

5/11/07-00740

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May 11, 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 2B, 2C, and 2E*
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. 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. *A short discussion concerning the source of the free-phase diesel fuel detected at SWMU 2E should be included Site Background section. Additionally, please discuss and identify the two different areas that make up SWMU 2E, the oil soaked ground and the separate area where vinyl chloride was detected in the groundwater.*

According to former base personnel, the source of the diesel fuel is believed to be from a former pipeline in the vicinity of SWMU 2E. However, attempts have been made to confirm the presence of such a pipeline, and none was identified nor was any other source of diesel fuel identified. It is likely that the location of the CERLCA release and the diesel fuel spill overlap. However, all chlorinated solvents detected in groundwater were found south of the diesel fuel plume (Attachment 1). It is likely that some constituents have migrated downgradient while those in the source area degraded via anaerobic reductive dechlorination due to the reducing conditions created by the fuel spill.

2. *The source area and lateral extent of northeastern-most groundwater contamination at SWMU 2B does not seem to have been clearly outlined, please include an assessment of what additional work will be done during LTM.*

No additional delineation activities are planned for this SWMU. The disposal reportedly occurred north and east of Buildings 130 and 131. Since groundwater flows to the

southwest, it is unlikely that contaminants are migrating to the northeast. There have been no MCL exceedances in upgradient wells 2B-MW08, 2B-MW09, and 2B-MW10 during recent rounds of investigation. As requested during the April 4, 2007 conference call, analytical results for 2B-MW08 were provided via separate correspondence.

3. *The draft Proposed Plan is in good shape, except for Table 3.*

Comment noted.

4. *Please number all the pages and replace "in situ" with "in-situ".*

The text has been edited as requested.

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 1, Section 1, Third Paragraph, next to last sentence. Please change this sentence to read "Therefore, the public is encouraged to review all the alternatives for each SWMU."*

The text has been edited as requested.

7. *Page 2, Section 2.1, Second Paragraph, 3 new sentences. At the end of the paragraph, please add a discussion that indicates "Also during the 1993 Phase 1 RCRA Facilities Investigation (RFI) 7-feet of free product, judged to be diesel fuel, was detected in one well. This free product was not present at the time of the field work for the Interim RFI in 1990. No past or continuing source for the diesel fuel has been identified."*

The text has been edited as requested. One additional sentence has also been added that reads, "It is assumed VOCs are unrelated to this free product."

8. *Page 2, Section 2.2, IAS Paragraph, first sentence. Please insert "of" after "review" in the first line.*

The text has been edited as requested.

9. *Page 2, Section 2.2, IAS Paragraph, third sentence. Please replace "petroleum-related waste" with "waste oil".*

The text has been edited as requested.

10. *Page 2, Section 2.2, Round 1 Verification Study Paragraph. Please add "This study also recommended additional sampling at SWMU 2A and SWMU 2D was not evaluated as part of this study." at the end of the paragraph.*

Consistent with our April 4, 2007 phone conversation, the Navy agreed to address this comment and subsequent comments related to SWMUs 2A and 2D by adding additional text to focus the discussion of the Proposed Plan to SWMUs 2B, 2C, and 2E. Therefore, the following paragraph was added to the IAS section: "Although additional investigation of SWMUs 2A and 2D were completed and the action determinations for these SWMUs are addressed within the following investigation summarizes, the focus of this Proposed Plan is to present the Preferred Alternative for SWMUs 2B, 2C and 2E. As a conclusion of the Interim RCRA Facility Investigation, a guide to scope the requirements of the RFI as defined in the NAS Oceana RCRA 3008 (h) Consent Order, SWMU 2A was determined to require no further action. The action determination for SWMU 2D, which was investigated as part of the RFI, is addressed under a previous Proposed Plan and Decision Document."

11. *Page 3, Section 2.2, Interim RFI Paragraph. Please add "This investigation recommended more sampling at SWMU 2D and that no additional investigations were needed for SWMU 2A." at the end of the paragraph.*

See response to comment 10.

12. *Page 3, Section 2.2, Phase 1 RFI Paragraph, first and third sentences. Please add "2D," after "2B, 2C," in the second line of the first sentence. At the end of the third sentence, please replace "free-product" with "7-feet of diesel fuel floating on the water table" and please add "No past or continuing source for the diesel fuel has been identified." as a new fourth sentence. At the end of the paragraph, please add "Additionally, the Phase 1 RFI recommended additional sampling for SWMU 2D."*

Please see response to comment 10 with respect to comments related to SWMU 2D. All other suggested edits will be made.

