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EMAIL AND THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY COMMENTS ON THE REVISED DRAFT FINAL PROPOSED PLAN SITE 22 GROUNDWATER THE BURN PAD
NWS YORKTOWN VA
05/09/2012
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Marrow, Monica/VBO

From: Friedmann, William/VBO
Sent: Wednesday, May 09, 2012 4:38 PM
To: Sawyer, Stephanie/VBO
Cc: Forshey, Adam/VBO
Subject: FW: NWSY: Site 22 Revised Draft Final Proposed Plan - DEQ Comments
Attachments: Yorktown_Site22_PRAP_revised_draft final-05072012_redline(DEQ).docx

Follow Up Flag: Follow up
Flag Status: Completed

Stephanie,
Wade's comments on the draft final PP.
Bill

From: Smith, Wade (DEQ) [mailto:Wade.Smith@deq.virginia.gov]
Sent: Wednesday, May 09, 2012 9:29 AM
To: james.gravette@navy.mil
Cc: Friedmann, William/VBO; Forshey, Adam/VBO; Moshood Oduwole
Subject: NWSY: Site 22 Revised Draft Final Proposed Plan - DEQ Comments

The DEQ's comments are attached (track changes via Word).

Upon receipt of the requested revisions, the DEQ will issue an official letter for your files.

Please let me know if you have any questions.

Sincerely,

Wade M. Smith
Remediation Project Manager
Virginia Department of Environmental Quality
Office of Remediation Programs
Phone: (804) 698-4125
wade.smith@deq.virginia.gov

From: William.Friedmann@CH2M.com [mailto:William.Friedmann@CH2M.com]
Sent: Monday, May 07, 2012 5:13 PM
To: Oduwole.Moshood@epamail.epa.gov; Smith, Wade (DEQ)
Cc: james.gravette@navy.mil; Stephanie.Sawyer@CH2M.com; Adam.Forshey@CH2M.com; nvrouse@gmail.com
Subject: Revised Draft Final Site 22 Proposed Plan
Importance: High

Good Afternoon All,
Attached, for your review and approval, is the revised draft final PP for Site 22 that addresses EPA and VDEQ comments. If each of you can review the edits and approve changed text ***no later than Wednesday, May 9th*** so that we may proceed with placing the document in the library to start the 45-day review period. The public notice will appear in two newspapers this weekend and well will provide you copies of those announcements.

Moshood, this also includes language regarding evaluation of treatment effectiveness at the end Section 9. Note that the language does not specify performance standards (e.g. time X for reducing contaminants by X) as the ROD is not the place to define these but defers to the five-year. It is also common that the RA work plan will help define the performance and the routine LTM will support whether the remedy is functioning properly or needs to be re-evaluated.
Thanks,
Bill

William J. Friedmann, Jr.
Project Manager
Virginia Beach Office
5700 Cleveland St., Suite 101
Virginia Beach, VA 23462
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Draft Final Proposed Plan

Site 22 Groundwater: ~~The~~ Burn Pad

Naval Weapons Station Yorktown
Yorktown, Virginia

March 2012

1 Introduction

This **Proposed Plan** describes the preferred alternative for mitigating unacceptable human health **risks** due to exposure to **groundwater** at **Environmental Restoration Program (ERP) Site** 22, the Burn Pad, located on Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia. Groundwater is the only remaining environmental medium to be addressed at Site 22. A No Further Action (NFA) **Record of Decision (ROD)** was signed for **soil** at Site 22 in September 2003 and a~~n~~ NFA ROD for **sediment** and **surface water** at Site 22 was signed in September 2011.

~~This plan summarizes the remedial alternatives that were evaluated and provides the rationale for the preferred alternative selection for groundwater treatment on the site.~~ The preferred alternative consists of the following components: ~~three components: 1) Hot Spot Treatment of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) using **Enhanced In Situ Bioremediation (EISB)** and **Associated Performance Monitoring**; (2) **Monitored Natural Attenuation (MNA)** of RDX, trichloroethene (TCE), and vinyl chloride (VC); and (3) **Land Use Controls**.~~ 1) Refining the **conceptual site model (CSM)** through a pre-design investigation; 2) Implementing **Enhanced In Situ Bioremediation (EISB)** of RDX using emulsified vegetable oil (EVO) bio-barriers perpendicular to groundwater flow in the target treatment area with RDX above 100 micrograms per liter (µg/L) to accelerate the total time for achieving remedial goals (RGs); 3) Using **monitored natural attenuation (MNA)** for the dissolved trichloroethene (TCE) and vinyl chloride (VC) **plumes** and the remaining dissolved RDX plume (< 100 µg/L) following active treatment; 4) Conducting periodic groundwater monitoring and synoptic groundwater level measurements; 5) Enforcing **Land Use Controls** in the form of land and groundwater use restrictions (controls on intrusive activities, such as excavation, residential development, or groundwater use) until RGs are met. This plan summarizes the remedial alternatives that were evaluated and provides the rationale for the selection of the preferred alternative for Site 22 groundwater.

Please Mark Your Calendar

Public Comment Period

May 14 to June 28, 2012

The Navy will accept written comments on this Proposed Plan during the public comment period. To submit comments or obtain further information, please refer to the names and contact information included at the end of Section 7. A blank sheet has been added at the end of the document to be used for writing comments.

Attend the Public Meeting

May 24, 2012 at 3PM

York Co. Public Library - Yorktown
8500 George Washington Hwy,
Yorktown, VA 23692

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

Location of Administrative Record File:

NAVFAC Atlantic
6506 Hampton Boulevard, Norfolk, Virginia 23508
Phone: 757-322-4785

This Proposed Plan is issued jointly by the U.S. Navy (Navy), the lead agency for site activities, and the **U.S. Environmental Protection Agency (USEPA)** Region 3, the lead regulatory agency, in consultation with the **Virginia Department of Environmental Quality (VDEQ), t**he support regulatory agency.

This Proposed Plan will be available for public review and comment at the York County Public Library – Yorktown (8500 George Washington Memorial Hwy, Yorktown, Virginia 23692, (757) 890-3376) during a 45-day **public comment period** that includes a public meeting and fulfills participation responsibilities required under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**, as amended, and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**. The Navy and USEPA Region 3, in consultation with VDEQ, will make the final decision on this plan for Site 22 groundwater after reviewing and considering all information submitted during the 45-day public comment period.

In addition to presenting a preferred alternative for Site 22 groundwater, this Proposed Plan summarizes previous CERCLA investigations that have been conducted at Site 22 for groundwater and~~,~~ NFA RODs for soil, waste, sediment, and surface water that have already been signed. Information documenting all environmental investigations at Site 22 (including soil, waste, sediment, and surface water) is available to the public in the **Administrative Record (AR)** file for WPNSTA Yorktown. Details regarding the dates of the public comment period, the date and time of the public meeting, and the location of the AR are included in the text box entitled "Please Mark Your Calendar" on the first page of the plan. In addition, a glossary of key terms is provided at the end of this Proposed Plan; glossary terms are identified in bold print the first time they appear.

