4/30/07-00738

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April 30, 2007

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Bruce Beach
Office of Federal Facility Remediation
United States Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: *Response to Comments on Proposed Plan for SWMUs 1 and 24*
Naval Air Station Oceana
Virginia Beach, Virginia

Dear Mr. Beach

This letter presents the Navy's responses to USEPA comments provided in your letter dated March 30, 2007. These comments are presented, shown in italics, followed by Navy responses. Additionally, the Navy has incorporated these responses in the enclosed redline-text for your review.

GENERAL COMMENTS

1. *The draft Proposed Plan is in very good shape.*
Thank you.

2. *Please number all the pages.*
All pages have been numbered.

3. *Please replace "in situ" with "in-situ".*
This global edit has been made.

4. *For SWMU 1, the EPA questions the propriety of assigning the LTM of a disposal pit to the state UST Program.*

Although SWMU 1 consisted of a waste oil disposal pit, there are no longer any unacceptable risks associated with media at the site. Volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) have degraded to levels below applicable maximum contaminant levels (MCLs) and risk based preliminary remediation goals (PRGs). The provisions of CERCLA are in place to address potential risks to human and ecological receptors. Because there are no unacceptable risks associated with SWMU 1, no further remedial action is necessary at SWMU 1 to address the CERCLA release.

In the initial review of the Proposed Plan for SWMUs 1 and 24 in 2004, the VDEQ representative (Ms. Amy Webster) noted that the Virginia Underground Storage Tank (UST) Program has clean-up requirements for free product which are unrelated to risk. In order to qualify for closure, Virginia UST sites must have a product thickness of less than 0.01 foot in all wells. Therefore, consistent with a September 2004 VDEQ request (see email Attachment 1), the Navy agreed to transfer the site to the UST Program to address the free product following finalization of the Decision Document for the SWMU.

The EPA's questioning of the appropriateness of addressing free product under the UST program is understandable. For the purpose of improving clarity, this discussion will be removed from the proposed plan and decision document for SWMU 1. However, any additional actions at SWMU 1 to address the free product will be negotiated between the Navy and VDEQ under regulatory considerations other than CERCLA.

SPECIFIC COMMENTS

5. *Page 1, Text Box 1. Please insert dates for the public comment period and the public meeting.*
This edit will be made once regulatory consensus on the proposed plans has been reached and the documents can be finalized.

6. *Page 2, Section 2.1, IAS Paragraph, fourth line. Please add ", mixed with hazardous waste oil, fuel, and solvents," after "contaminants"*

The document has been edited as requested.

7. *Page 2, Section 2.1, Interim RFI Paragraph, fifth sentence. Please indicate how these contaminated sediments were handled.*

These sediments were not removed. These sediments were not sampled for TPH again, but they were sampled later for PAHs and BTEX. TPH concentrations are not useful in assessing risk, which is why this parameter was not collected again. PAHs and BTEX constituents were not detected in sediment samples collected immediately adjacent to the SWMU during the Round I RFI. The highest concentrations of PAHs detected during the Phase I RFI were detected at location SD-4 (See attached Figure and Table Attachment 2 from Phase I RFI) located side-gradient of the site (groundwater flow is from east to west). This is likely due to the use of the drainage ditches for stormwater conveyance.

8. *Page 3, Section 2.1, Phase 1 RFI Paragraph, last sentence. Please add "waste oil and" before "petroleum-related".*
The document has been edited as requested.

9. *Page 3, Section 2.1, CMS Paragraph, second and third lines. Please add "waste oil and" before "petroleum".*
The document has been edited as requested.

10. *Page 3, Section 2.1, HHRA Paragraph. Please discuss the assessment and potential risk from exposure to benzene, toluene, and 1,1 DCA.*
These compounds were evaluated in the human health risk assessment, but no unacceptable risks were identified. A sentence will be added to indicate that, "There were no unacceptable risks associated with any other contaminants," following the sentence that reads, "The Human Health Risk Assessment (HHRA) concluded that exposure to naphthalene in groundwater by future residents may pose a potential unacceptable risk."

11. *Page 3, FS Paragraph. Were any PRGs developed for benzene and/or 1,1 DCA?*
No unacceptable risks were identified for these constituents; as noted in the response to comment 10.

12. *Page 4, Section 2.1, Additional Groundwater Sampling Paragraphs. In the first paragraph, please delete the last sentence from this paragraph. This sentence should be included in the rationale of the Preferred Alternative.*

Consistent with our April 4, 2007 discussion, the first part of the last sentence was left as it was, but the second half which reads, "...and the Navy in consultation with USEPA and VDEQ determined that no additional evaluation or action was warranted at SWMU 1 under CERCLA," has been deleted.

Also, in the first paragraph, please change the reference to Figure 2, but then provide a more detailed figure, like figure 2-4 in the decision document, to indicate the distribution of benzene, naphthalene, and floating product at SWMU 1.

The figure was edited as requested.

Also, please delete the second paragraph.

The paragraph was deleted as requested.

13. *Page 5, Section 2.2, CMS Paragraph. Please add a new sentence, "For this study, residential use, MCLs, and beneficial reuse of the groundwater were not considered in developing cleanup goals." after the fifth sentence.*

The text was edited as requested.

14. *Page 5, Section 2.2, Phase III RFI Paragraph. Did the report evaluate the leaching to groundwater SSL. Is there a potential for a residual source in the soil?*

All petroleum contaminated soils above the water table in the source area were excavated and disposed offsite. There were no RBC exceedances for subsurface soils surrounding the area of the release.

15. *Page 6, Section 2.2, Additional Groundwater Sampling Paragraph. Please delete the fourth sentence in this paragraph. This sentence should be included in the rationale of the Preferred Alternative. Please include and reference a more detailed figure, like figure 1 in the Arsenic Technical Memo, which indicates all well locations and sampling results.*

As discussed in our April 4, 2007 conference call, these statements were requested by the previous EPA RPM because the RPM believed that it was confusing that the remedy recommended in the Proposed Plan was inconsistent with the recommended remedy in the FS. The second half of the paragraph that read, "...and the Navy in consultation with USEPA and VDEQ determined that no additional evaluation or action was warranted at SWMU," was deleted from the sentence. The requested figure was included.

16. *Page 7, Section 3, Only Paragraph. Please rewrite the third sentence to read "A **Decision Document (DD)** for SWMUs 2B, 2C, and 2E is scheduled for 2007." Also, please delete the fourth and fifth sentences in this paragraph; this is not the right section to make these statements.*

The document was edited as requested.

17. *Page 7, Section 4.1, SWMU 1 subsection, last paragraph. In the fifth line, is the cancer risk that is reported for adults, children, or the combination?*

The reported cancer risk is for the lifetime (child through adult) resident. The sentence was reworded to clarify this.

18. *Page 8, Section 4.1, SWMU 1 subsection, top paragraph. Please add a short discussion concerning potential risk from benzene and 1,1 DCA.*

No unacceptable risks were identified associated with these constituents. A sentence was added to clarify this.

19. *Page 8, Section 4.1, SWMU 1 subsection, second paragraph. Please indicate if any there were any MCL or Action Levels exceeded.*

The following sentences were added to clarify this: "Although benzene did not present an unacceptable risk, this constituent was monitored as previously detected concentrations exceeded the MCL. Concentrations were below the MCL during the last three rounds of monitoring (Figure 2). No other chemicals were detected at concentrations in exceeding corresponding MCLs."

20. *Page 9, Section 5, First Paragraph. Please delete all the sentences in this paragraph after the sentence that reads "There is no cost to implement this alternative."*

This edit was made as requested. However, please note that this text is directly from the proposed plan guidance document.

21. *Page 9, Section 5, Second Paragraph. Please delete the second sentence.*

In accordance with the action to address comment number 4, this action is deemed unnecessary for this proposed plan and the associated text was deleted as requested.

22. *Page 9, Section 6, Only Paragraph. Please fill in the dates for the public comment period and the Public meeting.*

This edit will be made once regulatory consensus on the proposed plans has been reached and the documents can be finalized.

23. *Page 10, Glossary, Background Concentrations. Please delete the last sentence.*

The text was edited as requested.

