2004

A FS was completed to evaluate remedial action alternatives for Site 12 groundwater. Information from the SRI and several post-SRI activities (groundwater modeling) were used to develop the remedial alternatives described in this PRAP.

Further detailed information is contained in the Administrative Record for NAB Little Creek. A complete list of the documents included in the Administrative Record files for NAB Little Creek can be obtained from the NAB Little Creek Installation Restoration web site:

http://public.lantops-ir.org/sites/public/nablc/Site%20Files/AdminRecords.aspx

A Restoration Advisory Board (RAB) was formed in 1994. During the course of investigations at Site 12, the RAB has been apprised of all environmental activities related to the site. There have been no enforcement activities at Site 12.

## 3 Site Characteristics

NAB Little Creek is primarily an industrial facility. The surrounding areas are used for recreational, commercial, and residential purposes. The ground surface at Site 12 is generally level and consists of an asphalt parking lot for Commissary patrons. The site is mostly paved parking lot, a car wash and a commissary building. There is minimal viable ecological habitat and a complete exposure pathway to surface soil for ecological receptors does not exist. The drainage canal west of the site is a relatively steep-banked linear drainage ditch with a thick growth of vegetation at the top of the bank.

Depth to groundwater at the site ranges seasonally between 6 and 8 feet below ground surface and flows toward the west. Groundwater flow in the Columbia Aquifer is toward a leaky sanitary sewer located below the water table on the west side of the site. A clay confining unit separates the underlying Yorktown Aquifer from the Columbia Aquifer. Groundwater flow in the Yorktown Aquifer is north, toward the Chesapeake Bay.

Shallow groundwater is impacted by cVOCs at Site 12. Groundwater at NAB Little Creek is not currently used as a potable water supply. Potable water is supplied to the base by the City of Virginia Beach. Groundwater wells are located at the base golf course, which is approximately 4000 feet northwest of Site 12. These wells provide water from the Yorktown Aquifer for irrigation of the golf course.

### 3.1 Nature and Extent of Contamination

Site-related contamination is limited to cVOCs in shallow groundwater, principally PCE and its breakdown products (Table 1). Two areas of elevated PCE concentrations in shallow groundwater were identified at Site 12 (Figure 3). The cVOC shallow groundwater plume is confined to the area of the parking lot for the commissary and the self-serve car wash. While the plume extends as far west as the car wash, it does not extend to the canal. No cVOCs were detected in the underlying Yorktown Aquifer.

PCE was detected in two soil samples from the western side of the site at a low estimated maximum concentration of 16 micrograms per kilogram (µg/kg). No cVOCs were detected in the canal sediment or surface water.

| Chemical (µg/L) | |
|---|---|
| 1,1-Dichloroethene | 2.2 |
| cis-1.2-Dichloroethene | 4,900 |
| Tetrachloroethene | 23,000 |
| trans-1.2-Dichloroethene | 0.47 |
| Trichloroethene | 4,286 |
| Vinyl Chloride | 460 |

*Table 1 - Maximum Concentrations of cVOCs in Groundwater at Site 12*

### 3.2 Fate and Transport of Contamination

The primary fate and **contaminant migration pathway** for cVOCs at Site 12 is through groundwater flow in the Columbia Aquifer. The mechanisms of transport include dissolution, advection, and dispersion. The cVOC plume is located in the parking lot of the base commissary and extends west toward the car wash to a pump station in the southwest corner of the site (Figure 3). Discharge of water from the shallow aquifer to the sanitary sewer is occurring at a rate of 16 to 17 gallons per minute (gpm), which provides localized hydraulic control of the aquifer under most conditions and limits further migration of cVOCs to the west. The sanitary sewer drains to a pump station within Site 12, that discharges through Little Creek's main pump station to a publicly-owned treatment works (POTW) for treatment. Currently, the cVOCs in groundwater at Site 12 are undergoing chemical and biological changes over time.

### 3.3 Principal Threats

Under current land use groundwater is not used as a potable supply. For anticipated future land use scenarios, LUCs will prohibit potable groundwater use until concentrations are reduced to levels that allow for unlimited exposure and unrestricted use. Therefore there are no realistic exposure scenarios. All available data suggest that mobility and migration of contaminated groundwater is limited at Site 12, therefore, no principal threat waste has been identified at Site 12.

## 4 Scope And Role of Response Action

NAB Little Creek was placed on EPA's NPL in May 1999. Site 12 is one of several IRP sites being addressed under CERCLA at NAB Little Creek. The response action for Site 12 does not include or affect any other sites at the facility. The role of the Preferred Alternative presented in this Proposed Remedial Action Plan is to address all potential risks posed by Site 12 and to eliminate current exposure pathways that may pose unacceptable human health or ecological risk. The Preferred Alternative is groundwater treatment through in-situ chemical treatment, bio-augmentation technology, and post-injection monitoring.