2 Site Background

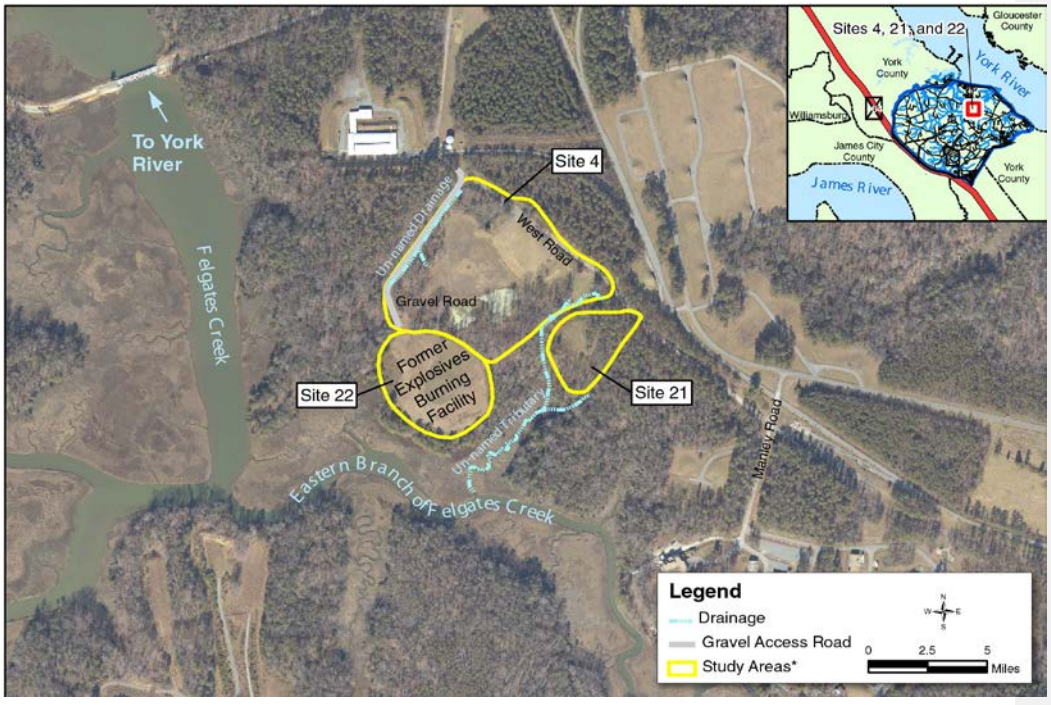

Figure 1 –Location of Site 22

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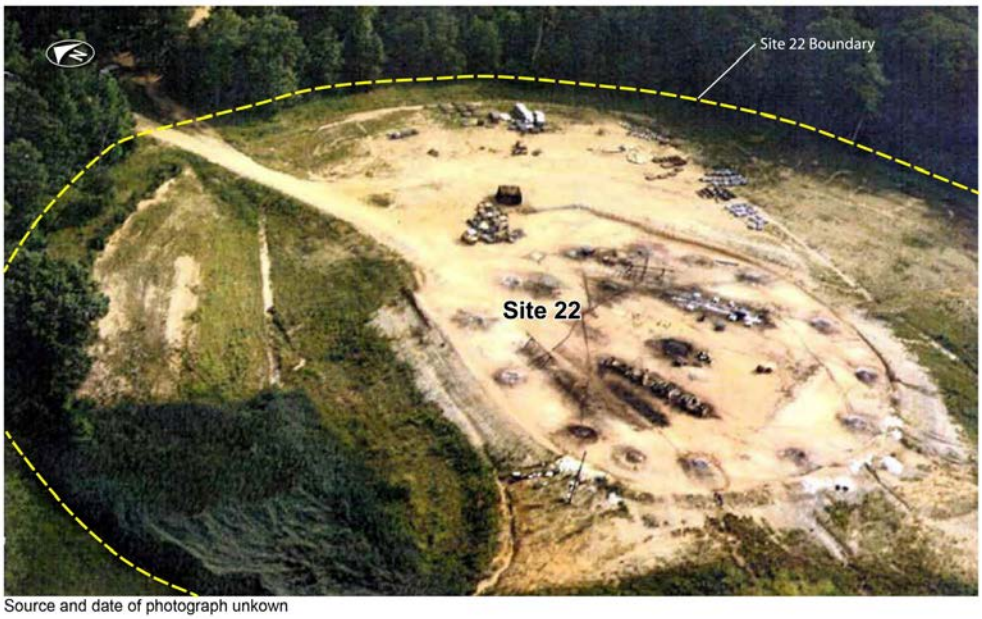
Site 22, the Burn Pad, encompasses a 9 acre area, located in the northeastern portion of WPNSTA Yorktown. The site is adjacent to and south of Site 4 (Burning Pad Residue Landfill) and west of Site 21 (Battery and Drum Disposal Area). An access road runs north-south along the west side of Site 4 and provides vehicle access to Site 22 from the north (Figures 1 and 2). Site 22 consists of a grassy field surrounded by woods, situated on a flat, elevated area with its ground surface sloping steeply to the east, south, and southwest toward the Eastern Branch of Felgates Creek and its unnamed **tributary**.

Site 22 was reportedly used for burning waste explosives and disposing of **spent solvents** generated from loading operations. The ash from the burned solvents and explosives was then transported to the landfill at Site 4. Burning was conducted at the site from the early 1940s until 1995. A removal action was completed in 2002 to remove contaminated soils from Site 22.

A ROD was signed in 2003 documenting that no further action was necessary for soil at Site 22. A ROD documenting that no further action was necessary for sediment and surface water at Site 22 was signed in September 2011.

Previous Groundwater Investigations and Actions

Groundwater at Site 22 has been characterized as part of several investigations since 2001. ~~Detailed information from these investigations is available in the AR for WPNSTA Yorktown.~~ In addition, detailed information from soil, surface water, and sediment investigations ~~are~~ is also available in the AR for WPNSTA Yorktown. The investigations conducted for groundwater at Site 22 are listed in Table 1 and summarized in the paragraphs below.



Source and date of photograph unkown

Figure 2 – Site 22 Historical Aerial Photograph

Table 1 - Documents Summarizing Previous Groundwater Studies at Site 22

Document Title/Milestone	Author/Date	AR Document Number
Round Two Remedial Investigation Report[1]	Baker, 2001	01296-01298
Remedial Investigation Report for Groundwater at Sites 4, 21, and 22.	CH2M HILL, 2009	000024

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~~Final~~ Feasibility Study Report for Groundwater at Site 22.	CH2M HILL, 2011	000181

[1] Although Site 22 had not been previously investigated, the Navy, in partnership with USEPA and VDEQ, agreed to include Site 22 in the ~~round~~ Round Two RI for Sites 4 and 21.

Round Two Remedial Investigation Report, Sites 4, 21, and 22, Naval Weapons Station Yorktown (Baker, 2001)

As part of the Round Two **Remedial Investigation (RI)**, soil, groundwater, sediment, and surface water were evaluated at Site 22; the Navy, in partnership with USEPA and VDEQ, agreed to address groundwater, surface water, and sediment separately from soil. The results of the Round Two RI indicated the presence of chlorinated **volatile organic compounds (VOCs)**, explosives, and metals in groundwater. Semivolatile organic compounds (SVOCs) and metals were detected in surface and subsurface soils. The team progressed with evaluating remedial alternatives for soil while an alternative evaluation for groundwater was postponed pending the results of further evaluation of the site groundwater.

Remedial Investigation Report for Groundwater at Sites 4, 21, and 22, Naval Weapons Station Yorktown (CH2M HILL, 2009)

Following completion of the removal action to address contaminated soil at Site 22, the Navy in partnership with USEPA and VDEQ agreed to conduct additional investigations of groundwater, surface water, and sediment. Because surface runoff from Sites 4, 21, and 22 is directed into the same surface water bodies, the surface water and sediment evaluation for Sites 4, 21, and 22 was performed as one study. The results of the 2009 RI Report demonstrated that exposure to surface water and sediments at Sites 4, 21, and 22 did not pose any unacceptable human health or **ecological** risks. Because RDX, TCE, and VC ~~and RDX~~ were identified at unacceptable levels in the upper portion of the Yorktown-Eastover **aquifer**, additional action was recommended to address groundwater.