24. *Figures 2 and 3. Please replace these figures with more detailed figures as mentioned in earlier comments.*

Figure 4 has been added to show the arsenic concentrations. Figure 2 has been edited to provide more detail regarding concentrations of naphthalene, benzene, and free product.

If you have any questions concerning these comments, please give me a call at 757-671-8311 x444.

Sincerely,

Laura J. Cook

Laura J. Cook, P.G.

Project Manager

cc: Mr. Steve Mihalko/VDEQ
Mr. Timothy Reisch/NAVFAC Mid-Atlantic
Ms. Mary Margaret Kutz/NAVFAC Mid-Atlantic

Proposed Plan
SWMU 1 and SWMU 24
Naval Air Station Oceana
Virginia Beach, Virginia

MAY~~NOVEMBER~~ 2007~~6~~

1 Introduction

This **Proposed Plan** describes the preferred alternative for **Solid Waste Management Units (SWMUs)** 1 and 24, Naval Air Station (NAS) Oceana, Virginia Beach, Virginia. The preferred alternative, based on current site conditions, is no further remedial action. This Proposed Plan describes the rationale for this preference.

SWMUs 1 and 24 were initially investigated following the requirements of the NAS Oceana **Resource Conservation and Recovery Act (RCRA)** 3008 (h) Consent Order. However, in July 1998, the Navy, the **Virginia Department of Environmental Quality (VDEQ)**, and the **United States Environmental Protection Agency (USEPA)** agreed to conduct site remediation activities at NAS Oceana following the procedural and substantive requirements of the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)** program [42 U.S.C. §§9601 et seq., 10 U.S.C. §2701 et seq., and Executive Order 12580 (January 23, 1987)]. This Proposed Plan is issued by the Navy, the lead agency for site activities, and USEPA Region III in consultation with **VDEQ**. The Navy is issuing this Proposed Plan as part of its public participation responsibilities under Sections 113(k) and 117(a) of CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This Proposed Plan summarizes information that can be found in greater detail in the **Administrative Record** file and **Information Repository** for NAS Oceana. This Proposed Plan focuses on SWMUs 1 and 24. Other areas of NAS Oceana have been addressed in separate Proposed Plans. The Navy and the USEPA, in consultation with the VDEQ, will make the final decision on the remedial approach for SWMUs 1 and 24 after reviewing and considering all information submitted during the 30-day **public comment period**. The preferred alternative may be modified, or another **remedial action** may be selected on the basis of new information or public comments received. Therefore, public participation is encouraged. Key terms used in this Proposed Plan are identified in bold print the first time they appear and are defined in the attached glossary.

Mark Your Calendar for the Public Comment Period

Public Comment Period
XXXX, 2006–XXXX, 2006

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

Attend the Public Meeting
Date—
Time—
Place—Virginia Beach Central Library
Virginia Beach, Virginia

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

Location of Information Repository
Virginia Beach Central Library
4100 Virginia Beach Blvd.
Virginia Beach, Virginia 23452
Phone: (757) 431-3001

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2 Site Background

NAS Oceana, in Virginia Beach, Virginia, was established in 1940 as a small auxiliary airfield (Figure 1). Since then, NAS Oceana has grown to more than 16 times its original size and is now a 6,000-acre master jet base supporting a community of more than 9,100 Navy personnel and 11,000 dependents. The primary mission of NAS Oceana is to provide the personnel, operations, maintenance, and training facilities to ensure that fighter and attack squadrons on aircraft carriers of the U.S. Atlantic Fleet are ready for deployment.

2.1 SWMU 1 Background and Characteristics

SWMU 1, the West Woods Oil Disposal Pit, is in the northwest part of NAS Oceana, approximately 1,000 feet (ft) west of abandoned Runway 9 (Figure 2). The SWMU was originally an open pit, 50 to 100 ft in diameter, where 110,000 gallons of waste oil, fuel, solvents, various chlorinated and aromatic hydrocarbons, aircraft maintenance chemicals, paints, paint thinners and strippers, and lubricants were reportedly disposed of from the mid-1950s until the early 1960s. Metal, concrete, and other debris were also disposed of in the pit or were included in the fill material. During a significant storm in 1962, the contents of the pit are believed to have washed into the adjacent stormwater drainage ditch, located 100 ft to the west. As a result, waste disposal ceased, and the pit was filled with soil.

The area immediately surrounding the pit is dominated by trees, shrubs, and grass. The eastern perimeter of the SWMU is made up of mowed and old field grasses, impervious surfaces, and a small emergent freshwater wetland approximately 250 ft to the east. Surface drainage is directed toward drainage ditches oriented north-south and east-west that are part of an engineered stormwater and spill control system for NAS Oceana.

The surficial geology of the site consists of a 4- to 5-ft-thick layer of brown sandy silt underlain by an 11- to 13-ft-thick layer of clean, fine-to-very-coarse gray sand. These materials are members of the Columbia Group sediments. The Yorktown Formation underlies the sandy Columbia Group sediments and consists of gray silt. Shallow **groundwater** is generally encountered between 4 and 8 ft below ground surface (bgs) and flows westward, discharging into the main drainage ditch at the site.

The results of the investigations conducted at SWMU 1 are summarized below.

Initial Assessment Study (RGH, 1984)
An Initial Assessment Study (IAS) at NAS Oceana identified 16 potential areas of concern through a review of historical records, aerial photographs, site visits, inspections, and interviews with NAS Oceana personnel regarding waste generation, handling, and disposal practices. The IAS indicated that petroleum, oil, lubricant (POL)-related contaminants mixed with hazardous waste oil, fuel, and solvents were likely present within the soil and on the water table at SWMU 1 (referred to as Site 1 in the IAS). Consequently, the site was recommended for further investigation.

Round 1 Verification (CH2M HILL, 1986)
On the basis of the IAS's results and recommendations, a Round 1 Verification Study was conducted at SWMU 1 to evaluate the potential for petroleum contamination in groundwater from the former pit. Three groundwater samples were collected from the vicinity of the former pit and analyzed for volatile organic compounds (VOCs). Low concentrations of VOCs were detected in the groundwater. The report concluded that there was very little potential for offsite migration of VOCs, but because the exact location of the former pit was unknown, additional investigation was warranted.

Interim RCRA Facility Investigation (CH2M HILL, 1991)
An Interim RCRA Facility Investigation (RFI) was conducted at SWMU 1. Five groundwater samples were collected and analyzed for VOCs, total petroleum hydrocarbons (TPH), ethylene dibromide (EDB), polychlorinated biphenyls (PCBs), and 2,3,7,8 dioxin. TPH and VOCs were detected in groundwater. Surface water and sediment samples were collected and analyzed for only those parameters detected in groundwater. TPH was detected in sediment collected from the main drainage ditch west of the former pit at concentrations up to 1,260 milligrams per kilogram (mg/kg). Petroleum constituents were not present in surface water at levels of concern. The Interim RFI recommended additional investigations to further characterize the nature and extent of contamination in groundwater, soil, and sediment at SWMU 1.

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Phase I RCRA Facility Investigation (CH2M HILL, 1993)
Eleven soil and groundwater and four surface water and sediment samples were collected during the Phase I RFI to further characterize the nature and extent of contamination at SWMU 1. The soil results indicated that the soil contamination was limited to polycyclic aromatic hydrocarbons (PAHs) and VOCs with minor amounts of PCBs and pesticides. PAHs, pesticides, and PCBs were not detected in groundwater. However, benzene, toluene, ethyl benzene, and xylenes (BTEX) and 1,1-dichloroethane (1,1-DCA) were present in the shallow groundwater at isolated sample locations. There was no indication of site-related contamination in the deeper groundwater or in sediment and surface water in the drainage ditch west of the site. Therefore, the Phase I RFI concluded that the contamination is likely limited to waste oil and petroleum-related compounds in soil and shallow groundwater and recommended additional sampling to delineate the lateral extent of contamination in soil and groundwater during the Corrective Measures Study (CMS).

