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PROPOSED REMEDIAL ACTION PLAN FOR SITE 5 GROUNDWATER FOR NAVAL AIR
STATION JOINT RESERVE BASE OPERABLE UNIT 2 NAS WILLOWGROVE PA
6/1/2011
TETRA TECH NUS

**Proposed Remedial Action Plan
for
Site 5 Groundwater (OU 2)**

**Naval Air Station
Joint Reserve Base (NAS JRB)
Willow Grove, Pennsylvania**



**Naval Facilities Engineering Command
Mid-Atlantic**

**Contract Number N62467-04-D-0055
Contract Task Order 412**

June 2011



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PHIL-24330

June 10, 2011

Project Number 00845

Base Realignment and Closure
Program Management Office, Northeast
4911 South Broad Street
Philadelphia, Pennsylvania 19112-1303

Attention: Mr. Jeff Dale

Reference: Contract No. N62467-04-D-0055
Contract Task Order (CTO) No. 412

Subject: Submission of Proposed Plan for Site 5 Groundwater (OU 2)
NAS JRB Willow Grove, Pennsylvania

Dear Mr. Dale:

Tetra Tech NUS, Incorporated (Tetra Tech) is pleased to provide copies of the Proposed Plan for Site 5 Groundwater. Three copies have been sent to Lisa Cunningham at EPA Region 3, one copy has been sent to Kathleen Patnode at Region 3 BTAG, two copies have been sent to Tim Sheehan at PADEP, one copy has been sent to Bill Heil at NAS JRB Willow Grove, one copy has been sent to the Executive Officer NAS JRB Willow Grove, one copy has been sent to Laurie Tynan at the Horsham Township Library, and two copies are enclosed for your use.

Each recipient named has received a bound paper copy of the document and an electronic copy on compact disk (CD). One additional copy has been forwarded to Bonnie Capito for NAVFAC Mid-Atlantic librarian use.

Thank you for this opportunity to submit these documents. Do not hesitate to contact me if you have any questions or require revisions.

Sincerely,

Russell E. Turner, P.E.
Project Manager

RET/mmp

Enclosure

c: Lisa Cunningham (EPA Region 3)
Kathleen Patnode (EPA Region 3 BTAG)
Tim Sheehan (PADEP)
Bill Heil (NAS JRB Willow Grove)
Executive Officer (NAS JRB Willow Grove)
Horsham Township Library (Attention Laurie Tynan)
NAVFAC Mid-Atlantic Librarian (Bonnie Capito)
Garth Glenn (Tetra Tech) (without enclosures)
File



PROPOSED REMEDIAL ACTION PLAN for Site 5 Groundwater (OU 2) Naval Air Station, Joint Reserve Base (NAS JRB) Willow Grove, Pennsylvania

June 2011

Navy Announces Proposed Remedial Action Plan

The purpose of this **Proposed Plan** ⁽¹⁾ is to present the preferred remedial action at Site 5 – Fire Training Area at the Naval Air Station Joint Reserve Base (NAS JRB) Willow Grove in Horsham Township, Pennsylvania. Site 5 groundwater has been designated Operable Unit (OU) 2. The Navy's Proposed Plan consists of treatment of Site 5 groundwater by **in-situ anaerobic bioremediation** (ISAB), natural attenuation, land use controls and long-term groundwater monitoring as the preferred remedial alternative to address risks associated with the groundwater located beneath Site 5.

Proposed Plan Summary: In-Situ Anaerobic Bioremediation, Natural Attenuation, Monitoring and Land Use Controls

Background information for the site and the rationale for choosing the preferred alternative are included in this plan.

This Proposed Plan is issued by the Navy, the lead agency for the **Installation Restoration Program (IRP)** and **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)** activities at the NAS JRB Willow Grove facility, and by the U.S. Environmental Protection Agency (EPA). The Navy is issuing this Proposed Plan as part of its public participation responsibilities under Sections 113(k), 117(a), and 121(f) of CERCLA and 40 C.F.R. § 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**.

A final decision on the remedial approach for Site 5 will be selected after review and consideration of all information submitted during the 45-day **Public Comment Period**. The Navy and EPA, in consultation with the Pennsylvania Department of Environmental Protection (PADEP), a support agency for Superfund activities at NAS JRB Willow Grove, will make the final decision.

Mark Your Calendar for the Public Comment Period

Public Comment Period

June 15, 2011 through August 1, 2011

Submit Written Comments

The Navy will accept written comments on the Proposed Plan during the public comment period. Send written comments postmarked no later than August 1, 2011 to the address on the back page.

Attend the Public Meeting

A public meeting to present this Proposed Plan will be held on **Wednesday, June 22, 2011 at 6:00 PM** in the Horsham Township Municipal Building, 1025 Horsham Road, Horsham, Pennsylvania. For directions to the Horsham Township Municipal Building, please see the Township's Web site, <http://www.horsham.org> or call them at (215) 643-3131. The meeting date and location will also be published in the *Intelligencer* newspaper.

(1) NOTE: A glossary of relevant technical and regulatory terms is provided at the end of this Proposed Plan. Terms included in the Glossary are initially indicated in **boldface** within this Proposed Plan.

The Navy and EPA may modify the preferred remedy in the Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on the remedy presented in this Proposed Plan.

This Proposed Plan summarizes the findings of the Site 5 - Fire Training Area **Remedial Investigation (RI)**, outlines the alternatives presented in the **Feasibility Study (FS)**, discusses the results of a pilot test conducted to evaluate the potential effectiveness of bioremediation, identifies the remedial alternative preferred by the Navy and EPA, and explains the reasons for this preference. In addition, this Proposed Plan explains how the public can participate in the decision-making process and provides addresses for the appropriate Navy and EPA contacts.

The Proposed Plan also summarizes information from other documents that are contained in the **Administrative Record** file for this site. The Administrative Record file is available at the Navy's **Information Repository** located at the Horsham Township Public Library, 435 Babylon Road, Horsham, Pennsylvania. The Navy invites the public to review the available materials and to comment on this Proposed Plan during the public comment period.