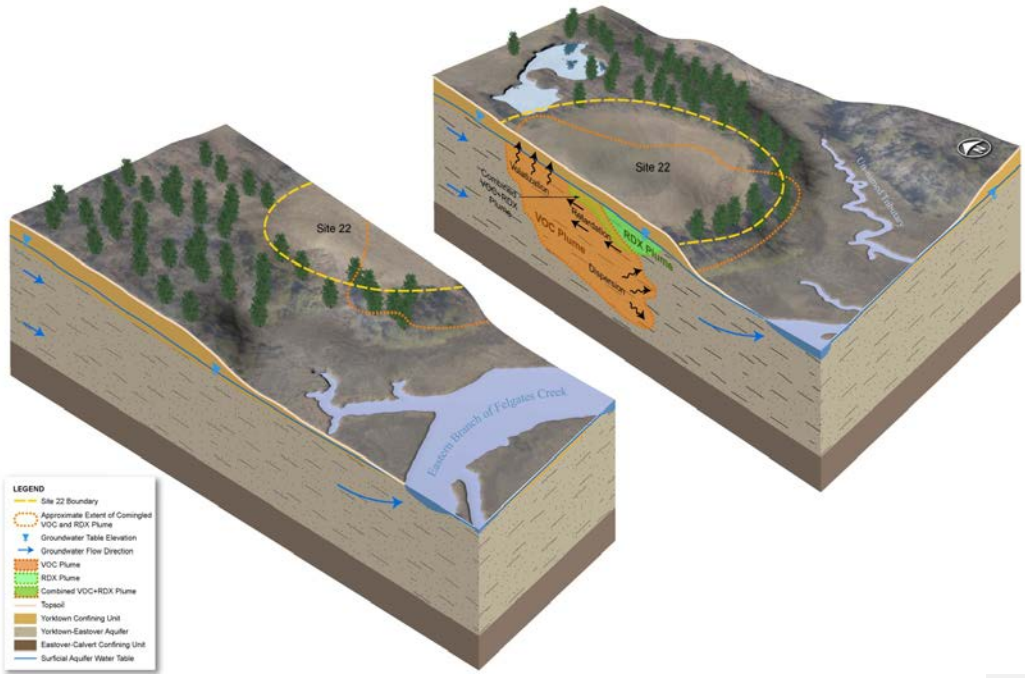

Figure 3 – Conceptual Site Model

Feasibility Study Report for Groundwater at Site 22 (CH2M HILL, 2011)

The **Feasibility Study (FS)** was generated to evaluate alternatives for remediation of RDX, TCE, and VC ~~, and RDX~~ present at unacceptable levels in the groundwater. The preferred alternative as presented in the FS was Alternative 2—Hot Spot Treatment of RDX using EISB and **Associated Performance Monitoring**; MNA of RDX, TCE, and VC ~~and RDX~~; and LUCs.

3 Site Characteristics

A CSM (Figure 3) illustrates site conditions, contaminant distribution, potential **receptors**, exposure pathways, and land use for Site 22. Site 22 consists primarily of a flat, grass-covered open area surrounded by wooded areas. The southern and eastern edges of the site slope steeply toward the east, south, and southwest toward the Eastern Branch of Felgates Creek and its unnamed tributary. The site is located within a restricted area of WPNSTA Yorktown ~~and is currently not used~~ with access limited by a locked wire gate.

The **geology** at Site 22 consists of unsaturated soils at the ground surface, which are lithologically consistent with the Yorktown **confining unit**. The uppermost saturated unit in the Site 22 area is the Yorktown-Eastover aquifer, which lies below the 10-to 20-foot (ft) thick Yorktown confining unit. The Yorktown-Eastover aquifer consists of coarse, shelly, gray sands. The Yorktown-Eastover aquifer is approximately 80 feet thick in the vicinity of Site 22 and overlies the approximately 100-to 200-ft thick Eastover-Calvert confining unit. There is no current or expected future use for groundwater at Site 22; drinking water is supplied to WPNSTA Yorktown and the surrounding area by the City of Newport News Waterworks. However, the Commonwealth of Virginia regards all groundwater as a potential drinking water source.

3.1 Nature and Extent of Contamination

Field activities were conducted in 2007 and 2008 to investigate the nature and extent of groundwater constituents at Site 22 and downgradient in the Eastern Branch of Felgates Creek. Results indicated that detected TCE and VC concentrations exceeded their respective **Maximum Contaminant Levels** (**MCLs)** in shallow groundwater, and RDX concentrations exceeded its **Regional Screening Level (RSL)** in shallow groundwater . TCE was detected in samples from nine of 12 shallow monitoring wells, exceeding the MCL (~~5~~ µg/L) in five wells. VC was detected in samples from two of 12 shallow monitoring wells at concentrations exceeding the MCL (2 µg/L). One pesticide, heptachlor epoxide, was detected in seven samples ranging from 0.03 µg/L to 0.21 µg/L, exceeding its RSL at four locations, but only one sample concentration (0.21 µg/L) slightly exceeded the MCL (0.2 µg/L) ~~from a number of wells at concentrations ranging from 0.03 µg/L to 0.21 µg/L, which exceeded the regional screening levels (RSL) (0.0074 µg/L) and MCL (0.2 µg/L) in one sample. RDX exceeded the RSL (0.61µg/L).~~ . Arsenic was detected in 4 of the dissolved samples at concentrations ranging from 3.6 J µg/L to 8.8 J µg/L. These concentrations exceeded the tap water RSL of 0.045 µg/L, but were less than the MCL of 10 µg/L. RDX was detected in samples from 10 of the 12 shallow monitoring wells. All the detections of RDX exceeded the RSL (0.61 µg/L).

The RDX, TCE, and VC ~~, and RDX~~ contamination is present in a "corridor" that runs through the middle of Site 22 from north to south (Figure 4). Analytical results indicated the VOCs detected in groundwater at Site 22 were within the upper portion of the Yorktown-Eastover aquifer and consisted of chlorinated VOCs, primarily TCE and VC. The highest concentrations of TCE and VC were detected between 10 and 50 feet below ground surface (bgs) along the central portion of the site in sandy soil containing a number of silt and clay stringers that may be retarding the downward mobility of the contaminants. No **constituents of concern (COCs**) were identified in samples taken from the base of the Yorktown-Eastover aquifer, just above the ~~Eastover~~ Eastover-Calvert confining unit. Contaminant discharge to surface water via groundwater was not found to occur at Site 22; groundwater is therefore not a continuing source of contaminants to the aquatic habitats adjacent to the site.

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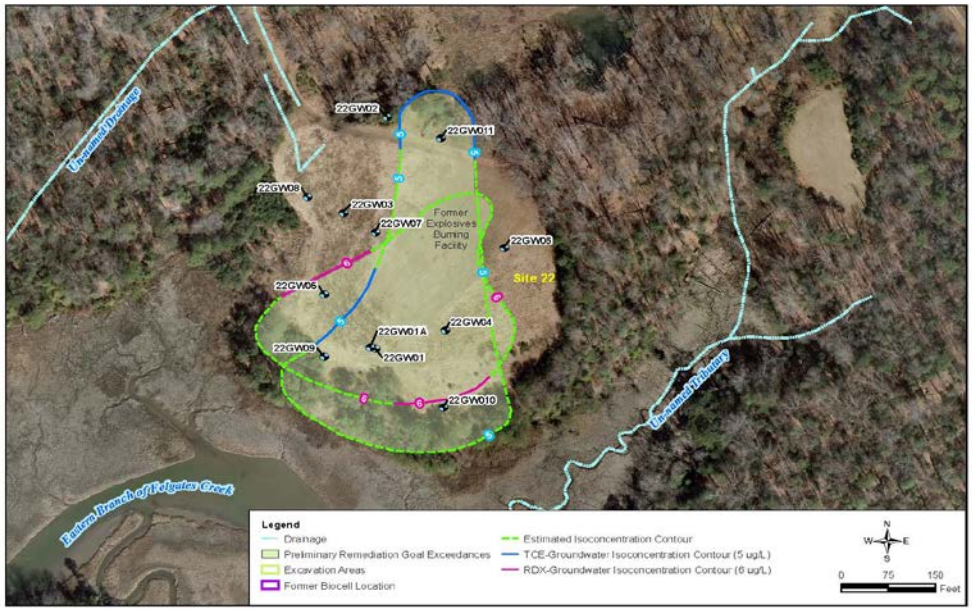

Figure 4 - Remedial Goal Exceedances RDX and TCE

Maximum detected concentrations of the COCs are provided in Table 2. Additional action is necessary to address these COCs.