Corrective Measures Study (CH2M HILL, 1996)
The CMS included delineating the extent of soil contamination and additional groundwater sampling to confirm the presence of waste oil and petroleum on top of the water table and evaluate potential corrective measures for treatment. The results confirmed the presence of waste oil and petroleum-impacted soil. Approximately 0.04 ft of petroleum was present on top of the water table. An extraction well and monitoring system were installed to test the viability of extracting free product from the top of the water table. Two pilot tests were completed; however, no free product was recovered during either test. The lack of recovery was attributed to the tightness of the silts that contained the product.

Phase III RCRA Facility Investigation (CH2M HILL, 1999)
During the Phase III RFI, the Navy installed two-solar powered skimmers and began recovering free phase petroleum from the top of the water table at SWMU 1. In addition, six subsurface soil samples were collected and analyzed for dioxins and furans; the concentrations of these did not exceed the USEPA screening value of 1 microgram per kilogram (µg/kg).

Human Health Risk Assessment (CH2M HILL, 2001)
The surface soil, subsurface soil, surface water, sediment, and groundwater data collected during the Phase I and III RFIs and the CMS were evaluated to assess potential risks to current and future human receptors. The **Human Health Risk Assessment (HHRA)** concluded that exposure to naphthalene in groundwater by future residents may pose a potential unacceptable risk. There were no unacceptable risks associated with any other contaminants. The detailed results of the HHRA are included in Section 4 of this Proposed Plan.

Ecological Risk Assessment (CH2M HILL, 2000 and 2001)
The surface soil, surface water, sediment, and groundwater data collected during the Phase I and III RFIs and the CMS were evaluated to assess potential risks to terrestrial and aquatic receptors. A **Screening Ecological Risk Assessment (SERA)** and a **Baseline Ecological Risk Assessment (BERA)** (through Step 3a) were performed for SWMU 1 in accordance with USEPA guidance and Navy policy. Negligible site-related ecological risks were identified at SWMU 1 based on the limited habitat at the site and the similarity of site and base-wide background concentrations. A detailed summary of the SERA and BERA is included in Section 4 of this Proposed Plan.

Feasibility Study (CH2M HILL, 2001)
A **Feasibility Study (FS)** was completed to develop and evaluate remedial alternatives to prevent unacceptable human health risks from future residential exposure to naphthalene in groundwater. Three remedial alternatives were evaluated: (1) No Action, (2) Free-Product Removal with Institutional Controls and Long-Term Monitoring (LTM), and (3) Application of Oxygen Release Compound (ORC®) and Free-Product Removal with Institutional Controls and LTM. Each remedial alternative was analyzed with respect to the **nine evaluation criteria** provided in the NCP. The alternatives were then compared to one another with respect to their rating under the NCP evaluation criteria. On the basis of the comparative analysis, Free-Product Removal with Institutional Controls and LTM (Alternative 2) was selected as the Preferred Alternative. A risk-based preliminary remediation goal (PRG) was calculated for naphthalene in groundwater. The calculated PRG for naphthalene was 170 micrograms per liter (µg/L).

Hot-Spot Remediation Baseline Sampling and Background Investigation (2003)
In order to evaluate the potential for inclusion of SWMU 1 in the proposed ~~in situ~~in-situ hot-spot treatability study that was being developed for other Oceana SWMUs (SWMUs 2C and 2E), additional

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samples were collected at SWMU 1 to further characterize the nature and extent of organic concentrations in groundwater. This sampling was conducted in conjunction with the facility-wide background investigation for select inorganics.

Naphthalene was detected in the sample from OW01-PZ03 at a concentration of 170 µg/L, which is equal to the calculated PRG for the site. Benzene was also detected in the sample from OW01-PZ03 at a concentration of 6.2 µg/L, which is just above the **Maximum Contaminant Level (MCL)** of 5 µg/L. These were the only detections at SWMU 1 of constituents at concentrations equal to or exceeding the PRGs or MCLs during this sampling event.

Additional Groundwater Sampling and Product Thickness Measurements (2004)
Since the concentrations of naphthalene detected in the 2003 study were very close to the PRG concentration, three additional rounds of sampling were completed (July 2003, November 2003, and January 2004) to determine whether treatment would be necessary at SWMU 1. Although benzene was not identified as a risk driver in groundwater (CH2M HILL, 2001), historical benzene concentrations from OW01-PZ03 were above the MCL; consequently, it was decided to also analyze the groundwater from this well for benzene. Since historical concentrations of naphthalene exceeded the PRG in samples from OW01-PZ03 and OW01-MW04, groundwater samples from these wells were analyzed for naphthalene and benzene. Other site wells without historical exceedances of screening criteria were not resampled. Concentrations of naphthalene and benzene did not exceed the corresponding PRG and MCL values during any of the three rounds of sampling (Figure 2-4). Therefore, the alternative proposed in the 2001 FS (Alternative 2, Free-Product Removal with Institutional Controls and LTM) was deemed no longer necessary~~, and the Navy in consultation with USEPA and VDEQ determined that no additional evaluation or action was warranted at SWMU 1 under CERCLA.~~

~~Because free-product was observed in the monitoring wells during 2003 and 2004, the Navy plans to complete a Site Check investigation to determine if regulatory oversight of this site should continue under the VDEQ Underground Storage Tank (UST) program to address cleanup of the POL-related contamination.~~

2.2 SWMU 24 Background and Characteristics

SWMU 24 is located in an industrial area of NAS Oceana near Building 840, which contained a waste-oil bowser, or portable tank. Waste solvents and oils generated between 1977 and 1982 at the equipment maintenance garage in Building 840 were hand carried over the unpaved lot and poured into the bowser in the southern portion of the Building 840 compound (Figure 3). The bowser was then transported to the tank farm for disposal. Environmental concerns were first recognized at this site during the 1988 RFI site inspection when heavy staining of the ground was observed in the area surrounding the waste oil bowser. The waste oil bowser has since been removed from the site.

SWMU 24 consists of a fenced gravel area surrounded by a perimeter of brush, forest, and mowed lawn. With the exception of the forested area, the site continues to be used as a parking and storage area. There is limited wildlife habitat in the immediate area of SWMU 24; however, wildlife inhabits the surrounding forested areas.

The surficial geology of the site consists of a 4- to 5-ft-thick layer of brown sandy silt underlain by an 11- to 13-ft-thick layer of silty and clean, fine-to-very-coarse sand. These sediments compose the Columbia Group. The Columbia Group silty sands grade into the gray silty to clean Yorktown Formation sands at approximately 17 ft bgs. The Yorktown Formation sands extend to a depth of approximately 51 ft bgs, at which point the lean clays of the Eastover-Calvert Confining Unit are encountered. Shallow groundwater is encountered at approximately 5 to 9 ft bgs and generally flows to the south/southwest.

The results of the investigations conducted at SWMU 24 are summarized below.

Phase I RCRA Facility Investigation (CH2M HILL, 1993)
The RFI was conducted to characterize the soils in the vicinity of the former waste-oil bowser. Two soil samples were collected to a depth of 1 ft below ground surface (bgs) and were analyzed for inorganics, VOCs, PAHs, and TPH. Benzo(a)pyrene and several inorganics were detected in the soils above mean **background concentrations** and/or human health-based screening levels. The RFI recommended additional characterization to determine if the potential soil contamination at the site was petroleum-related.

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Petroleum Oil Lubricant Corrective Measures Study (CH2M HILL, 1994)
As part of a CMS for Petroleum Contaminated Sites (POL-CMS), surface and subsurface soil was sampled at six locations and analyzed for TPH, PAHs, and metals to delineate the petroleum-related contamination to support a potential removal action. Additionally, four temporary monitoring wells were installed and groundwater samples were collected and analyzed for TPH, VOCs, PAHs, and metals. Most of the soils contained TPH concentrations above the VDEQ storage tank guidance notification standard of 100 mg/kg. TPH and VOCs were detected in groundwater. The POL-CMS recommended excavation of the TPH-contaminated soil and additional investigation to further characterize the nature and extent of groundwater contamination.

Excavation, Transportation, and Disposal of Petroleum-Contaminated Soils (ENSCI, Env. Inc., 1995)
A soil removal action was implemented based on the recommendations of the POL-CMS. The clean up goal was 100 mg/kg for TPH. Approximately 770 cubic yards of TPH-contaminated soil was excavated from SWMU 24. Soil was removed to the depth of the water table, but TPH concentrations in the confirmation samples remained above the cleanup goal of 100 mg/kg. Since excavation activities were terminated prior to meeting the cleanup goal for TPH, the USEPA requested confirmatory sampling of groundwater.