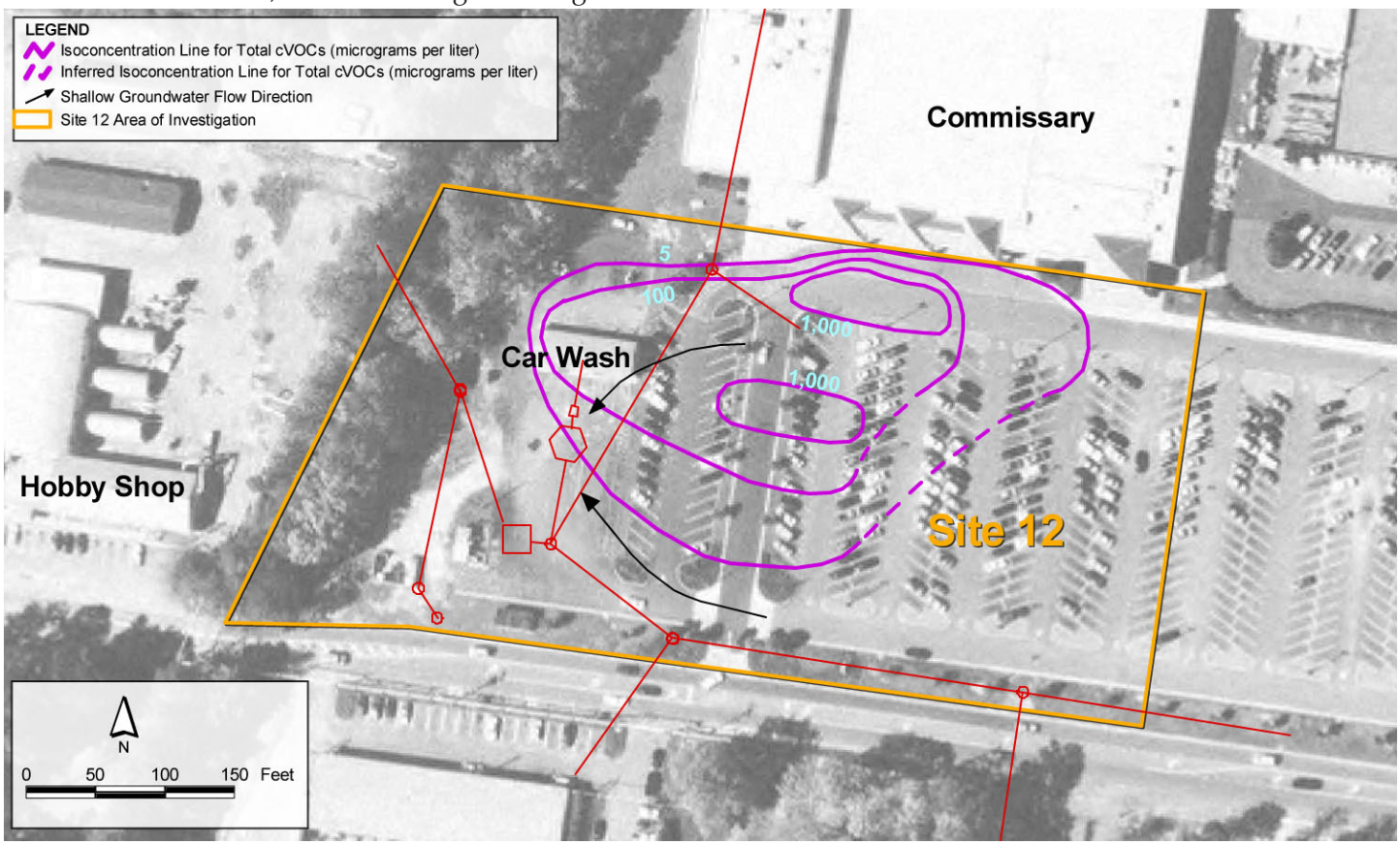



*Figure 3 - Extent of cVOCs in groundwater*

LUCs will be maintained within the boundaries of Site 12 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use.

## 5 Summary Of Site Risks

It is the current judgment of the Navy and USEPA, in consultation with VDEQ that the preferred alternative identified in this PRAP is necessary to protect public health, welfare, and the environment from actual or threatened releases of hazardous substances into the environment. Impacted groundwater lies beneath the parking lot of the base commissary and adjacent car wash. Impacted groundwater does not extend beneath the commissary, the base hobby shop west of Site 12, or residential areas to the south and east of the Site as shown on Figure 3. Current land use is expected to remain the same in the foreseeable future. Detailed results of human health and ecological risk assessments conducted for Site 12 are presented in the Supplemental RI and Baseline ERA. A risk assessment summary is provided in Table 2.