Table 2 - Maximum Detected Concentrations for Constituents of Concern

VOCs	Concentration (µg/L)
Trichloroethene	650
Vinyl Chloride	17
Explosives	**Concentration (µg/L)**
RDX	150

3.2 Fate and Transport of Contamination

The primary source of contamination was the release of chemicals that occurred during waste handling and the burning of materials on the ground surface at Site 22. The contaminants that were released to the ground surface leached into the soil as a result of infiltration of surface water, causing downward migration of contamination into subsurface soil and ultimately creating a **dissolved phase groundwater plume** (TCE and VC). The primary mechanism for reductions in chlorinated VOC concentrations under naturally occurring conditions is degradation. Geochemical and microbial samples collected from two wells at the site indicate that the site exhibits reducing conditions, which are ideal for the **biodegradation** of organic compounds. The presence of the TCE degradation product VC is further evidence that natural biodegradation is occurring at the site. The source of the RDX is most likely scattered minor releases from the burn activities previously conducted at the site. RDX can be biodegraded under most redox conditions and a variety of microorganisms. Since all contaminated soil was excavated and disposed of offsite in the fall of 2002, contaminant concentrations in the shallow groundwater are likely to decrease in the future because no source is present and there is no current ongoing release mechanism.

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Samples from two wells on the site identified the presence of ***Dehalococcoides species*** **(DHC)** demonstrating the potential for natural degradation of VOCs since this microbe is capable of degradation of chlorinated ethenes (such as TCE).

3.3 Principal Threats

"Principal threat wastes" are source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed. The contaminated soil has been removed from the site. Contaminated groundwater generally is not considered to be a source material; and~~,~~ VOC concentrations are below 1 percent aqueous solubility of each COC, indicating that groundwater contamination consists of a dissolved phase plume with no **dense non-aqueous phase liquid (DNAPL**) present. Therefore, the groundwater at Site 22 is not considered to be a principal threat waste.

4 Scope and Role of Response Action

WPNSTA Yorktown was placed on the **National Priorities List (NPL)** in October 1992. A **Federal ~~Facilities~~ Facility Agreement (FFA)**, signed in 1994, identified 16 Sites for remedial investigation and 19 **Site Screening Areas (SSAs)** for the **Site Screening Process (SSP)**. Subsequent to the FFA, six additional SSAs were identified for consideration under CERCLA. A summary of how the Navy, in partnership with the USEPA Region 3 and VDEQ, is addressing all CERCLA sites at WPNSTA Yorktown is provided in the **Site Management Plan**, which is updated annually and available in the AR file.

The Preferred Alternative presented in this Proposed Plan is intended to mitigate all unacceptable risks to human health from groundwater at Site 22 and is intended to be the final remedy for groundwater at the site. Because other relevant environmental **media** (soil, sediment and surface water) at Site 22 have already been addressed in NFA RODs, this action represents the final action for Site 22.

5 Summary of Site Risks

It is the current judgment of the Navy and USEPA, in consultation with VDEQ, that the Preferred Alternative or one of the other active remedial alternatives identified in this Proposed Plan is necessary to protect human health from actual or threatened releases of hazardous substances (RDX, TCE, and VC) into the environment. ~~from actual or threatened exposure to TCE, VC, and RDX in the shallow groundwater at Site 22.~~ Results of the human health and the ecological risk assessments conducted on the groundwater at Site 22 are presented in the 2009 RI report and are summarized below. Risk management decisions affecting this Proposed Plan are also discussed. General information regarding how human health ~~and ecological risk~~ evaluations are conducted is provided in the text box ~~es~~ within this section.

5.1 Human Health Risks

A **Human Health Risk Assessment (HHRA)** evaluated the risks for current and potential future site use (see text box, "What is Human Health Risk and How is it Calculated?") associated with current receptors (of which there are none) and hypothetical future receptors (construction workers, adult residents, child residents, lifetime residents) and exposure scenarios (**ingestion**; **dermal contact**; and inhalation, through showering or breathing indoor air) if no **R~~r~~emedial A~~a~~ction** was implemented for the groundwater (CH2M HILL, 2009). Health risks are based on a conservative estimate of the potential **cancer risk** and the potential to cause other health effects not related to cancer (**non-cancer hazard**, or **hazard index [HI]**). USEPA i~~n~~dentifies an acceptable cancer risk range of 1 in 10,000 (10^{-4}) to 1 in 1 million (10^{-6}) and a non-cancer hazard as an HI of less than or equal to 1.

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Based upon current site use and conditions, there are no complete **exposure pathways** for groundwater at Site 22. Site 22 is within a restricted area of WPNSTA and is secured with a locked wire gate. In addition, the site is located inside an area encumbered by the **Explosive Safety Quantity Distance (ESQD)** ~~which~~ that limits the activities that can be performed within the ESQD to explosives-related functions. Nevertheless, the human health risk evaluation performed for potential future land use included future lifetime adult/child residents and future construction workers as receptors. The potential exposure pathways included inhalation/ ingestion of and dermal contact with shallow groundwater for hypothetical future lifetime adult and child residents and ingestion and dermal contact with shallow groundwater for hypothetical future construction workers.

RDX, TCE, ~~heptachlor epoxide~~VC, heptachlor epoxide,~~RDX~~ and arsenic were identified as potential human health COCs within the Yorktown-Eastover aquifer at Site 22 under a future resident or construction worker exposure scenario.

Using conservative assumptions (**Reasonable Maximum Exposure [RME]** scenario), the HHRA for Site 22 determined that risks to future adult and child residents and future construction workers were above acceptable limits~~the acceptable risk range of 10^{-6} to 10^{-4} under the NCP~~. The total RME cancer risk for a future lifetime resident (7.6×10^{-4}) exceeded the acceptable risk range (Table 3). The RME non-cancer hazard for adult (3.8) and child residents (8.7) exceeded the acceptable HI of 1.0. In addition, the total RME cancer risk for the future construction worker (4.9×10^{-5}) falls within the acceptable risk range of 10^{-6} to 10^{-4} (Table 3). The RME non- cancer hazard for a future construction worker (3.7) exceeded the acceptable HI of 1.0.

Although arsenic and heptachlor epoxide contributed to the total RME cancer risk to a future lifetime resident, the Navy in partnership with USEPA and VDEQ agreed that no additional action is required for these constituents for the following reasons:

- Although arsenic was considered a human health COC under the RME scenario, concentrations of arsenic did not pose risk under the **central tendency exposure (CTE)** scenario
- Dissolved arsenic concentrations did not exceed the MCL (10µg/L)
- Arsenic concentrations reflect **geochemical conditions** rather than a site-related CERCLA source
- Heptachlor epoxide, only slightly exceeded the MCL (0.2 µg/L) in one sample
- The low concentrations of heptachlor epoxide at Site 22 suggest its presence is attributable to routine pesticide treatment activities by the base and not a CERCLA-related release.