Phase II RCRA Facility Investigation (CH2M HILL, 1995)
Following the soil removal action, additional groundwater investigation activities were conducted as part of the Phase II RFI. Nineteen groundwater samples were collected from temporary wells and analyzed for VOCs. Additionally, six shallow permanent monitoring wells were installed, sampled, and analyzed for VOCs, TPH, PAHs, total metals, and dissolved metals. The sample results indicated chlorinated VOCs in the deeper portion of the shallow aquifer and POL-related VOCs in the upper portion of the shallow aquifer. Additional groundwater sampling was recommended to determine the horizontal and vertical extent of the VOC plume.

Corrective Measures Study (CH2M HILL, 1996)
Groundwater was further investigated during the CMS on the basis of the recommendations of the Phase-II RFI. Groundwater samples were collected from five existing and four new monitoring wells and analyzed for VOCs. The CMS determined that groundwater was contaminated with chlorinated VOCs, specifically, vinyl chloride, cis-1,2-dichloroethene (cis-1,2-DCE), and trichloroethene (TCE). The corrective action objectives for site groundwater were to prevent vertical and lateral migration of contaminated groundwater. Groundwater cleanup goals were developed on the basis of industrial land use for TCE (33 µg/L), cis-1,2-DCE (276 µg/L), and vinyl chloride (2.9 µg/L). For this study, residential use, MCLs, and beneficial reuse of the groundwater were not considered in developing cleanup goals. Three alternatives were evaluated to address the groundwater contamination at SWMU 24: (1) No Action, (2) Plume Monitoring and Remediation of the Hot Spot, and (3) Plume Containment and Extraction at the Hot Spot. The recommended alternative was Plume Monitoring and Remediation of the Hot Spot (Alternative 2).

Phase III RCRA Facility Investigation (CH2M HILL, 1999)
Ten subsurface soil samples were collected during the Phase III RFI to confirm VOCs and PAHs in soil were at acceptable concentrations following the 1995 removal action. The maximum detected concentrations were compared to the human health residential risk-based concentrations (RBCs). No RBCs were exceeded in any of the subsurface soil samples collected. Therefore, human health risks in soil were considered acceptable, and no additional action was recommended. A SERA was recommended to evaluate potential exposure pathways and risks to ecological receptors.

~~In Situ~~In-situ Aeration Pilot Test (CH2M HILL, 1996--1997)
In late 1996 and early 1997, an ~~in situ~~in-situ aeration pilot study was initiated at SWMU 24 to reduce the concentrations of VOCs in groundwater. This treatment method involved air stripping to remove VOCs from groundwater. Concentrations of VOCs were significantly reduced during the pilot study.

Direct-Push Technology Investigation (CH2M HILL, 1998)
A direct-push technology investigation was conducted to determine the boundaries of the cis-1,2-DCE groundwater plume and to assess the overall effectiveness of the ~~in situ~~in-situ aeration pilot study. Groundwater samples were also collected from the existing monitoring wells to support an HHRA. The groundwater sampling results indicated that VOC concentrations had been reduced to below MCLs in all but three monitoring wells and piezometers, suggesting the presence of a localized cis-1,2-DCE hot spot

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in the immediate vicinity of the former soil hot spot. The results of this groundwater investigation and subsurface soil samples collected following the removal action were used to complete an HHRA.

Human Health Risk Assessment (CH2M HILL, 2001)
The HHRA characterized risks to potential future receptors from exposure to post-removal action subsurface soil and groundwater. There were no constituents detected above the RBCs in subsurface soil. Human health risks were identified on the basis of exposure to cis-1,2-DCE, arsenic, iron, and manganese in groundwater by potential future residents. The detailed results of the risk assessment are included in Section 4 of this Proposed Plan.

Screening Ecological Risk Assessment (CH2M HILL, 1999)
In 1999, SWMU 24 was included in a multi-site SERA to determine if potentially complete exposure pathways exist for ecological receptors. No complete exposure pathways were identified at SWMU 24. Therefore, NFA to address ecological risk was recommended for SWMU 24.

Feasibility Study (CH2M HILL, August 2001)
An FS was completed to develop and evaluate remedial alternatives for potential unacceptable human health risks associated with groundwater. PRGs were selected for the chemicals posing potential human health risks. The MCLs were selected as the PRGs for cis-1,2-DCE (70 µg/L) and arsenic (10 µg/L). Risk-based PRGs were developed for iron (2,300 µg/L) and manganese (310 µg/L) because an MCL value does not exist for these analytes. The remedial alternatives evaluated were (1) No Action, (2) Institutional Controls and LTM, and (3) Use of ORC®, Institutional Controls, and LTM. Each remedial alternative was evaluated with respect to the nine evaluation criteria provided in the NCP. The alternatives were then compared with one another with respect to their rating under the NCP evaluation criteria. Based on the comparative analysis, Alternative 2, Institutional Controls and LTM, was selected as the Preferred Alternative.

Hot-Spot Remediation Baseline Sampling and Background Investigation (2003)
In order to evaluate the potential for inclusion of SWMU 24 in the proposed ~~in situ~~in-situ hot-spot treatability study that was being developed for other Oceana SWMUs (SWMUs 2C and 2E), additional samples were collected at SWMU 24 to further characterize the nature and extent of organic concentrations in groundwater. This sampling was conducted in conjunction with the facility-wide background investigation for select inorganics. During this investigation, only cis-1,2-DCE was detected (83 µg/L) above the MCL (70 µg/L) at one monitoring well location (OW24-PZ03) at SWMU 24.

Additional Groundwater Sampling (2003-2004)
Since the concentration of cis-1,2-DCE detected in the 2003 study was very close to the MCL concentration and there was a decreasing trend in concentrations of this constituent, three additional rounds of sampling were completed in 2003 and 2004 to further evaluate trends in contaminant concentrations and to determine whether treatment would be necessary at SWMU 24. For this evaluation, groundwater samples collected from OW24-PZ03 were analyzed for chlorinated volatiles. Concentrations of chlorinated volatiles did not exceed the corresponding MCL values in any of the three rounds of sampling. Therefore the alternative proposed in the 2001 FS (Institutional Controls with LTM) was deemed no longer necessary to address organics at SWMU 24. ~~, and the Navy in consultation with USEPA and VDEQ determined that no additional evaluation or action was warranted at SWMU 24 under CERCLA~~. However, arsenic concentrations remained above the MCL of 10 µg/L in samples collected during the 2004 groundwater monitoring. The NAS Oceana partnering team, comprising remedial project managers (RPMs) from the Navy, USEPA, and VDEQ agreed that further evaluation of arsenic in groundwater was warranted.

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Arsenic Technical Memoranda (CH2M HILL, 2005)
A statistical evaluation of arsenic in groundwater was completed to support an action determination at SWMU 24. Following guidelines for making risk management decisions, which were developed by the Navy, USEPA, and VDEQ RPM managers/supervisors, the NAS Oceana partnering team determined NFA is warranted to address arsenic in groundwater at SWMU 24 based on the following rationale: (1) there is no discernable arsenic plume; (2) statistical analysis indicates that concentrations of arsenic upgradient of SWMU 24 are higher than concentrations downgradient, indicating that the source of arsenic is not related to site activities; (3) the central tendency non-cancer and cancer risks associated with exposure to arsenic in groundwater is comparable to the risk posed by exposure to arsenic at the MCL concentration; and (4) the availability of potable water within the vicinity of SWMU 24 further

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reduces the potential that groundwater from the site would ever be used as potable water. Arsenic concentrations in SWMU 24 groundwater are shown on Figure 4.