13. *Page 3, Section 2.2, Phase III RFA Paragraph, third sentence. Please indicate what exposure scenario (residential?) was used in this risk assessment. In the last sentence, please indicate what clean-up levels were used for the removal and if post-removal samples were taken. Also, please add "Additionally, the Phase III RFI recommended no further action at SWMU 2D." at the end of the paragraph.*

Residential and construction worker scenarios were evaluated. The text has been edited to clarify this. With respect to the filling of the ditch at SWMU 2C, no clean up values were used as the filling was completed as part of an engineering effort rather than an environmental effort. Although some PAHs exceeded BTAG screening values in ditch sediment, the ditch is no longer present, therefore, there is no longer a habitat in this area. Please see response to comment 10 for comment related to SWMU 2D.

14. *Page 3, Section 2.2, Ecological Risk Subsection, Second Paragraph. Please change "4" to "5.2" in the last line.*

The text has been edited as requested.

15. Page 4, Section 2.2, HHRA Paragraph, third sentence. Please indicate what exposure scenario (residential?) was used in this risk assessment for soil.

Soil was evaluated for residential, industrial, construction worker, and trespasser use. The text has been edited accordingly.

16. Page 4, Section 2.2, FS Subsection, first paragraph, second sentence. Please bold "preliminary remediation goals (PRGs)" and "chemicals of concern (COCs)" and include the write-ups in the Glossary.

The text has been edited as requested.

17. Page 4, Section 2.2, FS Subsection, SWMU 2E, number 2. Please insert ", " after "Removal".

The text has been edited as requested.

18. Page 4, Section 2.2, FS Subsection, last paragraph. In the first line, please insert "7 of" after "respect to" and add a new second sentence "Community and state acceptance criteria could not be evaluated until the alternatives were presented in a proposed plan". Also, please delete the last two sentences.

These edits will be made with the exception of the deletion of the last two sentences. The Navy believes that the FS section should provide information on the alternatives recommended. However, the alternatives will be referred to as "preferred" alternatives to provide clarity.

19. Page 4, Section 2.2, FS Addendum for SWMU 2E Subsection, first paragraph. Please add "the portion of" before "SWMU 2E" in the second sentence. Also, please drop "inorganics and" at the end of the second sentence, the petroleum exclusion only applies to pure petroleum product and not inorganics or waste oil.

The text has been edited as requested.

20. Page 4, Section 2.2, FS Addendum for SWMU 2E Subsection, second paragraph. Please delete "Based on the POL exclusion," in the first sentence and add a space between the current second and third sentences.

The text has been edited as requested.

21. Page 5, Section 2.2, Groundwater TS Subsection, second paragraph. Please bold "aerobic" and "anaerobic" in the first sentence and include the write-ups in the Glossary and define "ORC" and "HRC". Also, for this subsection, please change the date of the CH2M HILL Report to 2007.

These edits will be made. However, the date in the header will be modified to read, "(2004 through 2007)" to accurately indicate the duration of the treatability study and the post-treatment monitoring.

22. Page 5, Section 2.2, *Statistical Evaluation and Metals Risk Management TM Paragraph*. Please add "(MCLs)" after "EPA's acceptable risk levels" in the third sentence.

The text has been edited as requested.

23. Page 6, Section 2.2, *FS Addendum Paragraph*. In the fifth line, please insert "7 of" after "against". Also, please add ", with LTM" to each of the active alternatives. Please change "selected" to "preferred" in the last sentence.

The text has been edited as requested. However, since Alternative 3 was titled "Institutional Controls and Enhanced Bioremediation," the title itself was left consistent with the Feasibility Study addendum and a parenthetical was added to indicate that the alternative includes LTM.

24. Page 6, Section 3.1, *SWMU 2B Subparagraph, third line*. Please add ", below EPA action-levels," after "concentrations".

The text was edited as requested.

25. Page 6, Section 3.1, *SWMU 2E Subparagraph*. Please add "No past or continuing source for the diesel fuel has been identified." as a new fourth sentence.

The text was edited as requested.

26. Page 6, Section 3.1, *SWMU 2E Subparagraph*. Please add ", separate and over 250 feet away from the area of diesel fuel related contamination." after "well location" at the top of the page. Also, please delete the last sentence.

The text was edited as requested.

27. Page 7, Section 4, *Only Paragraph*. Please rewrite the fourth sentence to read "A Decision Document (DD) for SWMUs 1 and 24 is scheduled for 2007." Also, please delete the last two sentences in this paragraph; this is not the right section to make these statements.