Site Background

NAS JRB Willow Grove, Pennsylvania is located in Horsham Township, Montgomery County in southeastern Pennsylvania, approximately 20 miles north of the city of Philadelphia. NAS JRB Willow Grove occupies approximately 900 acres of flat to slightly rolling terrain and is generally bounded by State Route 611 to the east, State Route 463 to the southwest, and Keith Valley Road to the north (Figure 1).

The former fire training area is located near the southern end of the Navy's property, west of the

runways and east of Horsham Road, and covers an irregularly shaped area of approximately 1.25 acres (see Figure 1). Fire training operations included storage and burning of flammable liquid wastes generated by the Air Station from 1942 through 1975 when burning exercises ceased. As a result of the historical storage and burning operations, groundwater has been impacted.

A No Further Action ROD for Site 5 Soil (OU 4) was signed by the Navy and EPA in September 2007. Contaminated soil had been excavated and disposed off site followed by confirmation soil sampling, including analysis for dioxins. Calculation of residual risks after soil removal concluded no adverse risk remained. Therefore, this Proposed Plan applies to Site 5 groundwater (OU 2) only.

In 2005, NAS JRB Willow Grove was designated for closure under the authority of the Defense Base Realignment and Closure Act (BRAC) of 1990, Public Law 101-510 as amended. Under the Defense Base Realignment and Closure Act, as amended, the Navy is required to dispose of NAS JRB Willow Grove in accordance with the laws and regulations governing the disposal of property made available as a result of the closure or realignment of a military installation. At the time of preparation of this Proposed Plan in the spring of 2011, the Horsham Land Reuse Authority (HLRA) was taking steps to develop a reuse plan for the facility.

Site Characteristics

The principal contaminants associated with Site 5 groundwater are volatile organic compounds (VOCs). VOCs were detected at concentrations exceeding drinking water standards in groundwater samples from well clusters 05MW01, 05MW04, 05MW09, 05MW10, 05MW13, and 05MW14 (see Figure 2). Compounds detected included trichloroethene (TCE) at concentrations up to 480 ug/L,



Site 5 General Location and Nearby Features

benzene at concentrations up to 8.7 ug/L, tetrachlorethene (PCE) at concentrations up to 50 J* ug/L, 1,1,1-trichlorethane (1,1,1-TCA) at concentrations up to 945 ug/L, 1,1-dichlorethene (1,1-DCE) at concentrations up to 185 ug/L, and cis-1,2-dichloroethene (cis-1,2-DCE) at concentrations up to 270 ug/L.

Results from the Phase II RI show that the source area for the groundwater VOC contamination in the former Fire Training Area is near monitoring well cluster 05MW01, where drums of solvents had been stored on the ground surface and were removed after fire fighting training exercises ceased in the mid 1970's.

One semivolatile organic compound (SVOC), 1,4-dioxane, was detected in one Site 5 groundwater sample at a concentration of 12.5 ug/L).

Inorganic compounds lead, arsenic, and beryllium were detected in Site 5 groundwater at levels above risk-based levels. Statistical tests

*J indicates estimated concentration.

conducted during the RI data analysis indicated that these inorganics are not site related.

Groundwater from Site 5 does not appear to encounter surface water and has no impact on Site 5 ecology.

Scope and Role

This Proposed Plan addresses the evaluation and selection of the final remedial alternative for Site 5 groundwater (OU 2). It does not include or directly affect any other sites at the facility that fall under the CERCLA process, as summarized in Table 1 and shown on Figure 1.

The purpose of the Proposed Plan is to summarize activities performed to date to investigate Site 5 groundwater and provide a rationale for the proposed remedial action. In order to fully address the potential risks associated with exposure to contaminated groundwater at Site 5, the Navy proposes, ISAB, natural attenuation, land use controls, and long-term groundwater monitoring.

Summary of Site Risks

A baseline HHRA was performed in 1997 for the Phase II RI to characterize the potential risks to human receptors under current and potential land uses. A limited update of the Human Health Risk Assessment (HHRA) was performed in February 2007 to address changes in risk assessment methodology and risk values that had occurred after the performance of the 1997 assessment. The Technical Memorandum of Risk Assessment Evaluation for Site 5 – Fire Training Area Groundwater (Tetra Tech, 2007) provides the updated technical evaluation of the HHRA to reflect current guidance for decision-making. An ecological risk assessment (ERA), conducted for the RI report issued in 2002 concluded that Site 5 groundwater has no impact on surface ecology. The nearest surface water body into which site groundwater could discharge is approximately 4,500 feet south of the site. There is no evidence that site groundwater discharges to surface water.

Summary of Human Health Risk Assessment

Groundwater concentrations were initially compared to EPA **Maximum Contaminant Levels (MCLs)** and Region 3 EPA **Risk-Based Concentrations (RBCs)** [RBCs are now replaced by regional screening levels (RSLs)] for tap water to be protective of all receptors that could be exposed to groundwater. A chemical was eliminated from consideration if the maximum detected concentration did not exceed the lesser of the MCL and the RBC (RSL) screening value determined at a **cancer risk** level of 1×10^{-6} or a **non-cancer risk, Hazard Quotient (HQ)** of 0.1.

Selected compounds of concern (COCs) for groundwater remediation goals listed in Table 2 include, 1,1,1-TCA, 1,1,2-TCA, 1,1-DCA, 1,1-DCE, 1,2-dichloroethane (1,2-DCA),

HISTORY OF INVESTIGATIONS

1984-1988: The **Initial Assessment Study (IAS)** [also known as the Preliminary Assessment (PA)] was a Base-wide preliminary study that assessed 17 sites (10 Navy, 7 Air Force Reserve).

1989: Site Inspection (SI) included investigation of 12 of the 17 IAS sites. Based on the IAS and SI, RI/FS activities were subsequently completed or are underway at four Navy IR program sites (Sites 1, 2, 3 and 5).

1993: The Phase I RI characterized the physical and chemical nature of the four Navy sites and identified data gaps requiring further study. Recommendations for further investigation lead to Phase II RI activities at Site 5 that began in 1997.

1997: Phase II RI investigations included installing eleven monitoring wells and sampling surface soil, subsurface soil, surface water, groundwater, and sediments to fill data gaps. Background samples were collected and analyzed. Phase II RI activities at Site 5 were summarized in the April 1998 draft Phase II RI Report, that addressed all four Navy IR program sites and included a human health risk assessment (HHRA) completed in 1997 for each site.