3 Scope and Role of Response Action

Sixty SWMUs were recommended for study in the Draft RCRA Consent Order issued by the USEPA. After reviewing the results of the RFI, the Navy and the USEPA determined that 41 of these SWMUs required no further CERCLA action or should be regulated under other federal or state programs. With the exception of SWMUs 1, 2B, 2C, 2E, and 24, the remaining SWMUs were closed out in CERCLA with no further action. A **Decision Document (DD)** forwith a remedy of enhanced bioremediation and groundwater use restrictions to address groundwater contamination at SWMUs 2B, 2C, and 2E is scheduled for 2007. Given the results of the investigations and risk assessments conducted at SWMUs 1 and 24, it is concluded that there are no CERCLA releases posing unacceptable human health or ecological risks. Therefore, the Preferred Alternative for SWMUs 1 and 24 is no further action. The Proposed Plan for SWMUs 1 and 24 does not include or directly impact any other sites at NAS Oceana.

4 Summary of Site Risks

The human health and ecological risks at SWMUs 1 and 24 and risk management decisions are summarized in the following subsections.

4.1 Human Health Risk Summary

A Baseline HHRA was completed for SWMUs 1 and 24 to evaluate potential risks from current and future human exposure to site **media**. The HHRAs for SWMUs 1 and 24 are an estimate of the likelihood of health problems occurring if no cleanup action is taken. Potential **cancer risks** and **noncancer hazards** were calculated on the basis of conservative reasonable maximum exposure (RME) concentrations that portray the highest level of human exposure that could be expected to occur, and a more-realistic central tendency (CT) exposure concentration based on more reasonably expected exposure levels. Potential unacceptable cancer risks are expressed as the probability that a person has greater than a 1 in 10,000 (1×10^{-4}) chance of developing cancer, with an acceptable risk range of 10^{-4} to 10^{-6}. The potential for noncancer hazards was evaluated by comparing an exposure level over a specified time period with a reference dose concentration that an individual may be exposed and not harmfully affected. The ratio of exposure to toxicity is called a **hazard quotient (HQ)**. An HQ greater than 1 indicates that a **receptor's** dose of a single contaminant is greater than the reference dose and that exposures may present an unacceptable risk. The **hazard index (HI)** is generated by adding the HQs for all **chemicals of potential concern (COPCs)** that affect the same target organ (for example, the liver). For noncancer, an HI value greater than 1 may indicate exposure that may present an unacceptable risk. A summary of the HHRA results are provided by SWMU below.

SWMU 1

Potential human health risks were identified at SWMU 1. These potential risks were associated with soil (dermal contact and ingestion), groundwater (dermal contact, ingestion, and inhalation), and sediment (dermal contact). The potential human receptors evaluated were the current and future industrial worker, current and future adult trespasser/visitor, current and future adolescent trespasser/visitor, future construction worker, and future adult and child residents.

Surface water constituent concentrations did not exceed the human health risk-based screening values; therefore, risk was not further quantified. The noncancer hazards and cancer risks associated with exposure to drainage ditch sediment were below or within USEPA's acceptable levels.

On the basis of current land use scenarios, there were no unacceptable risks or hazards associated with exposure to soil or groundwater. Additionally there were no unacceptable risks or hazards associated with future land use by adult/adolescent trespasser/visitors, construction workers, and industrial workers.

The noncancer hazard associated with exposure to site soil by the future adult resident is 0.40, which is below USEPA's target threshold of 1. The noncancer hazard associated with exposure to site soil by future child residents is 1.8 primarily due to ingestion of surface and subsurface soil. However, there were no individual target organ effects (HQs) greater than 1 and the CT noncancer HI was below 1. Additionally, the cancer risk (CR = 2.5×10^{-5}) associated with the future lifetime (child through adult)

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residential use of the site was within USEPA's acceptable risk range of 10^{-4} to 10^{-6}. Therefore, there were no unacceptable risks for potential future residents due to exposure to site soil.

The HHRA (CH2M HILL, 2001) established that potable use of site groundwater was within USEPA's acceptable cancer risk range (CR = 2.5×10^{-5}); however, potable use would result in a noncancer hazard for adult (HI = 10) and child (HI = 1.3) residents due to ingestion, dermal contact, and inhalation of naphthalene. Although benzene and 1,1 DCA were detected in previous investigations, no unacceptable risks were identified for these constituents.

During development of the FS, a PRG of 170 µg/L for naphthalene in groundwater was calculated on the basis of a hypothetical future residential exposure. Following the HHRA and FS, four rounds of groundwater samples were collected at SWMU 1 to evaluate the contaminant concentration trends. Naphthalene was not detected in groundwater above the PRG during this 1-year groundwater-monitoring period, indicating that the groundwater no longer poses unacceptable human health risks to future receptors. Although benzene did not present an unacceptable risk, this constituent was monitored as previously detected concentrations exceeded the MCL. Concentrations were below the MCL during the last three rounds of monitoring (Figure 2). No other chemicals were detected at concentrations in exceeding corresponding MCLs.

SWMU 24

A quantitative HHRA was not conducted for surface soil because contaminated soil at the site was excavated, and confirmation samples did not exceed human health risk-based screening criteria. Potential human health risks were assessed for future land use by an industrial worker, construction worker, and resident. It was assumed that these receptors could be exposed to subsurface soil through incidental ingestion, dermal contact, and inhalation of fugitive emissions from soil. The noncancer hazard and cancer risks associated with exposure to subsurface soil by all receptors and pathways were below USEPA target levels.

During the HHRA (CH2M HILL, 2001), potential human health risks associated with ingestion and dermal contact with groundwater by future residents and dermal contact by future construction workers were calculated. The noncancer hazards and cancer risks associated with dermal contact with groundwater by future constructions workers were below USEPA's target levels. RME noncancer hazards were identified on the basis of the use of groundwater as a potable residential water supply. The RME noncancer hazard for exposure to groundwater by child (HI = 31) and adult (HI = 14) residents were above the USEPA's target HI of 1. Additionally, the CT noncancer hazards were also above the target HI for child (HI = 21) and adult (HI = 12) residents. These hazards were primarily associated with ingestion of cis-1,2-DCE, arsenic, iron, and manganese. Potable use of groundwater would also pose a RME cancer risk (2×10^{-3}) and CT cancer risk (6.8×10^{-4}), above USEPA's acceptable risk range of 1×10^{-4} to 1×10^{-6} due to ingestion of arsenic. However, the potential risks associated with cis-1,2-DCE, arsenic, iron, and manganese in groundwater are considered acceptable on the basis of the following:

- cis-1,2-DCE—concentrations detected in groundwater-sampling events conducted after the HHRA was completed were below the MCL of 70 µg/L, indicating that the groundwater no longer poses unacceptable human health risks to future receptors from exposure to cis-1,2-DCE
- Arsenic—additional groundwater-sampling and statistical analysis conducted after the HHRA was completed indicated that (1) there is no discernable arsenic plume; (2) statistical analysis indicates that concentrations of arsenic upgradient of SWMU 24 are higher than concentrations downgradient, indicating that the source of arsenic is not related to site activities; (3) the central tendency noncancer and cancer risks associated with exposure to arsenic in groundwater is comparable to the risk posed by exposure to arsenic at the MCL concentration; and (4) the availability of potable water within the vicinity of SWMU 24 further reduces the potential that groundwater from the site would ever be used as potable water.
- Iron and manganese—CT exposure concentrations of these constituents are within daily nutrient intake guidelines and do not pose a potential unacceptable risk to human health if groundwater is used for residential purposes

On the basis of this rationale, no further action to protect human health is warranted.

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4.2 Ecological Risk Summary

Site-specific risk assessments are summarized in the following subsections.

SWMU 1

A BERA was completed at SWMU 1 in 2001 and indicated that contaminant levels of inorganic COPCs identified in the soil, surface water, and sediment at SWMU 1 were generally consistent with basewide concentrations throughout NAS Oceana. Additionally, organic contamination in the soil poses a relatively low risk and occurred only in localized areas. SWMU 1 contains a main drainage ditch and a tributary drainage ditch near the former oil disposal pit. No COPC exceeded both a screening value and an upgradient concentration in surface water or sediment in the main drainage ditch and tributary drainage ditch near the former oil pit. In addition, considering the relatively low habitat value of these ditches, which are periodically maintained as part of the stormwater system, wildlife is likely to forage elsewhere, where the habitat quality is better.

On the basis of this evidence, the potential risk from organics in surface soils to ecological receptors is negligible. Consequently, the final BERA concluded that no further ecological investigation or evaluation is warranted for SWMU 1.