### 5.1 Human Health Risk Summary

A **human health risk assessment (HHRA)** was conducted to evaluate the potential human health risks associated with exposure to soil, surface water, sedimen t, and groundwater at Site 12. An estimate of potential risk was developed for Site 12 incorporating the following likely exposure scenarios: current industrial workers, current adult and adolescent trespassers/visitors, future adult and child residents, future adult and adolescent trespassers/visitors, future industrial workers, and future construction workers. Health risks are based on a conservative estimate of the potential **carcinogenic risk** or the potential to cause other health effects not related to cancer [**non-cancer risk** or **hazard index (HI)**]. There were no unacceptable risks exceeding EPA's acceptable target risk levels for HI of 1 and cancer risk range of 10-4 to 10-6 or hazards under current site use for exposure to individual **media**.

| Media | Human Health Risk | Ecological Risk |
|---|---|---|
| Surface Soil | Acceptable | Acceptable |
| Subsurface Soil | Acceptable | Not Applicable |
| Shallow Groundwater | Unacceptable | Not Applicable |
| Deep Groundwater | Acceptable | Not Applicable |
| Sediment | Acceptable | Acceptable |
| Surface Water | Acceptable | Acceptable |

*Note: Subsurface soil and groundwater are incomplete pathways for ecological risk*

*Table 2 - Site 12 Risk Summary*

The future potable use of shallow groundwater is the only media posing unacceptable human health risk at Site 12. The unacceptable risk and hazard is to both child and adult residents based on concentrations of cVOCs in shallow groundwater. The non-cancer hazard index (HI)

### What is Human Health Risk and How is it Calculated?

A human health risk assessment estimates the "baseline risk." This is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. To estimate the baseline risk at a site, the Navy performs the following four-step process:

**Step 1: Analyze Contamination**

**Step 2: Estimate Exposure**

**Step 3: Assess Potential Health Dangers**

**Step 4: Characterize Site Risk**

In **Step 1**, the Navy looks at the concentrations of contaminants found at a site as well as past scientific studies on the effects these contaminants have had on people (or animals, when human studies are unavailable). Comparisons between site-specific concentrations and concentrations reported in past studies help the Navy to determine which contaminants are most likely to pose the greatest threat to human health.

In **Step 2**, the Navy considers the different ways that people might be exposed to the contaminants identified in Step 1, the concentrations that people might be exposed to, and the potential frequency (how often) and length of exposure. Using this information, the Navy calculates a "reasonable maximum exposure (RME) scenario that portrays the highest level of human exposure that could reasonably be expected to occur.

In **Step 3**, the Navy uses the information from Step 2 combined with information on the toxicity of each chemical to assess potential health risks. The Navy considers two types of risk: (1) cancer risk, and (2) noncancer risk. The likelihood of any kind of cancer resulting from a contaminated site is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. An extra cancer case means that one more person could get cancer than normally would be expected to from all other causes. For noncancer health effects, the Navy calculates a "hazard index." The **hazard index** represents the ratio between the "reference dose", the dosage at which no adverse health effects are expected to occur, and the "reasonable maximum exposure", the estimated maximum exposure level for a given category of individuals coming into contact with contaminants at the Site. The key concept here is that a "threshold level" (measured usually as a hazard index of less than 1) exists below which noncancer health effects are no longer predicted.

In **Step 4**, the Navy determines whether site risks are great enough to cause health problems for people at or near the site. The results of the three previous steps are combined, evaluated, and summarized. The Navy adds up the potential risks from the individual contaminants and exposure pathways and calculates a total site risk.

for a child resident and the cancer risk both exceed EPA's acceptable target risk levels for HI of 1 and cancer risk range of 10-4 to 10-6.

There is no unacceptable risk for the adult and adolescent trespassers/visitors from individual exposure to soil, surface water or sediment. While exposure to combined surface soil, sediment, and surface water by an adolescent trespasser/visitor may result in a non-cancer hazard of 1.2, slightly above EPA's target index of 1, there is no unacceptable risk to this receptor based on central tendency exposures.

Future residential use of the site by a child would result in an hazard index (2.7) above the EPA target level of 1 due principally to chromium (HI of 1.3) and iron (HI 0.94) in soil; all other non-cancer hazards are individually less than 1, and there is no unacceptable risk based on **central tendency exposure concentrations**. Furthermore, this hazard assumes that all chromium found in the soil is hexavalent chromium which is highly unlikely since hexavalent chromium is not present under natural conditions and chromium (24 milligrams per kilogram [mg/kg] is only slightly higher that the base-wide **background** 95% upper tolerance limit (UTL) (20 mg/kg). Similarly, iron is present at concentrations reflective of background, where only one of 11 soil samples (19,000 mg/kg) slightly exceeded the background UTL for iron (15,000 mg/kg). Chromium and iron are not part of the dry cleaning process and do not represent a release to soil from Site 12.

### 5.2 Ecological Risk Summary

A complete exposure pathway to surface soil for ecological **receptors** does not exist at Site 12 since all potentially contaminated soil is covered by buildings, asphalt, or concrete. Ecological risks were only evaluated for drainage canal surface water and sediment at Site 12. A **hazard quotient (HQ)** was used to evaluate ecological risks at Site 12. For an HQ below 1, adverse effects to ecological receptors are not expected.