What is Human Health Risk and How is it Calculated?

A ~~Human Health Risk Assessment (~~**HHRA**~~)~~, which estimates the likelihood of health problems occurring if no cleanup action were taken, consists of 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**, comparisons of the concentrations of site chemicals to scientific studies on the effects those chemicals have on people help identify which chemicals pose the greatest threat to human health.

In **Step 2**, the Navy considers different ways people might be exposed to chemicals, the concentrations, how often, and how long they may be exposed in order to assess 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 **toxicity** information, to assess potential health risks. The Navy considers two types of risk: (1) cancer risk and (2) non-cancer hazard. The likelihood of any type of cancer resulting from a contaminated site is generally expressed as a probability: "1 in 10,000 chance" (for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure). For non-cancer health effects, the Navy calculates a "hazard index" (HI), which is the ratio between the "reference dose," (the dosage at which no adverse health effects are expected), and the RME. A "threshold level" (HI less than 1) exists below which non-cancer health effects are no longer predicted.

In **Step 4**, the Navy calculates whether site risks are high 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.

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Table 3 - RME Risks and Hazards for Site 22 COCs

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI >1
Future Resident Adult	Yorktown Aquifer Groundwater	Ingestion	N/A				2.9E+00	
		Dermal Contact	N/A				8.0E-01	
		Inhalation/Shower	N/A				1.0E-01	
		Total	N/A				3.8E+00	
Future Resident Child	Yorktown Aquifer Groundwater	Ingestion	N/A				6.8E+00	RDX, Arsenic
		Dermal Contact	N/A				1.8E+00	Heptachlor epoxide
		Inhalation/Shower	N/A				N/A	
		Total	N/A				8.7E+00	
Future Resident Adult/Child	Yorktown-Eastover Aquifer Groundwater	Ingestion	6.4 x 10-4	Vinyl Chloride, RDX, Arsenic	1,2-Dichloroethane, Tetrachloroethene, Trichloroethene, Heptachlor epoxide	Benzene, carbon Tetrachloride, Chloroform	N/A	
		Dermal Contact	8.4 x 10-5	None	Tetrachloroethene, Trichloroethene, Heptachlor epoxide	1,2-Dichloroethane, Carbon tetrachloride Chloroform, Vinyl chloride	N/A	
		Inhalation/Shower*	3.3 x 10-5	None	Trichloroethene	1,2-Dichloroethane, Benzene, Carbon tetrachloride, Vinyl chloride, RDX	N/A	
		Total	7.6 x 10-4	--	--	--	N/A	
Future Construction Worker – Adult	Yorktown-Eastover Aquifer Groundwater	Ingestion	N/A	None	None	None	N/A	
		Dermal Contact	1.2 x 10-6	None	None	None	4.7E-01	
		Inhalation	4.8 x 10-5	None	1,2-Dichloroethane, Trichloroethene	Benzene, Carbon tetrachloride, Chloroform, Vinyl chloride	3.3 E+00	
		Total	4.9 x 10-5	--	--	--	3.7E-+00	

N/A = Not Applicable
*Calculated for adult only

- The HHRA concluded that in the upper portion of the Yorktown-Eastover aquifer, TCE and VC in groundwater exceed MCLs and pose potential risk under hypothetical future exposure scenarios. No MCL exists for RDX, but the concentrations were found to pose potential risk under hypothetical future exposure scenarios. COCs were not detected above MCLs or RSLs in the deep portion of the Yorktown-Eastover aquifer. The Navy in partnership with USEPA and VDEQ agree ~~r~~Remedial Aa~~c~~tion for groundwater is only necessary to address TCE, VC, and RDX in the upper portion of the Yorktown-Eastover aquifer.

Table 4- Remediation Goals for COCs at Site 22

Constituent of Concern	Remediation Goal (µg/L)
Trichloroethene	5 µg/L
Vinyl Chloride	2 µg/L
RDX	6 µg/L

Ecological Risk Assessment

An **Ecological Risk Assessment (ERA)** was also completed for groundwater as a transport medium since there are no ecological exposures to groundwater until it **discharges** to a water body or to the ground surface as a **seep**. Therefore, groundwater was considered qualitatively during the ERA, but was not evaluated as an ecologically relevant medium. Since no ecological COCs were identified for surface water, sediment, or seep exposures at Site 22 (NFA ROD signed in September 2011), the source areas at Site 22 were removed during the previous removal action, and groundwater is not a significant continuing source of contaminants to the aquatic habitats adjacent to the site, the Navy, USEPA Region 3, and VDEQ agreed that Site 22 groundwater does not pose unacceptable ecological risks.

6 Remedial Action Objectives

Remedial Action is necessary to protect human health from exposure to the site-related COCs RDX, TCE, and VC~~, and RDX~~ within the groundwater at Site 22. Therefore, the following **remedial action objectives (RAOs)** were established for Site 22 groundwater:

- To reduce RDX, TCE, and VC~~, and RDX~~ concentrations in groundwater to established risk-based **remedial goals (RGs)**.
- To maintain LUCs to prevent human (residential and construction worker) exposure to groundwater until RGs are met.

The ESQD arc does not impact the RAOs for the site. The ESQD arc will be in effect as long as ordnance and munitions activities are being conducted at WPNSTA Yorktown. The RAO to maintain LUCs is necessary in the event that ordnance activities and development restrictions posed by the ESQD arc are discontinued at WPNSTA Yorktown.

RGs were developed for those site-related COCs (TCE, VC, and RDX) with cancer risks exceeding 1 in 10,000, or with concentrations exceeding the established MCLs (Table 4). MCLs were used to establish the groundwater RGs for TCE and VC (5 µg/L and 2 µg/L, respectively). MCLs are considered to be protective and allow for **unlimited use and unrestricted exposure.** Because no MCL has been established for RDX, a risk-based RG of 6µg/L was calculated. The RG for RDX was determined based on **Remedial Goal Option (RGO)** calculations~~, (USEPA, 1991),~~ which incorporate pathways for the ingestion, dermal absorption, and inhalation of volatiles and particulates for future residents and the same exposure assumptions as the HHRA.

7 Summary of Remedial Alternatives

The remedial alternatives developed and evaluated to address COCs in groundwater at Site 22 are detailed in the FS Report (CH2M HILL, 2011). Following the initial screening of groundwater remediation technologies, the following remedial alternatives were selected for detailed evaluation and comparative analysis:

- Alternative 1: No action
- Alternative 2: Hot Spot Treatment of RDX using EISB and Associated Performance Monitoring; MNA of RDX, TCE, and VC, ~~and RDX;~~and LUCs
- Alternative 3: Hot Spot Treatment of RDX, TCE and VC using **In Situ Chemical Oxidation (ISCO)** and Associated Performance Monitoring; MNA of RDX, TCE, and VC ~~and RDX~~; and LUCs
- Alternative 4: Hot Spot Treatment of RDX, TCE, and VC~~, and RDX~~ using EISB and Associated Performance Monitoring; MNA of RDX, TCE, and VC~~TCE, RDX and VC~~; and LUCs

Based on the results of the alternative evaluation, Hot Spot Treatment of RDX using EISB and Associated Performance Monitoring; MNA of RDX, TCE, and VC ~~TCE, VCE, and RDX;~~ and LUCs (Alternative 2) was selected as the Preferred Alternative. With the exception of the no- action alternative (Alternative 1), each of the alternatives includes monitoring and implementation of LUCs to prevent unacceptable risk exposure. Alternative 1 is required by the NCP and serves as the baseline against which the other alternatives are compared. For Alternatives 2, 3, and 4, monitoring and LUCs would be maintained until the RAOs are met, with 5-year statutory reviews to ensure protection of human health and the environment. A description of each remedial alternative is provided in Table 5.