On the basis of the results of the SERA and BERA, no further action is recommended to protect ecological receptors at SWMU 1.

SWMU 24

No complete exposure pathways to ecological receptors were identified for SWMU 24 during the 2001–2002 SERA. Therefore, no risk was identified, and no further action is warranted to protect ecological receptors.

5 Preferred Alternative

On the basis of the field data collected during previous investigations and the results of the risk assessments summarized in Section 4, it is the current judgment of the Navy and USEPA, in consultation with VDEQ, that the site conditions at SWMUs 1 and 24 are protective of human health and the environment and that no further action is warranted to protect public health, welfare, and the environment from actual or threatened releases of CERCLA-related hazardous substances into the environment. Therefore, the no-further-action alternative is the only remedial alternative considered. Hence, the Navy recommends no further CERCLA action as the Preferred Alternative for SWMUs 1 and 24. There is no cost to implement this alternative. ~~On the basis of the information currently available, the Navy believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs with respect to the nine evaluation criteria as required by the NCP at 40 CFR Part 300.430(e)(9)(iii). The Navy expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b), insofar as it (1) is protective of human health and the environment, (2) complies with **Applicable or Relevant and Appropriate Requirements (ARARs)**, (3) is cost effective, (4) uses permanent solutions and alternative treatment technologies to the maximum extent practicable, and (5) satisfies the preference for treatment as a principle element (or justifies not meeting the preference).~~

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The Navy seeks to close out SWMUs 1 and 24 under CERCLA and thus the associated 3008(h) Consent Order requirements. ~~If necessary, any future regulatory oversight for SWMU 1 will be implemented in accordance with VDEQ's UST/POL Program.~~

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6 Community Participation

The Navy and USEPA provide information regarding environmental cleanups at NAS Oceana to the public through the Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, the information repository, and announcements published in *The Virginian-Pilot* newspaper. The public is encouraged to gain a more comprehensive understanding of SWMUs 1 and 24 and environmental actions at NAS Oceana. The public comment period for this Proposed Plan is from XXXX, 2006, through XXXX, 2006, and a public meeting will be held on XXXX, 2006, at 7:00 p.m. (See page 1 of this report for details.) The Navy will summarize and respond to comments in a responsiveness summary, which will become part of the official DD and will also be included in the Administrative Record file.

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Glossary

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

Applicable or Relevant and Appropriate Requirements (ARARs): These are federal or state environmental rules and regulations.

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

Baseline Ecological Risk Assessment (BERA): A study in which possible adverse effects to populations of plants and animals are evaluated using site data.

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

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

Chemical of Potential Concern (COPC): A compound present in site media at a concentration that exceeds risk screening criteria but has not yet been determined to pose risk; further evaluation is completed to evaluate site-specific risk in a quantitative risk assessment.

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

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

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

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

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

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

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

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 the site.

Nine Evaluation Criteria:

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

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2. **Compliance with ARARs**—Addresses whether a remedy will meet all of the ARARs of other federal and state environmental laws and/or justifies a waiver of the requirements.
3. **Long-Term Effectiveness and Permanence**—Addresses the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.
4. **Reduction of Toxicity, Mobility, and Volume through Treatment**—Discusses the anticipated performance of the treatment technologies a remedy may employ.
5. **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.
6. **Implementability**—Evaluates the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement an option.
7. **Cost**—Compares the estimated capital, operations, and maintenance and present worth costs.
8. **State Acceptance**—Considers the state support agency comments on the Proposed Remedial Action Plan (PRAP).
9. **Community Acceptance**—Considers the communities comments on the PRAP.

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

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

Preliminary Remediation Goal (PRG): Concentrations set for individual chemicals that for carcinogens, correspond to a cancer risk of one in one million, and for a noncancer risk correspond to a hazard quotient of 1. PRGs are generally selected when ARARs are not available.

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 remedy selection.

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

Screening Ecological Risk Assessment (SERA): A highly conservative desktop study used to evaluate the likelihood that adverse effects to populations of plants and animals are occurring or may occur as the result of exposure to one or more stressors.

Solid Waste Management Unit (SWMU): The area of the facility where a hazardous substance, hazardous waste, hazardous constituent, pollutant, or contaminant from the facility has been deposited, stored, disposed of, or placed; has migrated to; or has otherwise come to be located.

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

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

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Mr. Tim Reisch
NAVFAC MID LANT
9742 Maryland Avenue
Norfolk, VA 23511-3095

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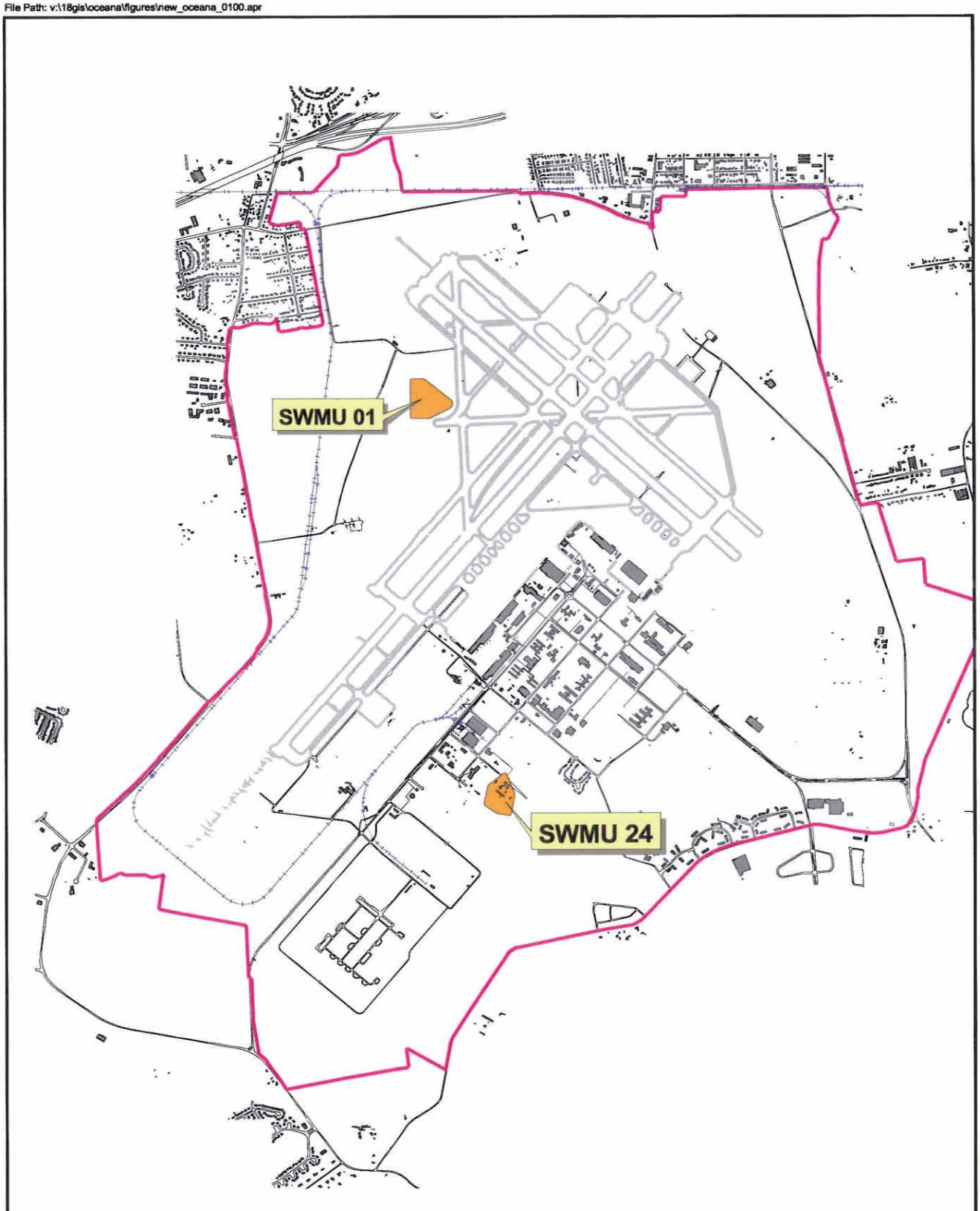