The text was edited as requested. However, this paragraph has also been edited to reflect satisfaction of the RCRA Consent Order in accordance with the email attachment from Stacie Driscoll/USEPA.

28. Page 7, Section 5.1, *SWMU 2B Subsection, First Paragraph*. Please add "-" between "non" and "cancer" in the last line.

The text was edited as requested.

29. Page 8, Section 5.1, *SWMU 2B Subsection, Second Paragraph*. Please delete the next to last sentence.

The text was edited as requested.

30. Page 8, Section 5.1, SWMU 2C Subsection. Please delete the next to last sentence.

The text was edited as requested.

31. Page 8, Section 5.1, SWMU 2E Subsection. Benzo(a)anthracene and pyrene may not be common constituents of diesel fuel, but can be related to waste oils, please delete this sentence. Also, please delete the next to last sentence.

As per my email dated April 16, 2007, diesel fuel is composed of 25% PAHs, and these constituents are common contaminants at diesel fuel sites, therefore, it is reasonable to believe that the contaminants are related to the diesel fuel that is still present as free product on the sites wells rather than the waste oil. This is also consistent with the analytical data that shows these constituents detected in only the wells where free product is present. The text has been edited to read, "Benzo(a)anthracene and pyrene are present only in wells containing free floating diesel fuel. Since diesel fuel is composed of 25% PAHs, such as benzo(a)anthracene and pyrene, the presence of these compounds in groundwater is likely a result of the fuel-related contamination which is exempt from action under CERCLA. The free-product diesel fuel at SWMU 2E is currently being addressed under the VDEQ POL/UST Program."

32. Page 9, Section 5.2, Third Paragraph. Please delete "further" in the next to last line.

The text was edited as requested.

33. Page 9, Section 6, Second Paragraph. Please rewrite to read "The site-specific Remedial Action Objectives (RAOs) are:

- Restrict land-use at the SWMUs 2B, 2C, and 2E to industrial purposes as long as the levels of CERCLA hazardous substances remain above levels allowing unlimited use and unrestricted exposure.
- Prevent exposure to groundwater from the shallow aquifer until such time as cleanup levels (shown in Table 2) for the contaminants in the aquifer have been obtained.
- Reduce concentrations of the specified contaminants identified in the shallow aquifer to the levels shown in Table 2. These quantitative RAOs are the Federal MCLs and are listed as in units of ppb.
- Maintain the integrity of any current and future remedial and monitoring system at these SWMUs.

Also, please delete the rest of the paragraph and move it to Section 8.

As per our April 4, 2007 conference call, the RAOs were reworded to read:

- To prevent exposure to shallow aquifer groundwater at SWMUs 2B, 2C, and 2E until concentrations of VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.

- To reduce concentrations of VOCs in SWMUs 2B, 2C, and 2E groundwater to the remediation goals (MCLs) to the maximum extent practicable within a reasonable amount of time.

The rest of the paragraph will be deleted as this information is already included in Section 8.

34. *Page 9, Section 7, Only Paragraph. Please list the three alternatives exactly as listed in the FS Addendum. In line three, please change "RAO" to "RAOs". Please add ", which restricts exposure to and use of the soils and groundwater at the SWMUs," after "controls" in line 6. In line 7, please change "unrestricted land use" to "unrestricted exposure and unlimited use". Please add "for the two active alternatives" after "ranked" in line 8. Please change "allow" to "use" in the 11th line. In the 13th line, please insert "7 of" after "against". Please add "Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Decision Document for these SWMUs." at the end of the paragraph.*

These edits will be made with the exception of the edit that implies that there will be land use controls restricting exposure to site soils. LUCs will consist of groundwater use restrictions only because no risks are associated with soils at these SWMUs.

35. *Page 10, Section 8, Only Paragraph. Please add "aerobic or anaerobic compounds for continued enhanced" after "of" in line 6. Please add a new sentence after the third sentence to indicate "The Navy, EPA, and VDEQ will evaluate the LTM reports to determine if additional injections are necessary."*

Instead of adding, "aerobic or anaerobic compounds for continued enhanced" as recommended, the Navy has added, "anaerobic and aerobic bioremediation substrates to support continued enhanced." The Navy believes this statement captures your intended content while preserving technical accuracy. As per our April 4, 2007 conference call, the second suggestion will be addressed by more appropriately defining the criteria for completing additional injection. The following sentences will be added: "During each five year review, data will be evaluated to determine whether the concentrations in wells at SWMUs 2B, 2C, and 2E are declining. If concentrations in wells have not met RAOs and have not shown a decline between year one and year five, additional injections will be completed."

36. *Page 10, Section 9, 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.