8 Evaluation of Remedial Alternatives

The NCP identifies nine evaluation criteria for use in a comparative analysis of remedial alternatives (Table 5). Each remedial alternative for Site 22 groundwater was evaluated against

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these criteria (Table 6) and in comparison to one another. Alternative 1 (no action) does not protect human health and the environment, is not effective in the long term, and does not reduce toxicity, mobility, or volume through treatment. Therefore, Alternative 1 serves only as a baseline.

Threshold Criteria

Protection of Human Health and the Environment

Alternatives 2, 3, and 4 are all protective of human health and the environment. All three alternatives rely to some degree on MNA to reduce the concentrations of site-related COCs plus LUCs to prevent contaminant exposure. The time estimated for each of the three remedial alternatives (not including the ~~No~~ no ~~Action~~ action alternative) to reach RAOs ranges from 25 to 34 years. Alternative 2 employs EISB to reduce RDX concentrations in a faster timeframe than would occur naturally. Alternative 3 employs ISCO to reduce concentrations in the RDX, TCE and VC target areas to reduce the remedial timeframe, and Alternative 4 uses EISB to reduce concentrations in the RDX, TCE and VC target areas to shorten the remedial timeframe.

Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives 2, 3, and 4 are expected to comply with **applicable or relevant and appropriate requirements (ARARs)**. Alternatives 2, 3, and 4 would all require measures to be taken to establish performance monitoring and LUCs. All of these alternatives would also require additional measures to ensure compliance with ARARs related to the injections of reagents into the subsurface.

Table 5 - Description of Remedial Alternatives for Site 22

Alternative	Components	Details	Cost
1-No Action	None	Allow the COCs to breakdown naturally over time.	**Capital Cost**: $0 **O&M Present Value:** $0 **Total Present Value:** $0
2-Hot Spot Treatment of RDX using EISB and Associated Performance Monitoring, MNA of RDX, TCE, and VC ~~TCE, VC, and RDX~~; and LUCs	• Refining the conceptual site model (CSM) through a pre-design investigation • Implementing EISB of RDX in areas where concentrations exceed 100 µg/L using emulsified vegetable oil bio-barriers • MNA for dissolved RDX, TCE, and VC ~~TCE, VC, and RDX~~ plumes where concentrations are less than100µg/L • Conducting periodic groundwater monitoring and groundwater level measurements • LUCs	Injecting a suitable insoluble substrate to the subsurface enhances the biodegradation of RDX by providing a carbon source for microorganisms to grow. Regular, long-term monitoring performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the Remedial Action LUCs prevent exposure and control changes in site use.	**Capital Cost:** $708,026 **O&M Present Value**:$1,028,565 **Total Present Value**:$1,907,000
3-Hot Spot Treatment of RDX, TCE and VC using ISCO and Associated Performance Monitoring; MNA of RDX, TCE, and VC ~~TCE, VC and RDX;~~ and LUCs	• Refining the conceptual site model (CSM) through a pre-design investigation • ISCO using permanganate (MN04) in active target treatment areas where TCE, VC, and RDX concentrations exceed100 µg/L • MNA for RDX, TCE, and VC ~~TCE, VC and RDX~~ areas where concentrations are less than100 µg/L • Periodic groundwater monitoring and water-level measurements • LUCs	Injection of oxidizing agent to promote **abiotic** in situ oxidation of COCs through reaction of **oxidants** with COCs to produce **innocuous** substances such as carbon dioxide (CO_2), water, and chloride. Electron donor source is provided to enhance naturally occurring **reductive dechlorination** process. Regular, long-term monitoring performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the Remedial Action LUCs prevent exposure and control changes in site use.	**Capital Cost:**$1,228,931 **O&M Present Value**:$833,902 **Total Present Value**:$2,482,000
4-Hot Spot Treatment of RDX, TCE, and VC ~~TCE, VC, and RDX~~ using EISB and Associated Performance Monitoring; MNA of TCE, RDX and VC; and LUCs	• Refining the conceptual site model (CSM) through a pre-design investigation • EISB of RDX and TCE/VC using Emulsified Vegetable Oil bio-barriers in areas with TCE, VC, and RDX concentrations greater than 100 µg/L • MNA for remaining RDX, TCE, and VC areas where concentrations are less than100µg/L • Conduct periodic groundwater monitoring and groundwater level measurements • LUCs	Injection of substrates into groundwater to facilitate reductive chlorination, thereby producing an electron donor source for biodegradation. Regular, long-term monitoring performed to demonstrate that: • COC concentrations continue to decrease • Potentially toxic transformation products are not created at levels that are a threat to human health • Impacted area is not expanding • There are no changes in hydrogeological, geochemical, or microbiological parameters that might reduce the effectiveness of the Remedial Action LUCs prevent exposure and control changes in site use.	**Capital Costs**: $1,024,061 **O&M Present Value**: $994,759 **Total Present Value**: $2,718,000

Table 6- Evaluation Criteria for Remedial Alternative Analysis

CERCLA Criteria	Definition
Threshold Criteria	
Protection of Human health and the environment	Addresses whether an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through mitigation, engineering controls, or institutional controls
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	Addresses whether an alternative will meet all of the ARARs of other federal and state environmental laws and/or justifies a waiver of the requirements
Primary Balancing Criteria	
Long-term effectiveness and permanence	Addresses the expected residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time, once clean-up goals have been met
Reduction in toxicity, mobility, or volume through treatment	Discusses the anticipated performance of the treatment technologies an alternative 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 cleanup goals are achieved
Implementability	Evaluates the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement an option
Present-worth cost	Compares the estimated initial, operations and maintenance, and present-worth costs
Modifying Criteria	
State acceptance	Considers the state agency comments on the Proposed Plan
Community acceptance	Provides the public's general response to the remedial alternatives described in the Proposed Plan, RI report, and the FS report. The specific responses to the public comments are addressed in the "Responsiveness Summary" section of the ROD.

8.1 Primary Balancing Criteria

Long-term effectiveness and permanence

Except for Alternative 1, all alternatives are expected to be effective in the long-term and be a permanent means of reducing the concentration of RDX, TCE, and VC~~TCE, VC, and RDX~~. Once RAOs are achieved, all alternatives, except Alternative 1, are expected to have **residual risks** of the same magnitude. Some residual risk will be apparent because Alternatives 2, 3, and 4 rely on monitoring and LUCs. Some emissions (NO_x [nitrogen oxide]), PM10 [particulate matter less than 10 micrometers in aerodynamic diameter], and CO_2 associated with greenhouse gas [GHG] and **criteria pollutants**) from reagent production, transportation, and heavy machinery use may persist for an extended period after RAOs are achieved. For each alternative, with planning and implementation, the controls put in place would effectively verify continued compliance with RAOs.

Reduction in toxicity, mobility, or volume through treatment

Alternatives 2, 3, and 4 are each expected to reduce toxicity, mobility, and volume by treating the groundwater, which is a statutory preference. Also, while MNA is not considered a treatment, the natural reduction of contaminant concentrations through a variety of physical, chemical, or biological activities is expected to occur over time.