No constituents of potential concern (COPCs) were identified in surface water. Although some metals (cadmium, copper, lead, and selenium) and butylbenzylphthalate exceeded ecological screening values that may pose minimal risk, these sediment COPCs were only present in a small portion of the canal. Due to the limited habitat available in the canal, actual exposures are likely to be low. Furthermore, based on site history, the metals detected are not the results of a release related to Site 12 activities. Thus, potential ecological risks in the canal associated with Site 12 are negligible (Table 2).

| Chemical (µg/L) | |
|---|---|
| Tetrachloroethene (PCE) | 5 |
| Trichloroethene (TCE) | 5 |
| cis-1.2-Dichloroethene | 70 |
| Vinyl Chloride | 2 |

*Table 3 - Maximum Contaminant Levels*

## 6 Remedial Action Objectives

The Navy, EPA, and State concur that remedial action is necessary to protect public health, welfare, and the environment from actual or threatened releases of hazardous substances from Site 12. The site-specific **Remedial Action Objectives (RAOs)** are as follows:

- To prevent unacceptable risk to human health and the environment from exposure to cVOCs in groundwater
- To reduce cVOC concentrations in groundwater to the maximum contaminant levels by applying best available technologies

The Preferred Alternative is groundwater treatment through in-situ chemical/bio-augmentation technology, and post-injection monitoring. LUCs will be maintained on groundwater within the boundaries of Site 12 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use (Table 3).

## 7 Summary of Remedial Alternatives

Remedial alternatives to address cVOCs in groundwater at Site 12 were developed and are detailed in the FS. With the exception of the no action alternative, all alternatives comply with **Applicable, Relevant, and Appropriate Requirements (ARARs)**, have the same RAOs, expected outcomes, and anticipated future land uses. The no action alternative does not protect human health and the environment, but is presented as a baseline for comparison purposes. A common element of each alternative (except no action), is the assumption that the existing sanitary sewer line that is serving to hydraulically control groundwater flow and contaminant migration is repaired prior to implementation of a remedial action. Following repair of the leaking sanitary sewer, groundwater flow direction and velocity will be re-evaluated and incorporated into the design of the preferred remedial alternative.

The most distinguishing feature of the alternatives is the expected timeframe to achieve RAOs. Alternative 6, in-situ chemical/bio-augmentation, has the shortest timeframe (<10 years). Other distinguishing features are cost and implementation requirements. In addition to capital, operation and maintenance (O&M), and present-worth costs, future value O&M costs have been determined to reflect the costs of long-term O&M assuming an inflation

| Alternative | Components | Details | Cost | |
|---|---|---|---|---|
| 1—No Action | Existing groundwater plume | Not Applicable | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame >70 years | $0<br>$0<br>$0 |
| 1a – Long-Term Monitoring of Natural Attenuation | - Monitored Natural Attenuation<br>- LUCs | - Baseline sampling for natural attenuation indicator parameters<br>- Groundwater monitoring and reporting to assess the progress of natural attenuation over time<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame >70 years<br>O&M Future-Value costs<br>Total Implementation cost | $10,000<br>$22,000<br>$584,000<br><br>$6,969,000<br>$6,979,000 |
| 2 – Pump and Treat | - Pump and treat with ex-situ on-site air-stripping treatment system<br>- LUCs | - On-site treatment system<br>- 3 extraction wells pumping 3 gpm each; total extraction rate of 9 gpm<br>- Air-stripping treatment system<br>- Long-term operation and maintenance of extraction wells and treatment system<br>- Groundwater monitoring and reporting to assess the progress of remedy over time<br>- Analytical testing for discharge (VPDES permit requirements)<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame 71 years<br>O&M Future-Value costs<br>Total Implementation cost | $114,000<br>$26,000<br>$828,000<br><br>$8,566,900<br>$8,681,000 |
| 3 – Permeable Reactive Barrier Wall | - Permeable zero-valent iron reactive barrier.<br>- LUCs | - Installation of a zero-valent iron permeable reactive barrier<br>- Funnel-and-gate configuration<br>- Trench 3 ft wide, 25 ft deep, 55 feet long<br>- Flanked by impermeable segments of sheet pile or slurry wall<br>- Extraction well downgradient to increase flow gradient through barrier<br>- Analytical testing for discharge (VPDES permit requirements)<br>- Long-term operation and maintenance of extraction well and barrier wall<br>- Groundwater monitoring and reporting to assess the progress of remedy over time<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame >70 years<br>O&M Future-Value costs<br>Total Implementation cost | $539,000<br>$30,300<br>$1,384,000<br><br>$9,598,000<br>$10,137,000 |
| 4 – Biostimulation | - In-situ biological treatment to enhance natural biodegradation<br>- LUCs | - Injection of electron donors<br>- Formate and propionate<br>- Cultured dehalorespiring organisms<br>- Replenishment of biostimulants every 10 years<br>- Groundwater monitoring and reporting to assess the progress of remedy over time<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame 49 years<br>O&M Future-Value costs<br>Total Implementation cost | $244,000<br>$29,000<br>$990,000<br><br>$3,865,000<br>$4,109,000 |
| 5 – Pump and Treat with Biostimulation | - Groundwater extraction and on-site air-stripping<br>- Infiltration gallery re-injection with bio-stimulation<br>- LUCs | - On-site treatment system<br>- 3 extraction wells pumping 3 gpm each for a total system extraction rate of 9 gpm<br>- Air-stripping treatment system<br>- Half of extracted and treated groundwater is amended with electron donors and re-injected through upgradient gravel–filled infiltration galleries<br>- Analytical testing for discharge of treated groundwater not reinjected (VPDES permit requirements)<br>- Long-term operation and maintenance of extraction wells and treatment system; replacement of remedial system components assumed at five year interval and biostimulant replenishment every 10 years<br>- Groundwater monitoring and reporting to assess the progress of remedy over time<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame 32 years<br>O&M Future-Value costs<br>Total Implementation cost | $332,000<br>$30,000<br>$972,000<br><br>$1,782,000<br>$2,114,000 |
| 6 – In-Situ Chemical/bio-augmentation | - In-situ chemical treatment<br>- In-situ biological treatment<br>- LUCs | - In-situ chemical treatment at source zone<br>- Injection of chemical oxidants (eg., 7,300 gallons (40% concentrate) of sodium permanganate<br>- Injected through 70 temporary boreholes on 20-foot cent<br>- Atomized injection by mixing the permanganate solution with a nitrogen gas stream - down-hole nozzle and packer assembly<br>- Injection of biostimulants for enhanced reductive chlorination (ERD)<br>- 100 injection wells<br>- Emulsified vegetable oil and lactate injected for biostimulation<br>- Groundwater monitoring and reporting to assess the progress of remedy over time<br>- Statutory remedy 5-year reviews | Capital Cost<br>Annual O&M<br>Present-Worth<br>Time Frame <10 years<br>O&M Future-Value costs<br>Total Implementation cost | $1,195,000<br>$22,000<br>$1,461,000<br><br>$260,500<br>$1,455,000 |