37. *Page 10, Glossary. Please add "aerobic", "anaerobic", "Chemicals of Concern", and "Institutional Controls" to the glossary.*

The text has been edited as requested.

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

The text has been edited as requested.

39. Page 10, Glossary, COPC. Please change "Constituent" to "Chemical".

The text has been edited as requested.

40. Page 12, Glossary, Nine Evaluation Criteria. Please add "Community Acceptance" as a new bullet at the end of the write-up.

The text has been edited as requested.

41. Table 3, Row 2, Column 4. Please add "and LTM" to the Alternative 3 title.

Because the title of the Alternative in the FS Addendum did not include LTM, the Navy prefers to add a parenthetical indicating that LTM will be included in the remedy.

42. Table 3, Row 4, Column 3 and Column 4. Please add "But no treatment to drinking water standards therefore this alternative is not protective." as a new second sentence in column 3. Also, in both column 3 and 4, please add ", until groundwater is restored to drinking water standards" after "potable use" in line 5. In column 4, please delete the third sentence.

The table has been edited as requested. However, prior to the clause, "no treatment to drinking water standards would take place, therefore, this remedy is not effective," another clause stating, "However, if concentrations did not decline," was added. The Navy believes the remedy would be protective if the treatability studies already implemented continued to provide treatment to the groundwater.

43. Table 3, Row 6, Column 2. Please replace with "There would be no action involved, therefore, no chemical-specific ARARs would be triggered".

The table has been edited as requested.

44. Table 3, Row 6, Column 3. Please replace the first sentence with "This alternative is capable of achieving RAOs over the long-term."

The table has been edited as requested.

45. Table 3, Row 6, Column 4. Please replace everything with "This alternative is capable of achieving RAOs."

The table has been edited as requested.

46. Table 3, Row 7, Column 2. Please replace with "There would be no action involved, therefore, no action-specific ARARs would be triggered".

The table has been edited as requested.

47. Table 3, Row 7, Column 3 and Column 4. Please replace with "Long-term groundwater monitoring provided." Also, in column 4 please replace with "Underground Injection Control regulations under SDWA for injection into an aquifer would be followed. Long-term groundwater monitoring provided."

The table has been edited as requested.

48. Table 3, Row 8. Please check to be sure there are location-specific ARARs, if not just say so and if there are please state that the specific ARAR will be met.

There are no location-specific ARARs. All columns have been edited to indicate that this category is not applicable.

49. Table 3, Row 10, Columns 1 and 2. Please change "Groundwater" to "Risks" in column 1. Please delete the first sentence in column 2.

The table has been edited as requested.

50. Table 3, Row 10, Columns 3 and 4. Please replace with "NAS Oceana is expected to remain an active Base for the foreseeable future, so institutional controls will provide long-term protection of human health on-Base."

The table has been edited as requested.

51. Table 3, Row 11, Columns 1 and 2. Please replace "Need for Five Year Review" in column 1 with "Reliability of Controls." In column 2, please replace all with "Unknown. No mechanism to prevent exposure to groundwater or to monitor the groundwater conditions."

The table has been edited as requested.

52. Table 3, Row 11, Columns 3 and 4. Please replace with "Institutional controls as enforced by NAS Oceana are considered extremely reliable. Five year site reviews will be required until RAOs are met."

The table has been edited as requested.

53. Table 3, Row 13, Columns 1 and 2. Please replace "Groundwater" in column 1 with "Reduction in Toxicity, Mobility, and Volume through Treatment". In column 2, please replace all with "Not Applicable."

The table has been edited as requested.

54. Table 3, Row 13, Columns 3 and 4. In column 3, please replace "enhanced biodegradation and" with "continued long-term" in the first sentence. Please delete the second sentence in column 3. In column 4, please replace the last sentence with "There is no reduction in chemical mobility."

The table has been edited as requested.

55. *Table 3, Row 14, Column 2. In column 2, please replace all with "Not Applicable."*

The table has been edited as requested.

56. *Table 3, Row 14, Columns 3 and 4. Please replace all with "No residues generated. VOC degradation products generated and degraded as part of the long-term process."*

The table has been edited as requested.

57. *Table 3, new Row 15, Columns 1 and 2. In column 1, please insert "Treatment Process and Permanence". In column 2, please insert "Not Applicable."*

The table has been edited as requested.

58. *Table 3, new Row 15, Columns 3 and 4. In column 3, please insert "No additional treatment process would be provided. Natural attenuation would continue with long-term monitoring to confirm reduction of the concentration of contaminants." In column 4, please insert "Additional treatment process would be provided. Natural attenuation would continue with long-term monitoring to confirm reduction of the concentration of contaminants. Bioremediation results in the permanent removal of contaminants through irreversible processes."*

The table has been edited as requested.