Short-term effectiveness

The short-term effectiveness associated with Alternatives 2, 3, and 4 are similar with regard to how they affect the community and the local environment. It is expected that all three of these alternatives will take between 6 and 8 weeks for installation to be complete. Alternative 1 would not negatively affect the community or the local environment, as the site would not be changed from current conditions. Alternatives 2, 3, and 4 all rely on direct injection technology for implementation. The community would be impacted due to the transportation of injection materials and the generated investigation-derived waste. Alternative 2 would least impact the environment due to a lower amount of construction or intrusive activities and environmental impacts. Alternative 4 will have the highest amount of intrusive activities and would generate the most GHG with heavy machinery use. With the exception of no action, Alternative 2 provides the greatest short-term effectiveness due to its minimization of intrusive activities compared to Alternatives 3 and 4.

Implementability

Alternatives 2, 3 and 4 can each be implemented using standard and widely available technologies. These three alternatives (2, 3, and 4) require engineering and construction services, and each alternative requires thorough monitoring to ensure they continue to operate on a path toward achieving RAOs. Each of the three alternatives (2, 3 and 4) are reliable provided they are designed and implemented correctly.

Cost

An order of magnitude (OOM) cost for each alternative has been estimated based on an assumed 35-year project life. The estimated capital cost for implementation of Alternative 2 ($708,026) is less than that of Alternative 3 ($1.2 million) or Alternative 4 ($1.0 million). The estimated present value cost for Alternative 2 is $1.9 million, less than for Alternative 3 ($2.4M) and Alternative 4 ($2.7M). Alternative 2 has a lower capital cost due to the type and quantity of injection materials.

Table 7 provides a relative ranking of the four alternatives.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA remedy selection process. The State supports the Preferred Alternative, Alternative 2, and their final concurrence will be solicited following the review of all comments received during the public comment period.

Table 7 - Relative Ranking of Remedial Alternatives

CERCLA Criteria	No Action (1)	EISB and Performance Monitoring of RDX with MNA and LUCs (2)	ISCO and Performance Monitoring of RDX and VOCs with MNA and LUCs (3)	EISB and Performance Monitoring of RDX and VOCs with MNA and LUCs (4)
Threshold Criteria				
Protection of human health and the environment	❍	●	●	●
Compliance with ARARs	N/A	●	●	●
Primary Balancing Criteria				
Long-term effectiveness and permanence	❍	●	●	●
Reduction in toxicity, mobility, or volume through treatment	❍	●	●	●
Short-term effectiveness	❍	◘	◘	◘
Implementability	●	◘	◘	◘
Cost	N/A	●	◘	◘

Ranking: ● High ◘ Moderate ❍ Low N/A=Not Applicable

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

Community Acceptance

Community acceptance will be evaluated after the public comment period for the Proposed Plan, and public comments will be addressed and documented in the forthcoming ROD for Site 22 Groundwater.

9 Preferred Alternative

Based on the comparative analysis, the Preferred Alternative is Alternative 2, consisting of three components: (1) Hot Spot Treatment of RDX using EISB and Associated Performance Monitoring; (2) MNA of RDX, TCE, and VC; and (3) LUCs.

Based on the comparison of alternatives utilizing the NCP criteria, Alternatives 2 through 4 perform very similarly. All are capable of achieving clean up goals. The time estimated for each of the three remedial alternatives (not including the ~~No~~ no ~~Action~~ action alternative) to reach RAOs ranges from 25 to 34 years. Alternative 2 employs EISB to reduce the remedial timeframe in the RDX target area, Alternative 3 employs ISCO to reduce the remedial timeframe in the RDX, TCE, and VC target areas, and Alternative 4 uses EISB to reduce the remedial timeframe in the RDX, TCE, and VC target areas. All alternatives (Alternatives 2 through 4) rely to some degree on MNA to reduce the concentrations of site-related COCs plus LUCs to maintain protectiveness of human health and the environment until RAOs are achieved.

Alternatives 3 and 4 are similar in cost; however, Alternative 2 is the most cost-effective. Further, in accordance with the Navy's vision for Sustaining Our Environment, each alternative was evaluated using the approach described in the 2009 NAVFAC Sustainable Environmental Remediation guide ~~(NAVFAC, 2009)~~ under each of the NCP Criteria for Site 22. The eight sustainability metrics include: Energy Consumption, GHG Emissions, Criteria Pollutant Emissions, Water Impacts, Ecological Impacts, Resource Consumption, Worker Safety, and Community Impacts. The rankings in the sustainability evaluation for Alternatives 2, 3, and 4 were similar. Alternative 2 had the lowest CO_2 emissions and safety risk, Alternative 3 had the lowest air emissions since it requires less fuel consumption, and Alternative 4 had the lowest energy consumption. Although Alternative 2 is expected to take up to 9 years longer to achieve RAOs compared to Alternative 3, this additional time is not expected to be consequential given that this site is not currently used and there are no existing buildings or planned construction in the future. The cost versus benefit (such as length of time, sustainability) comparison indicates that although Alternative 2 takes longer to reach RAOs, it is more cost-effective and results in less disruptions to the environment and injury risk to humans than the other alternatives presented. ~~Therefore, Alternative 2 is the preferred~~ alternative for remediation of groundwater contamination at Site 22.

Because this remedy will result in pollutants or contaminants remaining on-site in groundwater above acceptable risk, a statutory review will be conducted within five years after the initiation of ~~remedial action~~Remedial Action to ensure that the remedy is functioning properly and remains protective of human health and the environment.

10 Community Participation

The Navy and USEPA Region 3, in consultation with VDEQ, will make the final decision on the remedial alternative for Site 22 after reviewing and considering all information and comments submitted during the 45-day public comment period. The public comment period for this Proposed Plan will extend from May 14 to June 28, 2012 and a public meeting to discuss the Proposed Plan will be held on May 24, 2012 beginning at 3:00 PM. Details regarding the public comment period and public meeting are included in the text box in Section 1 entitled, "Please Mark Your Calendar." The Navy will summarize and respond to all comments submitted during the public comment period in a responsiveness summary that will be included in the final decision document, the ROD, which will follow this Proposed Plan. This Proposed Plan and the ROD will become part of the AR file for WPNSTA Yorktown.

Public participation is encouraged since the preferred alternative presented in this Proposed Plan may be modified or another alternative selected based on new information and/or

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public comments received. The public is encouraged to gain a more comprehensive understanding of Site 22 and the Navy's ERP by attending this and other public meetings advertised in the Daily Press and Virginia Gazette newspapers and by accessing information included in the AR file. Minutes of all public meetings will be included in the AR file.

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

Mr. Jim Gravette
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Phone: (804) 698-4125
Email: wade.smith@deq.virginia.gov

Glossary

Abiotic: A non-living attribute of a system such as light, temperature and wind.

Administrative Record (AR): A compilation of documents relied upon to select a remedial response. The AR is available to the public and is in the ERP Information Repository.

~~**Adsorption:** The accumulation of gases, liquids and solutes on the surface of a solid or liquid.~~

Applicable or relevant and appropriate requirements (ARARs): Those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing law that specifically address a hazardous substance, pollutant, contaminant, ~~remedial action~~Remedial Action, location, or other circumstance found at a CERCLA site.

Aquifer: An underground layer of water-bearing soils and/or geologic formations from which groundwater can be extracted.

Associated Performance Monitoring: Measurement of environmental parameters such as water levels, dissolved oxygen, conductivity, and ~~ORP~~oxidation-reduction potential- to evaluate the effectiveness of a treatment system.

~~**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 adversely affected by spills, releases, or other site-specific activities. Background concentrations of some metals and other constituents are often at levels that could 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.~~

Biodegradation: Transformation of a substance into new compounds through biochemical reactions or the actions of microorganisms such as bacteria.

Cancer risk: The incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen.