1998: The Navy, in agreement with EPA and PADEP, delinked the RI reporting process to allow each of the four Navy IRP sites, including Site 5, to progress independently.

2000-2006: At the request of EPA, multiple groundwater follow-on RI investigations were performed by the Navy to respond to specific regulatory concerns regarding the nature and extent of contamination and to ensure that reliable down gradient sentinel wells were in place to monitor the potential advance of the groundwater plume. These follow-on RI results are discussed in the Site 5 RI report (Tetra Tech, February 2002), the Site 5 RI Addendum 2, Soil Investigation for Volatile Organic Compound Soil to Groundwater Impact (Tetra Tech, March 2006), and the RI Addendum 5 for Site 5 Groundwater (Tetra Tech, September 2006).

2008: In December 2008, a fifth site, Site 12-South Landfill, was added to the Navy program for full RI/FS activities. Site 12 is in the RI stage of the RI/FS process.

2008-2011: The Site 5 groundwater bioremediation pilot study was conducted from June 2008 to December 2010. Implementation of the pilot study consisted of baseline sampling and periodic biostimulation, bioaugmentation, and groundwater sampling events.

benzene, cis-1,2-DCE, TCE, PCE, vinyl chloride (VC) and 1,4-dioxane. Anticipated intermediate breakdown products ("daughter" compounds) from the proposed ISAB process have been included in this list.

Potential receptors evaluated in the initial HHRA included current occupational workers, current adolescent and adult trespassers, future excavation workers, future recreational children, and future residents. Risk estimates for the hypothetical future resident exposed to groundwater were recalculated in the 2007 updated HHRA since they were identified as the critical receptors in the initial study. The risk evaluation assumed that potential human receptors would be exposed to the compounds of potential concern (COPCs) in Site 5 groundwater via ingestion, dermal contact while bathing or showering, and inhalation of airborne vapors while showering.

The quantitative HHRA evaluated each potential receptor under a **reasonable maximum exposure (RME)** scenario and a less conservative **central tendency exposure (CTE)**. RME is the exposure that is expected to represent a high end, but not worst-case, exposure in a given medium of concern. CTE incorporates input parameters that are representative of an average or median exposure scenario.

Excess lifetime cancer risks were determined for each receptor by multiplying a daily dose by the chemical-specific cancer slope factor. Cancer slope factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. According to the NCP, the maximum acceptable range for

Note: The EPA uses an acceptable cancer risk range that corresponds to one additional case per one million (1×10^{-6}) to one case per ten thousand (1×10^{-4}) persons exposed.

WHAT IS A HUMAN HEALTH RISK ASSESSMENT AND HOW IS IT CALCULATED?

A human health risk assessment estimates the baseline risk, an estimate of the likelihood of health problems occurring if no cleanup action is 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 describing 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 threats 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 who could be exposed, one extra cancer may occur as a result of exposure to site contaminants. This is expressed in scientific notation as 1×10^{-4} . An extra cancer case means that one more person could get cancer than normally would be expected from all other causes. For noncancer health effects, the Navy calculates a "hazard index." The key concept here is that a "threshold level" (measured usually as a hazard index of 1) exists above which noncancer health effects are 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.

site-related exposure is 1×10^{-6} to 1×10^{-4} . This represents the increased chance of contracting cancer from being exposed to contaminants at this site, as explained in "Step 3" in the box on Page 5.

Non-cancer risks are presented in the form of Hazard Quotients (HQs), which are determined by dividing the daily dose of a chemical by the published reference doses (RfDs). RfDs have been developed by EPA and represent a level to which an individual may be exposed that is not expected to result in any deleterious effect. An HQ of less than or equal to 1.0 indicates that a receptor's dose of a single contaminant is less than the RfD and that adverse non-carcinogenic effects from that chemical are unlikely. The HQs for each COPC that the receptor is assumed to be exposed to via a specific pathway are summed to yield the **Hazard Index (HI)** for that pathway. A total HI is then calculated for each receptor by summing the pathway-specific HIs.

The results of the 2007 HHRA update indicated that the estimated RME incremental lifetime cancer risk (ILCR) for lifelong resident (3×10^{-4}) exceeds the target risk range. PCE is the major contributor to the ILCR for the lifelong resident ($ILCR = 2 \times 10^{-4}$).

ILCR for the lifelong resident ($ILCR = 6 \times 10^{-5}$) under the CTE scenario is within EPA's target risk range.

Non-carcinogenic HIs for the child residents and adult residents estimated for the RME scenario were within acceptable levels.

Summary of Ecological Risk Assessment

A screening-level ecological risk assessment was conducted for Site 5 to characterize the potential risks from site-related contaminants to potential ecological receptors (the flora and fauna) that inhabit the installation. The text insert

WHAT IS AN ECOLOGICAL RISK ASSESSMENT AND HOW IS IT CALCULATED?

An ecological risk assessment evaluates the potential adverse effects human activities have on the plants and animals that make up ecosystems. The ecological risk assessment process follows a phased approach similar to the human health risk assessment. The risk assessment results are used to help determine what measures, if any, are necessary to protect plants and animals.

Ecological risk assessment includes three steps:

Step 1: Problem Formulation

Step 2: Analysis

Step 3: Risk Characterization

The problem formulation includes:

- Compiling and reviewing existing information on the site habitat, plants, and animals that are present
- Evaluating how plants and animals may be exposed
- Identifying and evaluating area(s) where site-related chemicals may be found
- Evaluating potential movement of chemicals in the environment
- Evaluating routes of exposure (for example, ingestion)
- Identifying receptors (plants and animals that could be exposed)
- Identifying exposure media (soil, air, water)
- Developing how the risk will be measured for all complete pathways (determining the risk where plants and/or animals can be exposed to chemicals)

In **Step 2**, the potential exposures to plants and animals are estimated and the concentrations of chemicals at which an effect may occur are evaluated.