59. *Table 3, current Row 16, Columns 1 and 2. Please replace "Groundwater" with "Protection of the Community and Workers during Remedial Action". In column 2, please change to read "Because there would be no action there is no short term impact to the community or workers."*

The table has been edited as requested.

60. *Table 3, current Row 17, Columns 3 and 4. In column 3, please replace all with an estimate of time for natural attenuation to reduce contaminants to RAOs. In column 4, please delete the first sentence and most of the second. Leave only "Remediation goals are likely to be achieved within 2 to 4 years following treatment."*

The table has been edited as requested.

61. *Table 3, new Row 18, Columns 1 and 2. In column 1, please insert "Environmental Impact". In column 2, please insert "None".*

The table has been edited as requested.

62. *Table 3, new Row 18, Columns 3 and 4. In column 3, please insert "Minimal disturbance from long-term monitoring activities." In column 4, please add "Minimal disturbance from long-term monitoring activities. Environmental impacts related to additional injection are minimal."*

The table has been edited as requested.

63. *Table 3, old Row 18. Please center "Implementability".*

The table has been edited as requested.

64. *Table 3, old Rows 20 and 21, Column 2. Please replace all with "Not Applicable".*

The table has been edited as requested.

65. *Table 3, old Row 22. Please center "Cost".*

The table has been edited as requested.

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

Sincerely,



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

SWMUs 2B, 2C, and 2E

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) 2B, 2C, and 2E, Naval Air Station (NAS) Oceana, Virginia Beach Virginia. The preferred alternative is Continued Enhanced Bioremediation, Long Term Monitoring (LTM), and Land Use Controls (LUCs). This Proposed Plan describes the rationale for this preference.

SWMUs 2B, 2C, and 2E 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 the 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 2B, 2C, and 2E. Other areas of NAS Oceana have been addressed by separate Proposed Plans. The Navy and the USEPA, in consultation with the VDEQ, will make the final decision on the remedial approach for SWMUs 2B, 2C, and 2E after reviewing and considering all information submitted during the 30-day public comment period. The preferred alternative may be modified, or another remedial action may be selected based on new information and/or public comments received. Therefore, the public is encouraged to review all of the alternatives for each SWMU 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

2 Site Background

NAS Oceana, located in Virginia Beach, Virginia, was established in 1940 as a small auxiliary airfield (Figure 1). Since 1940, 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 Site Background

SWMUs 2B, 2C, and 2E, referred to as Site 2 in the 1984 Initial Assessment Study (IAS), comprise the areas surrounding several line shacks adjacent to the flight line at NAS Oceana (Figure 1). SWMU 2B is located southeast of Hangar 122 and encompasses Line Shacks 130 through 135 and the five aircraft cleaning stations northeast of Line Shack 130 (Figure 2). SWMU 2C encompasses Line Shack 400 and Buildings 301, 401, and 404 (Figure 3). SWMU 2E includes Line Shack 109, Building 110, and the surrounding storage yard (Figure 4). These areas are used for aircraft maintenance and cleaning. Between 1963 and 1981, various maintenance and cleaning chemicals were disposed on the ground around these line shacks. These chemicals contained semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs), such as trichloroethene (TCE).

Additionally, at the time of the IAS, a waste oil bowser and hazardous waste drums were observed on the ground along the fence at SWMU 2E. Waste oil was reportedly funneled into an electric manhole near Line Shack 109. This practice damaged some electrical circuits, which prompted a cleanup of the manhole affected by the waste oil. During a 1993 inspection of manholes at the site, two manholes near the south corner of Hangar 23 were found to be smeared with oil. Also during the 1993 Phase I RCRA Facilities Investigation (RFI) 7-feet of free product, judged to be diesel fuel, was detected in one well. This free product was not present at the time of the fieldwork for the Interim RFI in 1990. No past or continuing source for the diesel fuel has been identified. It is assumed VOCs are unrelated to this free product.

2.2 Summary of Previous Investigations

Initial Assessment Study (RGH, 1984)

The IAS 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 at NAS Oceana. The inspection of Site 2 indicated that there were five specific line shack areas of interest (SWMUs 2A, 2B, 2C, 2D, and 2E). Each of these disposal areas, except for Building 400 (SWMU 2C), displayed oil-soaked ground encompassing between 1,000 to 2,000 square feet that potentially was subject to the leaching effects of petroleum-related waste oil into the groundwater. At the time of the IAS, Line Shack 125 (SWMU 2E) appeared to have the most extensive contamination. Further investigations of the nature and extent of groundwater contamination were recommended.