*Table 4 - Description of Alternatives for Site 12*

rate of 3.7%. The total implementation cost is the capital cost plus the future value cost. A summary of remedial alternatives is presented in Table 4.

# 8 Evaluation of Alternatives

The NCP outlines the approach for comparing remedial alternatives using the **nine evaluation criteria** listed below (see glossary for a detailed description of each). Each remedial alternative for Site 12 was evaluated against the nine criteria listed below. Alternative 1 (no action) does not achieve RAOs and is not considered further.

## 8.1 Threshold Criteria

### Protection of human health and the environment

The LUC component of the alternatives provides protection of human health and the environment until such time as treatment reduces cVOCs to acceptable risk levels. The balance of trade-offs is the degree of treatment verses containment and the duration that LUCs must be maintained to ensure protection. The greatest protection occurs with Alternatives 5 and 6 where treatment is the principal component and requires the shortest timeframe for achieving RAOs.

### Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

All alternatives meet ARARs. As with protection of human health and the environment, the balance of trade-offs is the preference for treatment over containment when considered against the timeframe estimated to achieve RAOs.

## 8.2 Primary Balancing Criteria

### Long-term effectiveness and permanence

Alternatives with active treatment components designed to permanently reduce cVOCs to acceptable risk levels have the greatest impact on long-term effectiveness and permanence. Because treatment under Alternatives 5 and 6 are expected to permanently achieve RAOs in the shortest timeframes, these alternatives are valued over the other alternatives for this criterion. The chemical treatment source zone component of Alternative 6 increases the potential for long-term effectiveness and permanence over Alternative 5. Pump and treat, natural attenuation and reactive barrier technologies have a lower rate of successful site remediation as they are addressing contamination dissolved in groundwater and not directly addressing source zones.

### Reduction in toxicity, mobility, or volume

Alternatives with active treatment components designed to reduce cVOCs to acceptable risk levels have the greatest impact on reducing toxicity or volume. Containment components such as pump and treat and reactive barriers have the greatest impact on mobility. Alternatives 2 through 5 are considered moderately effective in reducing toxicity, mobility, or volume, whereas Alternative 6 is expected to reduce cVOC levels very quickly. The chemical oxidation source zone treatment component of Alternative 6 increases the potential for reduction in toxicity or volume over Alternative 5. Pump and treat, natural attenuation and reactive barrier technologies have a lower rate of successful site remediation, as they are addressing contamination dissolved in groundwater and not directly addressing source zones.

### Short-term effectiveness

Short-term effectiveness was evaluated with respect to the adverse effects the remedy may pose to the community, workers, and the environment during implementation. Alternatives involving extraction and ex-situ treat systems have the greatest potential to increase risk from short-term exposure through the extraction of contaminated groundwater. Alternative 3 has high short-term risk associated with exposure during construction of the reactive barrier. Alternatives involving in-situ treatment have the least short-term exposure risks while reducing contaminant concentrations. Alternative 6 has minimal exposure during implementation

### Implementability

This criterion was evaluated with respect to ease of implementing the remedy in terms of construction and operation, and the availability of services and materials required to implement the alternative. Alternatives with long-term O&M components increases the difficulty of implementation as these components must be inspected, monitored, and repaired over the decades the remedy is in place before achieving RAOs. Alternatives with extraction systems are more difficult to implement and maintain that in-situ treatment alternatives. While in-situ chemical injection alternatives are moderately difficult to implement in the short-term, the fact that RAOs are achievable in much shorter time frames increases ease of implementation over the life of the remedy.