In **Step 3**, all of the information identified in the first two steps is used to estimate the risk to plants and animals. Also included is an evaluation of the uncertainties (potential degree of error) that are associated with the predicted risk evaluation and their effects on the conclusions that have been made.

above describes the ecological risk assessment process.

There are no ecological risks associated with Site 5 groundwater because the groundwater does not discharge to the surface in the vicinity of the site or interact with any surface water bodies. There are no ecological receptors exposed to Site 5 groundwater. Consequently,

Table 2. Remediation Goals for Site 5 Area Groundwater

Contaminant	Range of Positive Detection ¹		Exceeds Federal SDWA ²	Remedial Goal	Rationale for Remedial Goal	
	(µg/L)					
	Min	Max	Yes/No	(µg/L)		
1,1,1-Trichloroethane	2	-	960	Yes	200	MCL
1,1,2-Trichloroethane	10	-	10	Yes	5	MCL
1,1-Dichloroethane	3	-	350	No MCL	2.4	RSL
1,1-Dichloroethene	6	-	300	Yes	7	MCL
1,2-Dichloroethane ³	3	-	4	No	5	MCL
1,2-Dichloroethene (cis)	0.51	-	270	Yes	70	MCL
1,4- Dioxane	12	-	13	No MCL	0.67	RSL
Benzene	3	-	28	Yes	5	MCL
Tetrachloroethene	1	-	35	Yes	5	MCL
Trichloroethene	5	-	300	Yes	5	MCL
Vinyl chloride ³	---	-	---	No	2	MCL

MCL – Maximum Contaminant Level.

RSL - Regional Screening Level for Tap Water, EPA Region 3, November 2010.

(1) Values are from the summer 2005 groundwater sampling event.

(2) Safe Drinking Water Act (SDWA) defines MCL

(3) These compounds are included because they are anticipated breakdown products of trichloroethene and other parent compounds.

no unacceptable ecological risk has been identified from site related contaminants.

Summary of Risk

Risk posed to human health by contaminated groundwater at Site 5, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to public health, welfare, or the environment.

Remediation Goals and Objectives

Site 5 groundwater is impacted with VOCs at concentrations in excess of regulatory or health-based criteria, which are listed in Table 2. While there are no water supply wells used for drinking water located at Site 5, groundwater from the aquifer underlying Site 5 is used as a potable source of drinking water through private and public wells in the area. The HHRA concluded that under a future residential land use scenario,

exposure to contaminated groundwater through ingestion, dermal contact, and inhalation would result in potential risks that exceed EPA's maximum acceptable carcinogenic risk range of 10^{-6} to 10^{-4} . Therefore, remedial action is warranted to protect human health.

The **remedial action objectives (RAOs)** for Site 5 groundwater are as follows:

Protection of Human Health RAO:

- Prevent potential human exposures to contaminated groundwater.
- Restore groundwater to MCL or below.

Protection of the Environment RAO:

- Prevent further degradation of groundwater.

Remediation Goals

Data from the RI, the human health risk assessment, and the **Applicable or Relevant and Appropriate Requirements (ARARs)** were reviewed to identify the Site 5 COCs that would be used to determine the appropriate **remediation goals (RGs)**. A set of proposed Site 5 groundwater RGs is presented in Table 2, along with the basis for selection. These proposed groundwater RGs can be used to estimate the volume of contaminated groundwater for potential remedial action.

Remedial Alternatives Considered

The purpose of the alternatives development and screening process was to assemble an appropriate range of possible remedial options to address potential risks related to VOC-contaminated groundwater at Site 5.

In this process, technically feasible technologies were combined to form remedial alternatives that would protect human health and the environment. These remedial alternatives were developed in accordance with the NCP and are detailed in the Site 5 Groundwater (OU 2) FS dated November 2008. Estimated costs for each alternative are summarized in Table 3.

Subsequent to the FS and with community input, the Navy implemented a pilot test of Alternative 4, ISAB, from 2008 to the present.

Alternative 1 - No Action

The no action alternative was developed as the baseline case, as required by the NCP. Under this alternative, no remedial actions would be taken. The only activity conducted under this alternative would be review of site conditions and risks every five years.

Alternative 2 - Natural Attenuation, Institutional Controls and Long-Term Groundwater Monitoring

This alternative involves no active treatment, relying on natural processes to achieve groundwater RGs. Under this alternative, the groundwater quality would be expected to gradually return to acceptable levels through natural attenuation (NA) processes. The NA processes consist of a variety of physical, chemical, or biological processes that act to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. Alternative 2 would limit human exposure to groundwater through the establishment of **institutional controls (ICs)**. Periodic monitoring would be conducted to assess the status of the plume.

Alternative 3A - Pump and Treat Groundwater from Entire Plume and Discharge

Under Alternative 3A, VOC-contaminated groundwater would be extracted from the entire plume and treated by air stripping in a treatment

Table 3. Comparison of the Estimated Cost for Each Alternative

Estimated Cost	Alternative 1	Alternative 2	Alternative 3A	Alternative 4	Alternative 5
Capital Cost	\$0	\$63,000	\$1,524,000	\$256,000	\$620,000
Average Annual Operation and Maintenance (O&M) Cost	0	\$20,000	\$268,000	\$91,000	\$99,000
Average Annual O&M Cost After Active Treatment	Not Applicable (N/A)	N/A	N/A	\$18,000	\$28,000
Total Present Worth*	\$32,400	\$358,500	\$5,057,000	\$769,000	\$1,176,000
Projected Maximum Timeframe to Achieve RAOs	N/A	30 years	30 years	15 years	12 Years

*Includes costs for review of site conditions and risks every five years.

plant constructed nearby. Effluent would be discharged to the sanitary sewer system. ICs would be implemented to prevent exposure to untreated groundwater. Long-term monitoring would be conducted to assess the effectiveness of the remedial action and to determine when remediation is complete. Site conditions and risks would be reviewed every five years.

Alternative 4 - In-Situ Treatment of Groundwater by Anaerobic Bioremediation and Natural Attenuation

Alternative 4 proposed in-situ enhanced biological anaerobic reductive dechlorination treatment and NA to promote remediation of the VOC-contaminated groundwater. As conceived in the FS, there were pre-design studies, a laboratory treatability study and a pilot test to evaluate and verify the effectiveness of several different electron donor nutrition supplements. A bioremediation pilot test was conducted from 2008 to 2010 and is described in the box to the right.