Although additional investigation of SWMUs 2A and 2D were completed and the action determinations for these SWMUs are addressed within the following investigation summarizes, the focus of this Proposed Plan is to present the Preferred Alternative for SWMUs 2B, 2C and 2E. As a conclusion of the Interim RCRA Facility Investigation, a guide to scope the requirements of the RFI as defined in the NAS Oceana RCRA 3008 (h) Consent Order, SWMU 2A was determined to require no further action. The action determination for SWMU 2D, which was investigated as part of the RFI, is are discussed in this document. SWMUs 2A and 2D were addressed under a previous Proposed Plans and Decision Document.

Round 1 Verification Study (CH2M HILL, 1986)

Three groundwater samples were collected and analyzed for VOCs from the Line Shack 130-131 area (SWMU 2-B) as part of the Round 1 Verification Study (RVS). The results indicated that VOCs were present at concentrations above the **Maximum Contaminant Levels (MCLs)**. Additional soil and groundwater sampling was recommended to further characterize the nature and extent of contamination. SWMUs 2C and 2E were not sampled as part of the RVS.

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Line Shack Inspection Study (CH2M HILL, 1989)

As a result of the IAS and RVS, SWMUs 2B and 2C were subjected to additional soil and groundwater sampling as part of the Line Shack Inspection Study. Six groundwater samples and 9 soil samples were collected from three locations at SWMU 2B. Four groundwater samples and 18 soil samples were collected from 14 boring locations at SWMU 2C. The samples were analyzed for VOCs and ignitability characteristics. The results indicated that VOC concentrations in soil and groundwater at SWMUs 2B and 2C were not indicative of hazardous waste and therefore did not warrant immediate action. Further investigations were recommended to evaluate potential risks to human health and the environment.

Interim RCRA Facility Investigation (CH2M HILL, 1991)

An Interim RCRA Facility Investigation (RFI) was conducted at SWMUs 2B, 2C, and 2E to further identify potentially contaminated areas. Field activities included groundwater sampling from 11 monitoring wells at SWMU 2B, 9 monitoring wells at SWMU 2C, and 3 monitoring wells at SWMU 2E. Additionally, 4 surface soil samples were collected at SWMU 2E. Soil and groundwater samples were analyzed for VOCs and total petroleum hydrocarbons (TPHs). TPHs were detected in SWMU 2E soil and VOCs were detected in groundwater from all three SWMUs. Therefore, additional well installation and/or groundwater sampling was recommended to further delineate the nature and extent of VOC contamination.

Phase I RCRA Facility Investigation (CH2M HILL, 1993)

Based on the recommendation of the Interim RFI, groundwater and soil samples were collected from SWMUs 2B, 2C, and 2E to further characterize the nature and extent of VOC contamination and evaluate potential risks to human health and the environment. Surface water and sediment samples were also collected at SWMU 2B to assess fate and transport of contaminants and potential impacts to ecological receptors. The results of the Phase I RFI indicated that media at SWMU 2B were potentially contaminated by VOCs and SVOCs; media at SWMU 2C were potentially contaminated by VOCs; and media at SWMU 2E were potentially contaminated by VOCs, SVOCs, and up to 7-feet of free product, judged to be diesel fuel floating on the water table free product. No past or continuing source for the diesel fuel has been identified. A Corrective Measures Study (CMS) was recommended for SWMUs 2B and 2C, based on the results of the Phase I RFI. Additional investigation during a Phase II RFI was recommended for SWMU 2E to further delineate groundwater and soil contamination.

Phase II RCRA Facility Investigation- SWMU 2E (CH2M HILL, 1995)

Based on Phase I RFI recommendations, additional groundwater and soil sampling was conducted at SWMU 2E during the Phase II RFI. The results indicated the presence of a dissolved-phase VOC groundwater plume and confirmed the presence of free-phase petroleum at the soil-groundwater interface. A CMS was recommended to evaluate remediation options for the free-phase petroleum and dissolved VOCs in groundwater.

Corrective Measures Studies (CH2M HILL, 1995 and 1996)

SWMU 2B and SWMU 2C were evaluated as part of a CMS in 1995, and SWMU 2E was evaluated separately in a CMS conducted in 1996. Following the evaluation of several alternatives, including no action, groundwater containment, and air sparging, groundwater containment and source area extraction of groundwater with treatment was chosen as the preferred treatment alternative for each site.