### Cost

Projected capital costs for Alternatives with in-situ chemical injection are greater than alternatives with groundwater extraction and ex-situ treatment components. The highest capital cost is for in-situ chemical/bio-augmentation, followed by the capital cost for construction of a permeable reactive barrier. However the greatest factor affecting the total implementation cost is the timeframe required for O&M. While the capital costs for in-situ chemical/bio-augmentation is high, the total implementation cost is lowest because RAOs are expected to be met within 10 years. Extraction and/or treatment of contaminants by maintaining hydraulic control of the site requires pumps and other ex-situ treatment compo-

nents that require continual operation along with periodic maintenance and replacement. Due to O&M costs lasting 50 years or more, annual monitoring/reporting, and maintenance of LUCs, total implementation costs are greater than Alternatives with shorter remedy time frames. Alternative 6 is the most cost-effective alternative.

### 8.3 Modifying Criteria

#### State Acceptance

State involvement has been solicited throughout the CERCLA process and proposed remedy selection. The State supports the Preferred Alternative and their final concurrence will be solicited following the review of all comments received during the public comment period.

#### Community Acceptance

This Modifying Criteria will be evaluated after the public comment period for the Proposed Remedial Action Plan.

A comparison of the alternatives is presented in Table 5. The Site 12 FS provides a more detailed comparative analysis of alternatives.

## 9 Preferred Alternative

Alternative 6, in-situ chemical/bioaugmentation treatment, is proposed at the Preferred Alternative to address groundwater contamination at Site 12. Although Alternative 6 has the highest capital costs, it is expected to achieve substantial risk reduction in significantly less time (less than 10 years versus 32 to 49 years) and has a higher rate of successful implementation for achieving the RAOs. Alternative 6 is expected to reduce cVOC concentrations in groundwater to the maximum extent practicable for the remedial technologies available.

Based on information currently available, the Navy and EPA, in consultation with VDEQ, believe the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Navy expects the Preferred Alternative to satisfy the following requirements of CERCLA: 1) protective of human health and the environment, 2) comply with ARARs, 3) cost-effective, 4) utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and 5) satisfy the preference for treatment as a

| CERCLA Criteria | No Action (1) | Natural Attenuation (1a) | Pump and Treat (2) | Permeable Reactive Barrier (3) | Bio-Stimulation (4) | Pump and Treat with Bio-Stimulation (5) | In-Situ Chemical / Bio-augmentation (6) |
|---|---|---|---|---|---|---|---|
| **Threshold Criteria** | | | | | | | |
| Protection of Human Health and the Environment | ❍ | ❍ | ◐ | ❍ | ◐ | ● | ● |
| Compliance with ARARs | ❍ | ● | ● | ● | ● | ● | ● |
| **Primary Balancing Criteria** | | | | | | | |
| Long-term Effectiveness and Permanence | ❍ | ❍ | ◐ | ❍ | ◐ | ◐ | ● |
| Reduction in Toxicity, Mobility, or Volume | ❍ | ❍ | ◐ | ◐ | ◐ | ◐ | ● |
| Short-Term Effectiveness | ❍ | ❍ | ◐ | ❍ | ◐ | ◐ | ● |
| Implementability | ● | ● | ❍ | ❍ | ● | ◐ | |
| Present-Worth Cost | ● | ● | ❍ | ❍ | ◐ | ❍ | ❍ |
| Total Implementation Cost | ● | ❍ | ❍ | ◐ | ◐ | ● | ● |

Ranking: ● High ◐ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria

*Table 5 - Relative Ranking of Alternatives*

principal element. The Preferred Alternative can change in response to public comment or new information.

The Preferred Alternative employs sequential implementation of multiple remedial technologies: chemical oxidation in "hot spot" areas followed by injection of a product such as emulsified vegetable oil and lactate to promote biological degradation. Throughout implementation of the remedy, the Navy will restrict access as necessary to prevent unacceptable risks to human receptors from exposure to contaminants in groundwater.

Although the effectiveness of treatment of cVOCs in groundwater will be measured by comparison to MCLs, the remedial technologies are not guaranteed to achieve cVOC concentrations at or below MCLs across the site. As required by CERCLA, five-year reviews will be conducted to monitor the effectiveness of the remedy. The remedy will be considered effective and complete based on the maximum reduction of cVOC concentrations over time as indicated by stabilized concentrations, and when all parties (Navy, EPA, and VDEQ) agree that cVOCs have been removed to the extent practicable. The need for LUCs to prevent exposure and ensure protection will be periodically reassess as cVOC concentrations are reduced over time.