The pilot in-situ treatment system was designed and installed based on the pilot study work plan (October 2008). The treatment system configuration included provision for groundwater recirculation and direct injection of amendments to evaluate enhanced biological remediation technologies.

When the majority of the VOCs have been degraded, treatment of groundwater may be continued by NA processes to achieve groundwater RGs. It is anticipated that the site groundwater will take ten additional years under NA process to reach the RGs.

This alternative also includes institutional controls, long-term monitoring, and five-year reviews until RGs are achieved.

GROUNDWATER PILOT TEST

The Site 5 groundwater bioremediation pilot study was conducted from June 2008 to December 2010. The first phase of the study included installation and sampling of five additional monitoring wells in the source area, and aquifer testing. As a result of initial tests, four injection/extraction wells were installed and a groundwater recirculation and treatment system was constructed to extract groundwater, add amendments under controlled conditions, and reinject treated groundwater/amendments.

Implementation of the pilot study consisted of baseline sampling and periodic biostimulation, bioaugmentation, and groundwater sampling events. Biostimulation events were performed to encourage the proper geochemical environment (less acidic, reducing, and anaerobic) for biodegradation to occur. Biostimulation consisted of groundwater extraction, addition of chemical amendments (sodium bicarbonate and sodium lactate), and reinjection of the groundwater mixture. Sodium bicarbonate was added to raise the aquifer pH. Sodium lactate provided the carbon substrate (food) source. When groundwater sampling indicated that the proper environmental conditions had been achieved, bioaugmentation (addition of specific bacterial stock) was performed to supplement the existing bacterial population. Large numbers of bacteria with the required genetic composition to complete the reductive biodegradation process were purchased commercially and added to the treatment unit. Subsequent sampling events indicated a reduction in the concentrations of the parent VOC compounds (1,1,1-TCA, TCE, and PCE) and a corresponding temporary increase in the concentrations of degradation products.

The Site 5 groundwater pilot study concluded that bioremediation through anaerobic, reductive dechlorination is an effective strategy for remediating Site 5 groundwater contaminants.

Alternative 5 - In Situ Treatment of Groundwater by Chemical Oxidation

Alternative 5 employs in-situ treatment of VOC-contaminated site groundwater by chemical oxidation. The effectiveness of this technology is highly dependent on the design and applications of oxidant injection, delivery, and distribution, the subsurface hydrogeology of the site, the nature and extent of contamination, and other site-specific conditions such as presence of total organic carbon (TOC), which can

competitively interfere with target contaminants for available oxidants.

Implementation of this alternative would include performance of bench-scale and pilot studies to investigate the site-specific effectiveness of in-situ chemical oxidation (ISCO) for mitigating contamination in Site 5 groundwater. Following successful completion of bench-scale and pilot studies, a full-scale ISCO treatment system would be implemented for injecting an oxidant blend into injection wells in the source area. Monitoring would be conducted during the treatment process to confirm the presence of chemical oxidation indicators throughout the remedial target areas, to maintain an effective remediation zone, and to monitor for treatment effectiveness with respect to the RGs. Experience at previous ISCO treatment sites indicates that the ISCO treatment could take approximately 1-2 years to achieve the RGs. Continued monitoring for approximately ten additional years would be needed to monitor the water quality to verify successful treatment. This alternative also utilizes institutional controls to prevent exposure to contaminated groundwater for the duration of the groundwater remediation period, until RGs are achieved. Site conditions and risks would be reviewed every five years until the groundwater remediation is complete.

Evaluation of Alternatives

As part of the FS, the remedial alternatives were evaluated using nine criteria, as established by the NCP. Also, a pilot study of Alternative 4 active biologically-mediated groundwater remediation was performed. Table 4 summarizes the comparative analysis of remedial alternatives.

(1) Overall protection of human health and the environment

Alternative 1 would provide no additional protection of human health and the environment. Alternative 2 would provide greater protection of human health and the environment than Alternative 1 because additional actions including implementation of land use controls (LUCs) and groundwater monitoring would prevent exposure to contaminated groundwater. Alternatives 3A, 4, and 5 would provide protection of human health and the environment through treatment of contaminated groundwater and implementation of institutional controls.

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

Alternative 1 would not comply with ARARs nor include a provision to seek temporary exemption. Alternatives 2, 3A, 4, and 5 would eventually comply with all chemical-specific ARARs, and Alternatives 3A, 4, and 5 would also comply with all action-specific and location-specific ARARs. None of the alternatives would initially comply with the ARARs for attainment of groundwater quality criteria; however, Alternatives 2, 3A, 4, and 5 would include a provision to implement institutional controls on the use of groundwater from Site 5 until the RGs are achieved through NA and active treatment in-situ or above-ground.

(3) Long-term effectiveness and permanence

Alternative 1 would provide no additional protection of human health or the environment. Alternatives 2, 3A, 4, and 5 offer long-term protection of both human health and the environment. Alternative 2 would not include actions to actively remediate VOCs, but would

Table 4. Comparative Analysis of Remedial Alternatives.

Criteria	Alternative 1	Alternative 2	Alternative 3A	Alternative 4	Alternative 5
Overall Protectiveness of Human Health and the Environment	○	●	●	●	●
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	○	●	●	●	●
Long-Term Effectiveness and Permanence	○	○	●	●	●
Reduction of Toxicity, Mobility, or Volume through Treatment	○	○	●	●	●
Short-Term Effectiveness	●	○	○	○	○
Implementability	●	●	○	○	○
Cost ¹	\$32,400	\$358,500	\$5,057,000	\$769,000	\$1,176,000
State/Support Agency Acceptance	○	○	●	●	○
Community Acceptance	To be determined				

Ranking: ● Well satisfies criterion ○ Moderately satisfies criterion ○ Poorly satisfies criterion

Alternative 1 - No Action

Alternative 2 - Natural Attenuation, Land Use Controls, and Long-Term Groundwater Monitoring (LTM)

Alternative 3A - Pump and Treat Groundwater from Entire Plume

Alternative 4 - In-Situ Treatment of Groundwater by ISAB, Natural Attenuation and LTM

Alternative 5 - In-Situ Treatment of Groundwater by Chemical Oxidation

¹ - Cost is the total present worth value: Cost accuracy ranges from -30% to +50%.

provide protection of human health through the use of institutional controls that place limitations on use of contaminated groundwater as drinking water.