Phase III RCRA Facility Investigation (CH2M HILL, 1999)

SWMU 2B and SWMU 2C were the subject of the Phase III RFI to confirm the presence of SVOC contamination in media sampled during previous sampling activities. Groundwater and sediment samples were collected at SWMU 2B and analyzed for SVOCs. The results indicated that although polycyclic aromatic hydrocarbons (PAHs) were present in sediment and groundwater, their concentrations did not pose a risk to human health (future residential and construction worker), and therefore no further action was warranted to protect human receptors from these contaminants. Sediment samples were collected from the drainage area at SWMU 2C and analyzed for SVOCs and total organic carbon. Following the Phase III sampling, the drainage ditch was removed; therefore, no further action was warranted to protect human and ecological receptors from exposure to sediment.

Ecological Risk Assessments (CH2M HILL, 1999 and 2001)

Ecological Risk Assessments (ERAs) for SWMUs 2B, 2C, and 2E were conducted in accordance with USEPA guidance and Navy policy. In 1999, SWMUs 2C and 2E were included in a multi-site screening ERA to identify potentially complete exposure pathways for ecological receptors. However, no complete

exposure pathways to ecological receptors were identified for these SWMUs. Therefore, no further action was recommended to address potential ecological impacts to SWMUs 2C and 2E.

In 2001, SWMU 2B was included in a multi-site ERA. Potentially complete exposure pathways were identified for ecological receptors at this site, via exposure to surface soil, surface water and sediment in the ditch southeast of the site. Constituent data were collected from these habitat areas, and potential risks were identified for sediment and surface soil. A detailed summary of the ERA is included in Section 5.2.4 of this Proposed Plan.

Groundwater Investigations (CH2M HILL, 2000, 2001)

Additional groundwater sampling was conducted at SWMU 2C to delineate the horizontal and vertical extents of the chlorinated VOC plume and to evaluate naturally occurring conditions for treatment options. Discrete groundwater samples were collected using direct push technology (DPT) and the vertical extent of the plume was verified using a membrane interface probe (MIP). The results of this investigation indicated that the VOC groundwater plume was present at 9 to 24 feet below ground surface and that the vertical and lateral extents were primarily controlled by lithology. Additionally, the report concluded that aquifer conditions at the site were favorable for natural degradation of chlorinated solvents in groundwater. In order to achieve complete degradation of chlorinated VOCs in groundwater, groundwater treatment to enhance natural degradation of chlorinated VOCs was recommended.

A complete round of groundwater samples was collected from existing monitoring wells at SWMUs 2B and 2E to confirm the presence of VOCs in site groundwater and support a quantitative human health risk assessment (HHRA). Groundwater samples were analyzed for VOCs, SVOCs, and pesticides.

Human Health Risk Assessment (CH2M HILL, 2002)

Soil and groundwater analytical results from samples collected during the various phases of the RFI, CMS, and groundwater investigation activities were used in support of a HHRA. The risk assessment involved characterizing potential risks to current and future receptors from exposure to site media. It was concluded that soil does not pose an unacceptable risk based on current and future land use (residential, industrial, construction worker, and trespasser use). However, potable use of groundwater at SWMUs 2B, 2C, and 2E may pose an unacceptable risk to future receptors because of the presence of VOCs and metals. The detailed results of the HHRA are included in Section 5 of this Proposed Plan.

Feasibility Study (CH2M HILL, 2002)

A Feasibility Study (FS) was completed to develop and evaluate remedial alternatives to prevent unacceptable human health risks from exposure to groundwater at SWMUs 2B, 2C, and 2E. Site-specific preliminary remediation goals (PRGs) were developed for chemicals of concern (COCs) identified in the HHRA. The site-specific remedial alternatives included:

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SWMU 2B

1. No action
2. Institutional Controls and Long-Term Monitoring (LTM)
3. Hydrogen Release Compound (HRC[®]) or Oxygen Release Compound (ORC[®]) with Institutional Controls and LTM

SWMU 2C

1. No Action
2. Monitored Natural Attenuation (MNA) and Institutional Controls
3. Enhanced Bioremediation with MNA and Institutional Controls

SWMU 2E

1. No Action
2. Free-Phase Removal, Institutional Controls, and LTM
3. ORC[®], Free-Phase Removal, Institutional Controls, and LTM

Each remedial alternative was analyzed with respect to seven of the nine evaluation criteria provided in the NCP. Community and state acceptance criteria could not be evaluated until the alternatives were

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presented in the proposed plan. The alternatives were then compared to one another with respect to their rating under the NCP evaluation criteria. Based on the comparative analysis, Alternative 2 was the selected as the preferred alternative for SWMUs 2B and 2E. Alternative 3 was the selected as the preferred alternative for SWMU 2C.