Figure 1
NAS Oceana Location and Vicinity
NAS Oceana, Virginia Beach, Virginia

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OW01-MW04	May '86	Aug '90	Jan '93	Nov '98	Jan '03	Jul '03	Nov '03	Jan '04
Benzene	4 J	ND	6	3 L	NA	NA	NA	NA
Naphthalene	NA	NA	NA	208	7	40	87	80

OW01-MW10	Mar '94	Nov '98
Benzene	ND	1 U
Naphthalene	ND	1 U

OW01-PZ04	Nov '98
Benzene	2
Naphthalene	22

OW01-MW08	Jan '93	Mar '94	Nov '98
Benzene	ND	ND	1 J
Naphthalene	ND	ND	1 U

OW01-PZ05	Nov '98
Benzene	1 U
Naphthalene	13

OW01-MW02	Nov '98
Benzene	1 U
Naphthalene	1 U

OW01-PZ01	Nov '98
Benzene	1 U
Naphthalene	1 U

OW01-PZ03	Nov '98	Jan '03	Jul '03	Nov '03	Jan '04
Benzene	6 J	6.2	2.9	4.7	5 J
Naphthalene	10 U	170	73	93	150

OW01-MW07	Jan '93	Nov '98
Benzene	ND	1 U
Naphthalene	ND	1 U

OW01-PZ02	Nov '98
Benzene	1
Naphthalene	22

OW01-MW05	Aug '90	Jan '93	Nov '98
Benzene	1 J	1 J	1 J
Naphthalene	NA	93	58

OW01-MW03	May '86	Aug '90	Jan '93	Nov '98
Benzene	ND	ND	ND	1 U
Naphthalene	NA	NA	ND	1 U

OW01-MW06	Jan '93	Mar '94	Nov '98
Benzene	ND	ND	1 U
Naphthalene	ND	ND	1 U

LEGEND

- Monitoring Well
- Piezometer
- SWMU 1 Boundary
- Area of Free Product

*Product thickness on well OW01-P203 May 2004 was 0.13 feet.

N

0 100 200 Feet

Figure 2
SWMU 1 Historic Benzene Concentrations
NAS Oceana
Virginia Beach, Virginia

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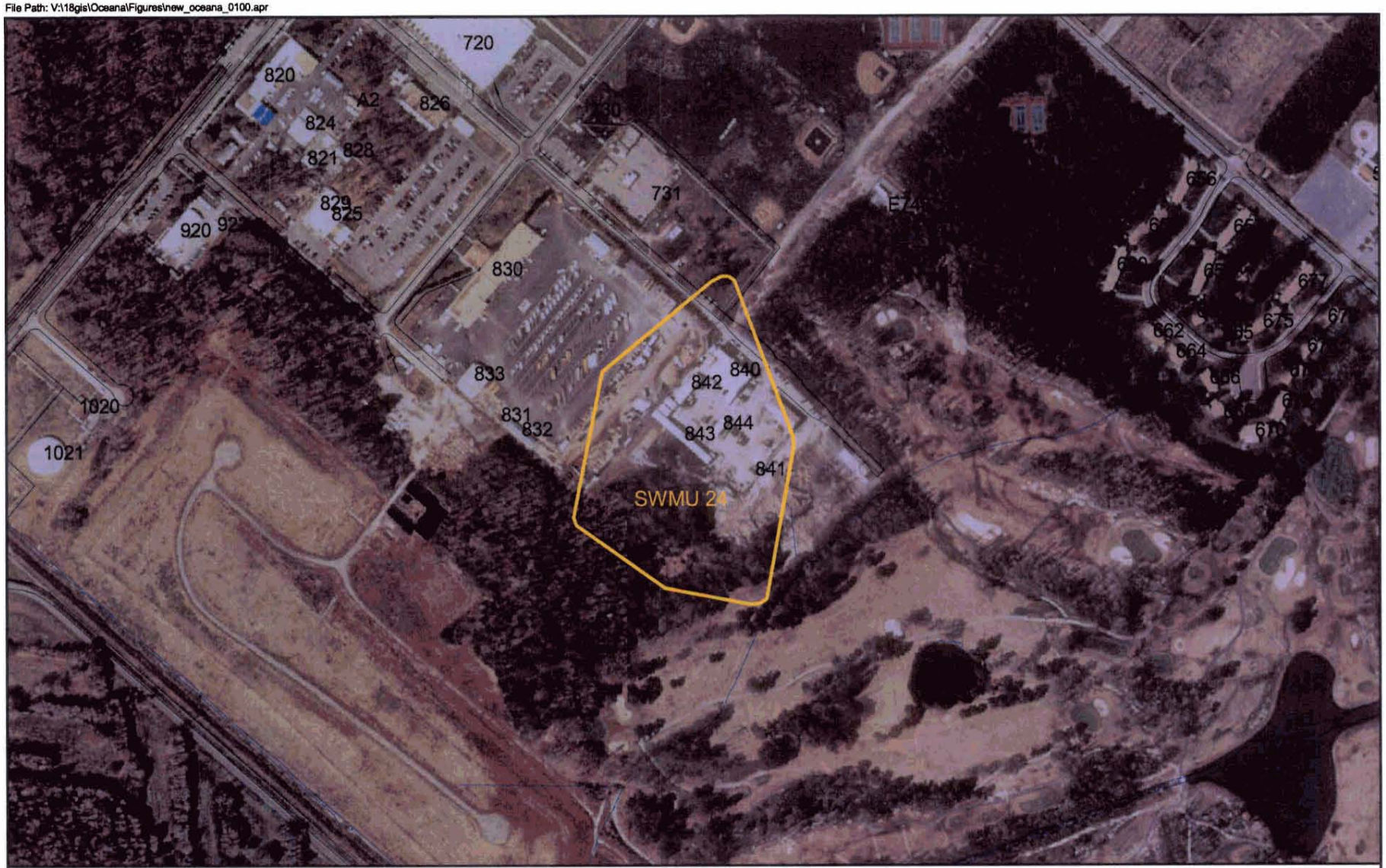

LEGEND

- OCEANA SWMUs
- Roads
- Stormwater Drains

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Figure 3
SWMU 24 Location and Vicinity
NAS Oceana
Virginia Beach, Virginia

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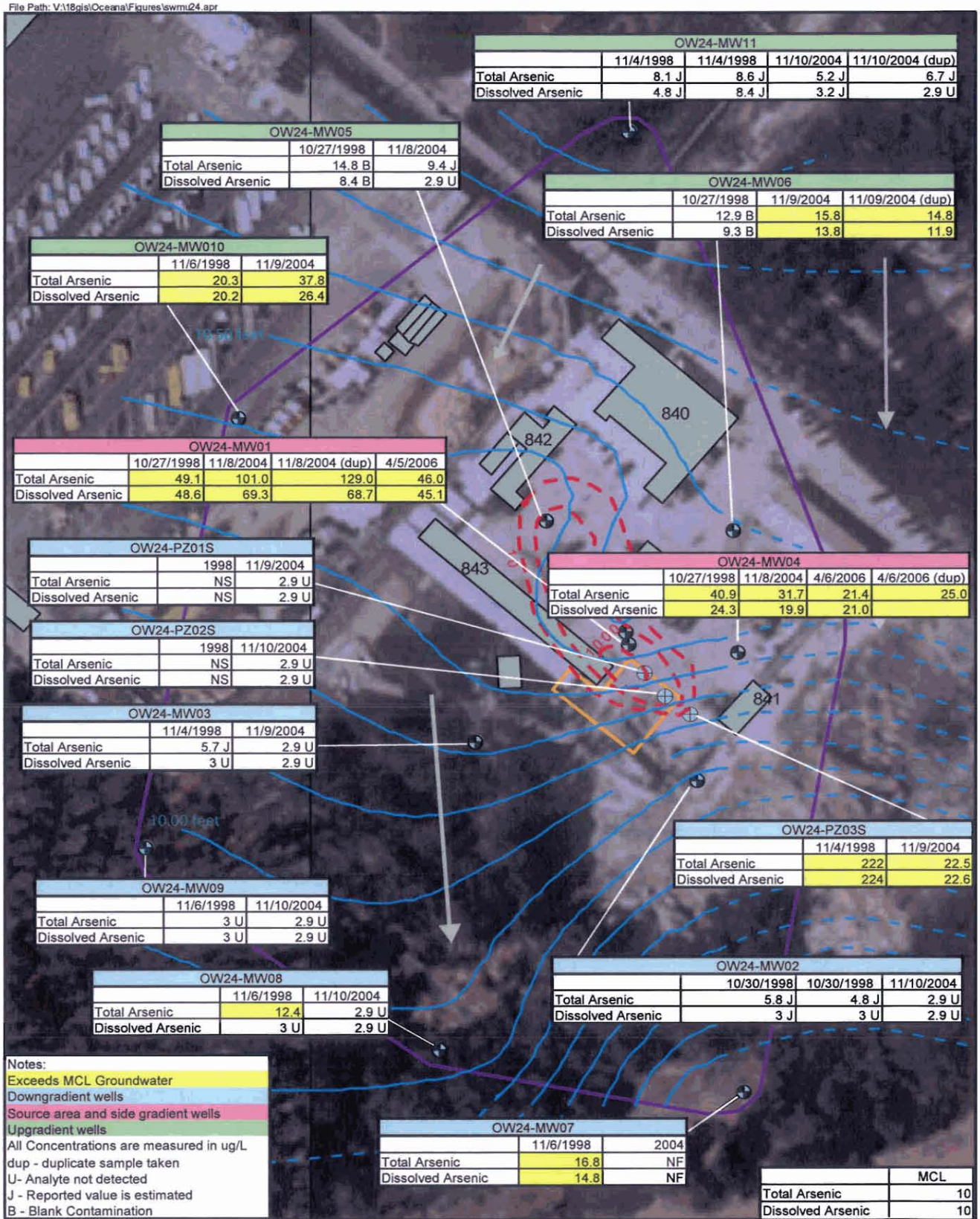