Central tendency exposure (CTE): Mean concentration of site data that 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 and amended by the Superfund Amendments and Reauthorization Act of 1986. CERCLA provides for cleanup and emergency response in connection with existing inactive hazardous waste disposal sites that endanger public health and safety or the environment.

Conceptual Site Model (CSM): A three-dimensional understanding of contaminant sources, pathways, and receptors and tools needed to identify and fill data gaps, screen remedial alternatives, and evaluate the performance of ~~remedial action~~Remedial Actions.

Confining unit: A geologic formation that consists of impermeable or distinctly less permeable material bounding one or more aquifers.

Constituents of concern (COCs): Specific chemicals that are identified for evaluation in the site assessment process

Criteria ~~Pollutants~~pollutants: Criteria pollutants include six air pollutants for which ~~the U.S.~~ USEPA has established health-based limits and two other pollutants which transform into criteria pollutants in the air. They include carbon monoxide, nitrogen oxides, lead, sulfur dioxide, particulate matter, ozone, and ozone precursors, volatile organic compounds and ammonia.

Dense non-aqueous phase liquid (DNAPL): One of a group of organic substances that are relatively insoluble in water and more dense than water. DNAPLs tend to sink vertically through sand and gravel aquifers to the underlying layer.

Dermal contact: Exposure to a chemical through contact with the receptor's skin.

***Dehalococcoides species* (DHC):** The presence of DHC at the site indicates the potential for natural degradation of VOCs since this microbe

is capable of degradation of chlorinated ethenes (such as TCE).

Discharge: The location at which groundwater leaves an aquifer and flows to the surface.

Dissolved phase groundwater plume: Dissolution of residual DNAPL source under natural conditions.

Ecological: Refers to plants and animals in the environment.

Ecological Risk Assessment (ERA): An organized process used to describe and estimate the likelihood of adverse impacts on the environment from exposure to chemicals in the environment.

Enhanced In Situ Bioremediation (EISB): Injecting insoluble or soluble substrates into a media to facilitate biodegradation.

Environmental Restoration Program (ERP): The Navy program charged with implementing environmental cleanups under CERCLA at Navy installations. The Navy, as lead agency, acts in partnership with USEPA Region 3 and VDEQ to address environmental investigations at Navy facilities through the ERP.

Explosive Safety Quantity Distance (ESQD): Requirements safeguard personnel against possible serious injury or equipment destruction from possible fires or explosions.

Exposure pathways: The pathway a chemical takes from the source of contamination to the exposed individual.

Feasibility Study (FS): Identifies alternatives for remediation or cleanup of a site and recommends the most feasible cleanup strategy.

Federal Facilities Agreement (FFA): Negotiated agreement that specifies required actions at a federal facility as agreed upon by various agencies (e.g., USEPA, RWQCB, DOE).

Geochemical conditions: Chemical conditions present within the earth, including those that could affect chemical reactions and processes.

Geology: Soil and rock that underlie the ground's surface.

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

Hazard index (HI): Summation of the non-cancer risks to which an individual is exposed. An HI value of 1.0 or less indicates that non-cancer adverse human health effects are unlikely to occur.

Human Health Risk Assessment (HHRA): An organized process used to describe and estimate the likelihood of adverse impacts on human health from exposure to chemicals in the environment.

Innocuous: having no adverse effect; harmless.

In Situ Chemical Oxidation (ISCO): Injection of oxidant chemicals to degrade organic chemicals of concern such as chlorinated organics, hydrocarbons, PAHs, Pesticides, and explosives.

Ingestion: Exposure to a chemical through a receptor's mouth, either directly or through transfer of contamination on the hands to food.

Land Use Controls (LUCs): Physical, legal, and/or administrative mechanisms that restrict the use of or limit access to real property to manage risks to human health and the environment.

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

Media: Soil, groundwater, surface water, or sediment at a site.

Monitored Natural Attenuation (MNA): Reduction in mass or concentration of a compound in groundwater over time or distance from the source of constituents of concern due to naturally occurring physical, chemical, and biological processes, such as; biodegradation, dispersion, dilution, adsorption, and volatilization.

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

National Priorities List (NPL): A list, developed by USEPA, of uncontrolled hazardous substance release sites in the United States that are

considered priorities for long-term remedial evaluation and response.

Non-cancer hazard: Probability that a chemical will produce a non-cancer effect in humans. Estimate of this probability is identified as the hazard quotient, the sum of which is identified as the HI.

Oxidants: A participant in a chemical reaction that absorbs electrons from another reactant. In the process a component atom of this substance undergoes a decrease in oxidation number. In this action as an oxidizing agent, the substance undergoes reduction.

Plume: A space in air, water, or soil containing pollutants released from a point source.

Principal threat wastes: As defined by the NCP, source materials that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed.

Proposed Plan: A document that presents information and requests public input regarding a 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 USEPA, such as a rulemaking, permit, or Superfund alternative selection.

Reasonable Maximum Exposure (RME): The highest exposure that is reasonably expected to occur at a site. The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures.

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

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

Reductive ~~Dechlorination~~dechlorination: Injection of a biodegradable soluble organic carbon into a solvent-contaminated aquifer formation.

Regional Screening Levels (RSL): Risk-Based concentrations derived from standardized equations combining exposure information assumptions with USEPA toxicity data without inputting site-specific information.

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

Remedial Action Objectives (RAOs): Specific goals for protecting human health and the environment. They are developed by evaluating ARARs protective of human health and environment and results of remedial investigations and risk assessments.

Remediation goals (RGs): Clean-up goals developed based on readily available information and include results of the baseline risk assessment. They also are used during analysis of remedial alternatives in the remedial investigation/feasibility study (RI/FS).

Remedial Goal Option (RGO): Incorporate ingestion, dermal absorption, and inhalation of volatiles and particulate pathways for future residents.

~~**Reasonable Maximum Exposure (RME):** The maximum exposure reasonably expected to occur in a population, or in different groups within a population (for example, the elderly or children).~~

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Remedial Investigation (RI): Extensive technical study conducted to characterize the nature and extent of risks posed by a site.

Residual risk: Hazards which remain on site after Remedial Action has been completed.

Risk: A measure of the probability that damage to life, health, property, or the environment will occur as a result of exposure to chemicals in the environment.

Sediment: Matter that settles to the bottom of a liquid.

Seep: A point where groundwater discharges to the surface.

Site: The area of a 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.

Site Screening Areas: ~~Property~~ Properties to be evaluated for further investigation.

Site Screening Process (SSP): Process to determine if an area should be considered a Site for further investigation.

Site Management Plan: Annual document generated in accordance with the Federal Facilities Agreement, which provides a 5-year plan for CERCLA Installation Restoration activities.

Soil: The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants.

Spent solvents: Materials such as degreasers, cleaners, extractants, and diluents that have been used and are no longer fit for use without being regenerated, reclaimed, or otherwise reprocessed.

Surface Water: A body of water on the surface of the earth.

~~**Terrestrial:** Of, on, or relating to the earth.~~

Toxicity: The degree to which a substance can harm human or ecological receptors.

Tributary: A stream that joins a river instead of the ocean.

Unlimited use and ~~Unrestricted~~ unrestricted ~~Exposure~~exposure: Full use of all environmental media including groundwater, soil, and surface water with no limits placed on the use of the environmental media.

U.S. Environmental Protection Agency (US): The federal agency responsible for administration and enforcement of CERCLA (and other environmental statutes and regulations), and with final approval authority for the selected alternative.

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

Volatile organic compounds (VOCs): ~~A c~~Compounds that easily vaporize~~s~~ and ~~has~~ have low water solubility. Many VOCs are manufactured chemicals such as those associated with paint, solvents, and petroleum.

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