### Location of Administrative Record and Information Repository

The Community Relations Plan for NAB Little Creek, IRP fact sheets, and final technical reports concerning Site 12 are available to the public at the following locations:

**Virginia Beach Central Library**
4100 Virginia Beach Blvd
Virginia Beach, VA 23452
Phone (757) 431-3001

**Ms. Lora Fly**
Commander, Navy Region Mid-Atlantic
Regional Environmental Group
Naval Weapons Station Yorktown
Building 406, Code N455
Yorktown, VA 23691
Phone (757) 887-4933

## 10 Community Participation

The Navy and EPA provide information regarding environmental cleanups at NAB Little Creek to the public through the Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, the information repository, and announcements published in The Virginian-Pilot newspaper. The public is encouraged to gain a more comprehensive understanding of Site 12 and the IRP. The public comment period for this Proposed Remedial Action Plan is from May 2, 2005 – June 2, 2005 and a public meeting will be held on May 9, 2005 at 7:00 pm (see Page 1 of this report for details). Minutes of the public meeting will be included in the Administrative Record file. The Navy will summarize and respond to comments in a responsiveness summary, which will become part of the official **Record of Decision (ROD)** and will also be included in the Administrative Record file.

### During the comment period, interested parties may submit written comments to the following addresses:

**Ms. Lora Fly**
Commander, Navy Region Mid-Atlantic
Regional Environmental Group
Naval Weapons Station Yorktown
Building 406, Code N455
Yorktown, VA 23691
Phone (757) 887-4933
Fax (757) 887-4478
flylb@pwcnorva.navy.mil

***For further information, please contact:***

**Ms. Dawn Hayes, Code EV22-DMH**
NAVFAC - Atlantic
6506 Hampton Blvd.
Norfolk, VA 23508-1278
Phone (757) 322-4792
Fax (757) 322-4805
dawn.hayes@navy.mil

**Ms. Mary Cooke, Code 3HS11**
US EPA (Region III)
1650 Arch Street
Philadelphia, PA 19103
Phone (215) 814-3361
Fax (215) 814-3051
Cooke.Maryt@.epamail.epa.gov

**Mr. Paul Herman**
Virginia Dept. of Environmental Quality
629 Main Street, 4th Floor
Richmond, VA 23219
Phone (804) 698-4464
Fax (804) 698-4234
peherman@deq.virginia.gov

## Glossary

**Administrative Record:** Site information is compiled in an Administrative Record and placed in the general IRP information repository for public review.

**Applicable or Relevant and Appropriate Requirements (ARARs):** These are Federal or State environmental rules and regulations.

**Background:** The concentration of a naturally occurring or manmade constituent, such as a metal, found in groundwater, soil, sediment, and surface water in areas not impacted by spills, releases, or other site-specific activities. Background concentrations of some metals and other constituents are often at levels that may pose a risk to human health or the environment. These background-related risks should be considered (i.e.: subtracted) when calculating the risk posed by site conditions.

**Carcinogenic Risk:** Cancer risks are expressed as a number reflecting the increased chance that a person will develop cancer if exposed to chemicals or substances. For example, EPA's acceptable risk range for Superfund sites is $1 \times 10^{-4}$ to $1 \times 10^{-6}$, meaning there is 1 additional chance in 10,000 ($1 \times 10^{-4}$) to 1 additional chance in 1 million (1 x 10-6) that a person will develop cancer if exposed to a site that is not remediated.

**Central Tendency Exposure Concentration:** Mean concentration of site data is used as an exposure concentration in the risk assessment.

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA):** A Federal law, commonly referred to as the "Superfund" Program, passed in 1980 that provides for cleanup and emergency response in connection with numerous existing inactive hazardous waste disposal sites that endanger public health and safety or the environment.

**Contaminant Migration Pathway:** The route that site contaminants may take to get from the source of contamination to a human being, animal, or plant.

**United States Environmental Protection Agency (EPA):** The Federal agency responsible for administration and enforcement of CERCLA (and other environmental statutes and regulations), and with final approval authority for the Selected Remedy.

**Ecological Risk Assessment (ERA):** An evaluation of the risk posed to the environment if remedial activities are not performed at the site.

**Feasibility Study (FS):** Analysis of the practicability of a remedial proposal. The FS usually recom¬mends the selection of a cost-effective alternative.

**Groundwater:** Subsurface water that occurs in soils and geologic formations that are fully saturated.

**Hazard Index (HI):** A number indicative of noncarcino¬genic health effects that is the ratio of the existing level of exposure to an acceptable level of exposure. A value equal to or less than one indicates that the human popu¬lation is not likely to experience adverse effect.

**Hazard Quotient (HQ):** HQs are used to evaluate noncarci¬nogenic health effects and ecological risks. A value equal to or less than one indicates that the human or ecological population are not likely to experience adverse effects.

**Human Health Risk Assessment (HHRA):** An evaluation of the risk posed to human health should remedial activities not be implemented.

**Information Repository:** A file containing information, technical reports, and reference documents regarding an NPL site. This file is usually maintained at a location with easy public access, such as a public library.