Down gradient receptors and the environment would be protected immediately upon installation and start-up of the treatment system under Alternative 3A. Under Alternatives 4, and 5, concentrations at the leading edge of the plume would be expected to decrease over time, as the contaminants in the concentrated plume source area are degraded.

(4) Reduction of toxicity, mobility, and volume through treatment

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of contaminants, because no treatment is included.

Alternatives 4 and 5 permanently reduce the contaminants through on-site treatment, with no off-site disposal required. Alternative 3A moves contaminants off-site for treatment via activated carbon disposal. Alternatives 3A, 4, and 5 would also generate small amounts of waste material for disposal such as empty nutrient or chemical

additive containers, used personal protective equipment, and used filters.

Depending on VOC concentrations in air from the air stripper, Alternative 3A may generate spent carbon as a treatment residual from a vapor-phase or aqueous-phase carbon polishing unit.

(5) Short-term effectiveness

Since no active response actions would be implemented under Alternative 1, no additional short-term impacts would be anticipated.

Alternative 2 would present a limited opportunity for short-term impacts to human health and the environment related to the one-time monitoring well installation activities and collection of samples and field parameters to monitor natural attenuation in groundwater.

Alternatives 3A, 4, and 5 would present the greatest opportunity for short-term impacts due to installation and operation of groundwater treatment systems. In all cases, short-term risks posed to Base personnel, site workers, and the environment would be mitigated through use of engineering controls, transportation planning,

appropriate personal protective equipment, and safe work practices. No permanent adverse impacts to the human health or the environment would be anticipated to result from implementation of Alternatives 2, 3A, 4, and 5.

(6) Implementability

Each of the alternatives would be implementable. Alternative 1 is the most easily implemented since the only activities proposed are five-year reviews.

Alternative 2 would be the next easiest to implement because it involves the relatively simple additional tasks of adding new monitoring wells, and field personnel collecting groundwater samples and field parameters, as well as additional professional services needed to implement the institutional controls and for evaluation of raw data.

Alternatives 3A, 4, and 5 would be somewhat more difficult to implement because all would require installation and operation of an on-site treatment and delivery system. However, no difficulties are anticipated in implementing these alternatives because they include proven technologies that employ relatively common equipment and materials. If additional actions are warranted, they could be easily implemented under any of the Alternatives.

(7) Cost

Costs are summarized in Table 3. Alternative 1 would be the least expensive to implement. Alternative 4 would be the least expensive alternative that includes active treatment for the VOC-contaminated site.

(8) State concurrence

PADEP has been a partner in the development and review of the remedial action decision-

making process. Formal agreement from PADEP (in the form of a concurrence letter) on this Proposed Plan will be issued before the ROD is finalized.

(9) Community acceptance

This criterion will be addressed following the receipt of public comments on this proposed plan, and will be discussed in the responsiveness summary in the ROD that will document the selection of a remedial action for OU 2.

Preferred Alternative



View of Site 5 showing Pilot Test treatment system trailer.

The Navy and EPA prefer Alternative 4, which consists of in-situ anaerobic bioremediation combined with NA for the remediation of VOC-contaminated groundwater within the source area.

The segment of the groundwater plume located down gradient of the source area will not immediately be impacted by bioremediation, and will initially contain contaminants at concentrations above remediation goals. Since bioremediation of the diffuse plume, outside the source area, would not be cost effective, this portion of the plume would be addressed through NA, monitoring, and groundwater use restrictions until the treatment of the source

material and NA reduce these concentrations to acceptable levels.

Implementation of the proposed remedy would largely consist of the continued operation of the pilot test treatment system and increasing the number of direct injection wells.

The capital costs identified for this alternative in the feasibility study have been expended by the pilot test. Periodic biostimulation events would be performed to maintain the geochemical conditions necessary for efficient bioremediation. Although sodium lactate was an effective electron donor material, it was rapidly consumed by the bacterial population. Other, longer lasting organic substrates, such as emulsified oil, will be considered for future biostimulation events. Sodium bicarbonate effectively conditioned the aquifer, but other materials will be considered based on project requirements. Periodic sampling will be performed to monitor the biodegradation process.

The pilot test results indicated that the remediation of the historical source area would be accelerated by the installation of several additional shallow injection wells. These wells would augment the existing shallow injection well (05MW01S), which, although effective, has a limited radius of influence. Additional shallow wells will ensure that a larger portion of the site's most highly impacted groundwater is addressed.

Groundwater use restrictions will be established to restrict the use of site groundwater during the BRAC process and prior to the transfer of the property. The restrictions will be protective of human health for future users by preventing unacceptable risks resulting from direct exposure to contaminated groundwater. The property will have land use controls to mitigate the potential for vapor intrusion from the subsurface into future structures.

When the affected property is transferred to a non-Federal entity, then the institutional controls will consist of deed restrictions to prohibit use of untreated groundwater.

Since the groundwater contaminants will remain at Site 5 during the remediation process, a review of site conditions and risks will be conducted every five years, as required by CERCLA.

Community Participation

Community acceptance of the preferred remedial action will be evaluated at the conclusion of the public comment period and will be described in the ROD. The ROD is the document that will present the Navy's decision for Site 5 groundwater.

The Navy encourages written comments from the community on the Proposed Plan for Site 5 - Fire Training Area Groundwater (OU 2). The public comment period is from **June 15 through August 1, 2011** to encourage public participation in the decision process.

The Navy will hold a public meeting during the comment period. At the public meeting, the Navy, with input from EPA, will present the Proposed Plan, and solicit both oral and written questions. **The public meeting is scheduled for 6:00 p.m. on Wednesday, June 22, 2011 and will be held at the Horsham Township Municipal Building.** The Horsham Township Municipal Building is located at 1025 Horsham Road, Horsham, Pennsylvania.