Figure 4
Arsenic Concentrations in Groundwater
SWMU 24, 1998, 2004 and 2006 data
NAS Oceana
Virginia Beach, Virginia

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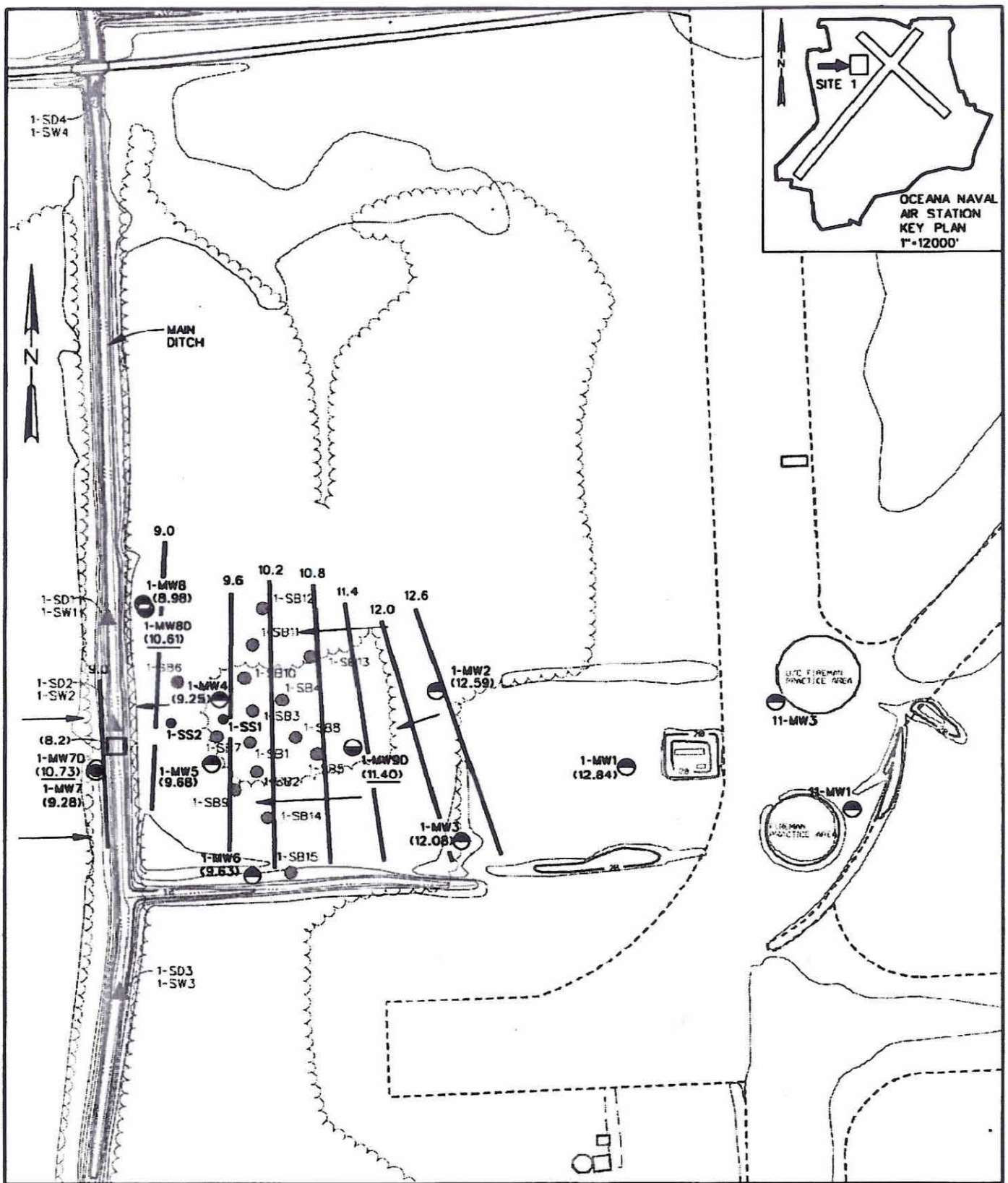

Figure 4-1-3
WATER TABLE ELEVATIONS WITH EQUIPOTENTIAL CONTOURS FOR THE SHALLOW AQUIFER AT SITE 1
JANUARY 26, 1993

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28-Oct-1993

Table 4-1-9
ORGANIC COMPOUNDS IN SEDIMENT AT SITE 1
RESULTS OF RFI AND PREVIOUS STUDIES
(All data in ppb)

Parameter	1-SD1		1-SD2		1-SD3		1-SD3 [&]	1-SD4
	Aug. 90	Jan 93	Aug. 90	Jan. 93	Aug. 90		Jan. 93	Jan. 93
					Initial	Duplicate		
PCBs	*	*	*	*	*	*	*	*
TPH	1,260,000	NA	1,180,000	NA	153,000	85,300	NA	NA
Dioxin	NA	*	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds								
Methylene Chloride	*	12[b]	24[c]	11[b]	90[c]	330[c]	19[b]	32[b]
Acetone	*	3[bj]	410[c]	12[j]	31[b]	24[b]	23	23
2-Butanone (MEK)	44	*	110	*	14[j]	*	*	*
Ethylbenzene	95	*	*	*	*	*	*	*
Xylenes (Total)	110	*	*	3[j]	*	*	*	*
Toluene	*	*	*	*	23	*	*	*
Polynuclear Aromatics (PAHs)								
Fluoranthene	NA	*	NA	*	NA	NA	*	400
Pyrene	NA	*	NA	*	NA	NA	*	400

Notes:

All volatile and polynuclear aromatic compounds not reported were below detection limits in all samples.
& - The 1-SD3 sampling location was farther upstream in 1993 than in 1990.
TPH - Total Petroleum Hydrocarbons
NA - Not analyzed; VOC duplicate not collected at this site.
* - Compound was analyzed but not detected.
[a]Detection limit range in water for Aroclor-1016, 1221, 1232, 1242, 1248, 1254, and 1260
[b]Compound was found in laboratory blank as well as in sample; sample concentration was less than 10 times the blank concentration.
[d]Detection limit range in soil for TPH samples was particular to this site.
[c]Compound was found in laboratory blank as well as in sample; sample concentration was more than 10 times the blank concentration.
[j]Estimated value. Measured value is less than the accurately quantitative limit.