**Installation Restoration Program (IRP):** The Navy, as the lead agency, acts in partnership with EPA and VDEQ to address environmental investigations at the facility through the IRP. The current IRP is consistent with CERCLA and applicable state environmental laws.

**Land Use Controls (LUCs):** Physical, legal, or administrative methods that restrict the use of or limits access to property to reduce risks to human health and the environment.

**Maximum Contaminant Levels (MCLs):** Enforceable standards that apply to public water systems, developed by EPA. The highest level of a contaminant that is allowed in drinking water.

**Media (singular, Medium):** Soil, groundwater, surface water, or sediments at the site.

**National Oil and Hazardous Substances Pollution Contingency Plan (NCP):** Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

**Nine Evaluation Criteria:**

- Overall Protection of Human Health and the Environment - Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with ARARs - Addresses whether a remedy will meet all of the ARARs of other Federal and State environmental laws and/or justifies a waiver of the requirements.
- Long-Term Effectiveness and Permanence - Addresses the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up goals have been met.
- Reduction of Toxicity, Mobility, and Volume Through Treatment - Discusses the anticipated performance of the treatment technologies a remedy may employ.
- Short-Term Effectiveness - Considers the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until clean-up goals are achieved.
- Implementability - Evaluates the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement an option.
- Cost - Compares the estimated capital, operations and maintenance and present worth costs.
- State Acceptance - Considers the State support agency comments on the Proposed Remedial Action Plan.
- Community Acceptance - Provides the public's general response to the alternatives described in the Proposed Remedial Action Plan, RI, and FS Reports. The specific responses to the public comments are addressed in the Responsiveness Summary section of the ROD.

**National Priorities List (NPL):** A list, developed by EPA, of uncontrolled hazardous substance release sites in the United States that are considered priorities for long-term remedial evaluation and response.

**Noncarcinogenic Risk:** Noncancer Hazards (or risk) are expressed as a quotient that compares the existing level of exposure to the acceptable level of exposure. There is a level of exposure (the reference dose) below which it is unlikely for even a sensitive population to experience adverse health effects. EPA's threshold level for noncarcinogenic risk at Superfund sites is 1, meaning that if the exposure exceeds the threshold, there may be a concern for potential noncancer effects.

**Present-Worth Cost:** Total cost, in current dollars, of the remedial action. The present-worth cost includes capital costs required to implement the remedial action, as well as the cost of long-term operations, maintenance, and monitoring.

**Proposed Remedial Action Plan:** A document that presents and requests public input regarding the proposed cleanup alternative.

**Public Comment Period:** The time allowed for the members of an affected community to express views and concerns regarding an action proposed to be taken by the Navy and EPA, such as a rulemaking, permit, or Superfund-remedy selection.

**Remedial Action Objectives (RAOs):** Objectives of remedial actions that are developed based on contaminated media, contaminants of concern, potential receptors and exposure scenarios, human health and ecological risk assessment, and attainment of regulatory cleanup levels, if any exist.

**Receptors:** Humans, animals, or plants that may be exposed to risks from contaminants related to a given site.

**Remedial Action:** A cleanup method proposed or selected to address contaminants at a site.

**Remedial Investigation (RI):** A study of a facility that supports the selection of a remedy where hazardous substances have been disposed or released. The RI identifies the nature and extent of contamination at the facility.

**Record of Decision (ROD):** A legal document that describes the cleanup action or remedy selected for a site, the basis for choosing that remedy, and public comment on the considered selected remedy.

**Site:** The area of the facility where a hazardous substance, hazardous waste, hazardous constituent, pollutant, or contaminant from the facility has been deposited, stored, disposed of, placed; has migrated; or otherwise come to be located.

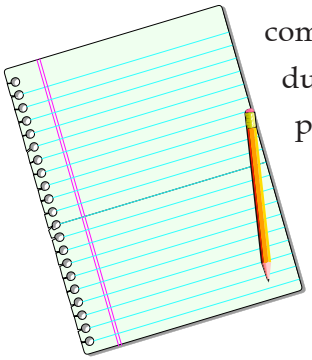
**Virginia Department of Environmental Quality (VDEQ):** The Commonwealth agency responsible for administration and enforcement of environmental regulations.

Please print or type your comments for PRAP Site 12 below.

## Mark Your Calendar for the Public Comment Period

### Public Comment Period
**May 2 – June 2, 2005**

### Submit Written Comments



The Navy will accept written comments on the Proposed Plan during the public comment period.

### Attend the Public Meeting

**Wednesday May 9, 2005 at 7:00 pm**
**Shelton Park Elementary School**
**1700 Shelton Road**
**Virginia Beach, VA 23455**

The Navy will hold a public meeting to explain the Proposed Plan and remedial actions conducted at the Site to date. Verbal and written comments will also be accepted at this meeting.

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Ms. Lora Fly
Commander, Navy Region Mid-Atlantic
Regional Environmental Group
Naval Weapons Station Yorktown
Building 406, Code N455
Yorktown, Virginia 23691