Comments received during the public comment period will be summarized and responses will be provided in the Responsiveness Summary section of the ROD.

To send written comments, or to obtain further information, contact:

Mr. Jeff Dale
Remedial Project Manager
BRAC Program Management Office, N.E.
4911 South Broad Street
Philadelphia, PA 19112

Or e-mail your comments to
jeffrey.m.dale@navy.mil

For further information, contact:

Robert Lewandowski, BRAC Environmental
Coordinator
Base Realignment and Closure
Program Management Office Northeast
4911 South Broad Street
Philadelphia, PA 19112-1303
Phone: (215) 897-4908
Email: robert.f.lewandowski@navy.mil

Lisa Cunningham, Remedial Project Manager
Environmental Protection Agency, Region III
1650 Arch Street (Mail Code: 3HS11)
Philadelphia, PA 19103
Phone: (215) 814-3363
Fax: (215) 814-3025
Email: Cunningham.Lisa@epa.gov

Please note that all comments must be submitted and postmarked on or before August 1, 2011.

Terms Used in the Proposed Plan

Administrative Record: An official compilation of site-related documents, data, reports, and other information that are considered important to the status of and decisions made relative to a CERCLA site. The public has access to this material.

Applicable or Relevant and Appropriate Requirements (ARARs): The federal and state requirements that a selected remedy must attain. These requirements may vary among sites and remedial activities.

Cancer Risk: A type of risk resulting from exposure to chemicals that may cause cancer in one or more organs.

Comment Period: A time for the public to review and comment on various documents and actions taken, either by the Navy, EPA, or PADEP. A minimum 30-day comment period is held to allow community members to review the Administrative Record and review and comment on the Proposed Plan.

Central Tendency Exposure (CTE): Human health risk assessment calculation approach using average, 50th percentile, receptor risk behavior patterns to estimate a realistic expectation of receptor risk.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The Act created a trust fund, known as the Superfund, to investigate and clean up abandoned or uncontrolled hazardous substance facilities.

Feasibility Study (FS): Report identifying and evaluating alternatives for addressing the contamination present at a site or group of sites.

Hazard Index (HI): The sum of chemical-specific Hazard Quotients. An HI greater than 1 is considered to indicate the likelihood that adverse non-cancer health effects may occur.

Hazard Quotient (HQ): A comparison of the level of exposure to a substance in contact with the body per unit time to a chemical-specific Reference Dose to evaluate potential non-cancer health effects. Exceedance of an HQ of 1 is associated with an increased level of concern about adverse non-cancer health effects.

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

Initial Assessment Study (IAS): Preliminary investigation usually consisting of review of available data and information on a site, interviews, and a non-sampling site visit to observe areas of potential waste disposal and migration pathways.

Installation Restoration Program (IRP): Navy program to restore old waste sites for reuse and to protect human health and the environment.

In-Situ: Latin for in place or position.

In-Situ Anaerobic Bioremediation (ISAB): Natural bacterially-mediated breakdown of complex (usually toxic) molecules into less complex and common (usually less toxic) molecules in the natural setting (in this case, in the groundwater beneath Site 5).

Institutional control (IC): An administrative action imposed on a property to limit or prevent property owners or other people from coming into contact with contamination on the property.

Maximum Contaminant Levels (MCLs): The maximum permissible level of a contaminant in water delivered to any user of a public water system. MCLs are established by EPA and are enforceable standards.

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

Non-cancer Risk: A type of risk resulting from the exposure to chemicals that may cause systemic human health effects.

Remediation Goals (RGs): Set of remediation cleanup goals for individual contaminants agreed upon by the Navy, EPA, and PADEP, usually based on various risk-based concentrations and/or a site specific risk assessment.

Proposed Plan: A public participation requirement of CERCLA and the NCP in which the lead agency summarizes the preferred cleanup strategy and rationale. This agency also reviews the alternatives presented in the detailed analysis of the feasibility study, if prepared. The Proposed Plan may be prepared either as a fact sheet or as a separate document. In either case, it must actively solicit public comment on all alternatives under consideration.

Reasonable Maximum Exposure (RME): Human health risk assessment calculation approach using 90th percentile receptor risk

behavior patterns to estimate a conservative expectation of receptor risk.

Record of Decision (ROD): An official public document that explains which cleanup alternative(s) will be used at NPL sites. The ROD is based on information and technical analysis generated during the RI/FS and consideration of public comments and community concerns. The ROD is a legal document and explains the remedy selection process and is issued by the Navy following the public comment period.

Remedial Action Objective (RAO): Medium-specific or operable unit-specific goals for protecting human health and the environment.

Remedial Investigation (RI): Study that determines the nature and extent of contamination at a site.

Risk-Based Concentrations (RBCs): Risk-based concentrations established by EPA Region III and associated with specific levels of risk. These concentrations have been developed for both industrial and residential scenarios and incorporate both the ingestion and inhalation pathways. These reference standards are now referred to as the Regional Screening Levels (RSLs).

Site Inspection (SI): Sampling investigation with the goal of identifying potential sources of contamination, types of contaminants, and potential migration of contaminants. The SI is conducted prior to the RI.

FOR FURTHER INFORMATION

MAILING LIST

If you did not receive this Proposed Plan in the mail and wish to be placed on the mailing list for future information pertaining to this site, please fill out, detach, and mail this form to:

Commanding Officer
NAS JRB Willow Grove
Building # 78, Environmental Division
Attn: Hal Dusen
Willow Grove, Pennsylvania 19090

Name: _____

Affiliation: _____

Address: _____

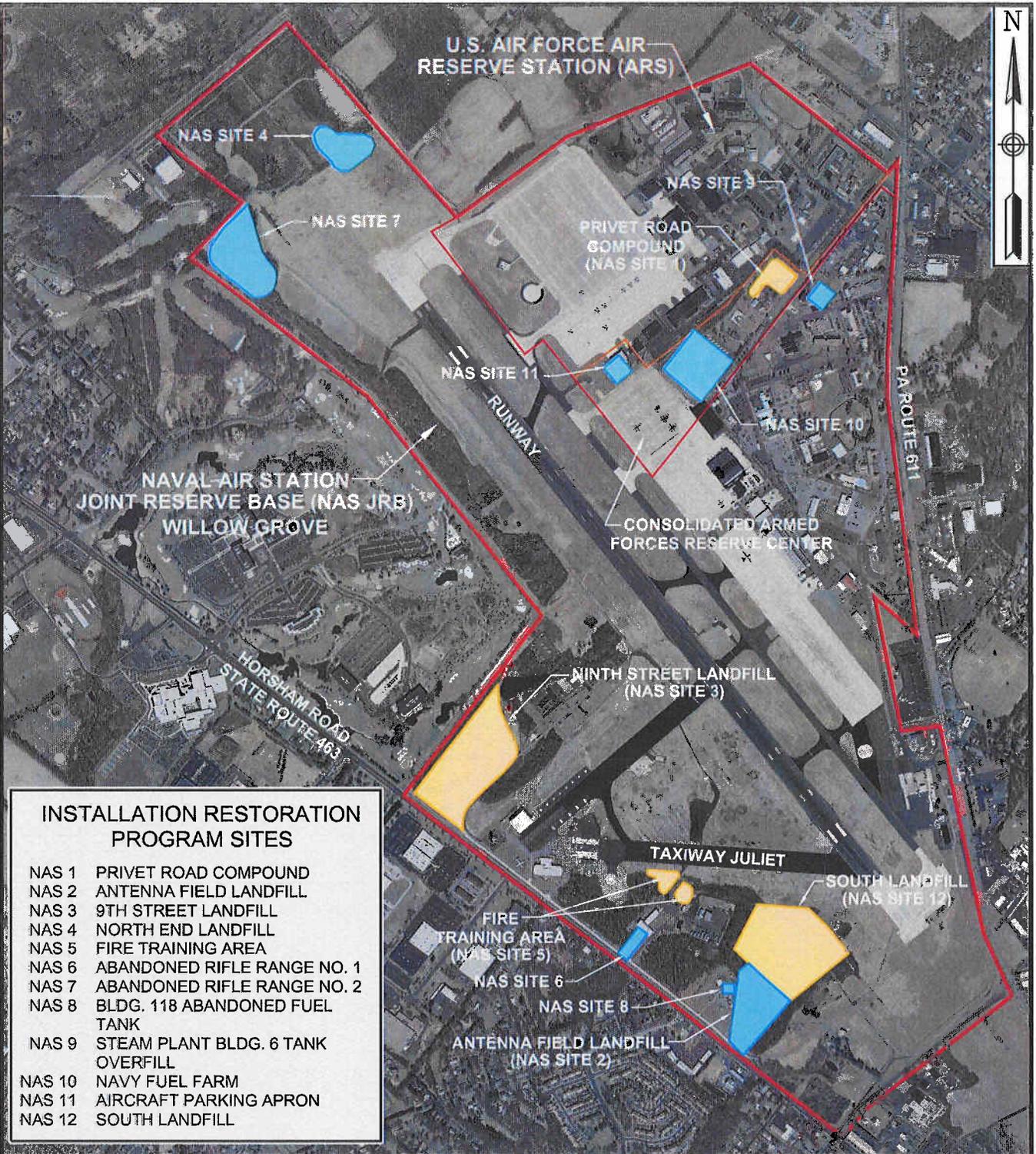
Phone: () _____

TABLE 1

**SITE SUMMARY
INSTALLATION RESTORATION PROGRAM
NAS JRB WILLOW GROVE
WILLOW GROVE, PENNSYLVANIA**

SITE	NAME	OPERABLE UNIT (OU)	STATUS
1	Privet Road Compound	Soil - OU 1 Groundwater - OU 3	Soil (OU 1) NFA ROD signed September 2006. Groundwater (OU 3) Interim ROD signed September 2008
2	Antenna Field landfill	Soil - OU 5 Groundwater- OU 9	No Action ROD Signed June 17, 2010
3	Ninth Street Landfill	Soil - OU 6 Groundwater- OU 10	RI/FS Report Pending
4	North End Landfill	---	Consensus Agreement for No Action January 2009
5	Fire Training Area	Soil - OU 4 Groundwater - OU 2	NFA ROD September 2007 Bioremediation Pilot Study ongoing
6	Abandoned Rifle Range No. 1	---	Consensus Agreement for No Action December 2007
7	Abandoned Rifle Range No. 2	---	Consensus Agreement for No Action August 2008
8	Site 8 - Building 118 Abandoned Fuel Tank	---	NFA Agreement October 2006
9	Steam Plant Building 6 Tank Overflow	---	NFA Agreement October 2006
10	Navy Fuel Farm	---	NFA at this time
SSA 11	Aircraft Parking Apron	---	Eliminated From Consideration
Site 12	South Landfill	---	RI/FS Process

NFA = No further action.



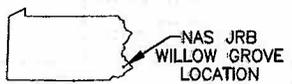
INSTALLATION RESTORATION PROGRAM SITES

NAS 1	PRIVET ROAD COMPOUND
NAS 2	ANTENNA FIELD LANDFILL
NAS 3	9TH STREET LANDFILL
NAS 4	NORTH END LANDFILL
NAS 5	FIRE TRAINING AREA
NAS 6	ABANDONED RIFLE RANGE NO. 1
NAS 7	ABANDONED RIFLE RANGE NO. 2
NAS 8	BLDG. 118 ABANDONED FUEL TANK
NAS 9	STEAM PLANT BLDG. 6 TANK OVERFILL
NAS 10	NAVY FUEL FARM
NAS 11	AIRCRAFT PARKING APRON
NAS 12	SOUTH LANDFILL

LEGEND

	ACTIVE SITE
	COMPLETED SITE*

* SEE TABLE 1



AERIAL BASE MAP PROVIDED BY THE PAMAP PROGRAM,
PA DEPARTMENT OF CONSERVATION AND NATURAL
RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY

0 1,400 2,800
SCALE IN FEET



**LOCATION OF IR SITES
NAS JRB WILLOW GROVE
WILLOW GROVE, PENNSYLVANIA**

SCALE AS NOTED	
FILE 112G00845BM02	
REV 0	DATE 05/27/11
FIGURE NUMBER FIGURE 1	