Feasibility Study Addendum for SWMU 2E (CH2M HILL, 2003)

An FS Addendum was completed for the northern portion of SWMU 2E to provide the technical justification for transferring regulatory oversight from CERCLA to the VDEQ Underground Storage Tank (UST)/Petroleum, Oil, and Lubricant (POL) program. The rationale for transferring SWMU 2E regulatory oversight to the UST/POL program was because the COCs were inorganics and fuel-related products. Fuel compounds and other constituents related to fuel are exempt from CERCLA actions.

Based on the POL exclusion, the only remaining organic COC at SWMU 2E was vinyl chloride. Vinyl chloride was detected in only one SWMU 2E well (OW2E-MW09). If fuel-related constituents were eliminated from the risk assessment, groundwater at SWMU 2E would not present unacceptable risk based on central tendency calculations; however, because vinyl chloride was detected at a concentration above the MCL, additional evaluation was necessary to address the presence of this contaminant. Because the CERCLA-related contamination was isolated to the area surrounding one well, the aerial extent of SWMU 2E, as related to the IRP, was reduced to encompass the vinyl chloride-contaminated area surrounding OW2E-MW09. The remainder of the former SWMU 2E site boundary that contained POL contamination has been deferred to the VDEQ UST/POL Program for regulatory oversight. Under the POL program, free product removal is conducted monthly and reported quarterly to VDEQ. The information provided includes plume thickness, quantity of product removed, and a means of tracking fuel product in groundwater within the flight line area.

Groundwater Treatability Studies and Reporting (CH2M HILL, 2004 through 2007)

Groundwater treatability studies were implemented at SWMUs 2B, 2C, and 2E in September 2004 to evaluate the performance and effectiveness of different remedial technologies to treat chlorinated VOCs comprising vinyl chloride, cis-1,2 dichloroethene (cis-1,2-DCE), trans 1,2-DCE, and TCE. Arsenic, iron, and manganese were also identified as COCs during the risk assessment. However, these treatability studies were not designed to mitigate these inorganic constituents

The treatment technologies implemented included enhanced aerobic biodegradation using ORC[®] and enhanced anaerobic biodegradation using an emulsified vegetable oil substrate (Newman Zone) and a time release substrate (HRC[®]). Treatment effectiveness was monitored through frequent collection of groundwater samples during the 12 months following treatment. Details of treatment at each SWMU are described in more detail below:

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- **SWMU 2B.** The treatability studies at SWMU 2B focused on groundwater in two "target" areas of the site, one area in the vicinity of OW2B-MW01, and one area in the vicinity of OW2B-MW14. Groundwater in the area surrounding OW2B-MW01 was treated using HRC[®] in order to stimulate dechlorination of TCE, cis 1,2-DCE, and vinyl chloride under anaerobic conditions. Groundwater in the area surrounding OW2B-MW14 was treated with an ORC[®] sock in order to stimulate dechlorination of vinyl chloride under aerobic conditions. The results of the treatability study in the vicinity of OW2B-MW01 did not indicate a significant reduction in chlorinated VOCs, but the site geochemistry indicated that conditions were still favorable for degradation during the final (12-month post-treatment) round of monitoring. Concentrations of vinyl chloride were lower than the MCL during the baseline (pre-treatment) round of monitoring at OW2B-MW14; however, the ORC[®] sock was still installed to help ensure that concentrations continued to decrease. There were also no MCL exceedances in the sample collected from OW2B-MW14 during the final round of monitoring.
- **SWMU 2C.** Groundwater in the northern portion of SWMU 2C and three small target areas was treated with ORC[®] in order to enhance aerobic degradation of vinyl chloride. Groundwater in the southern portion of SWMU 2C was treated with emulsified vegetable oil in order to enhance anaerobic degradation of TCE and vinyl chloride. Although the treatments were successful in reducing concentrations of chlorinated VOCs, vinyl chloride concentrations remain above the MCL in some wells. However, with the longevity of the substrate injected, continued degradation of vinyl chloride is likely to occur.

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- **SWMU 2E.** ORC® was used to stimulate aerobic degradation of vinyl chloride in SWMU 2E groundwater in one "target" area in the vicinity of OW2E-MW09. The treatment was successful in reducing the concentration of vinyl chloride; however, this constituent was detected at a concentration just above the MCL during the final round of post-injection monitoring.

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Statistical Evaluation and Metals Risk Management Technical Memoranda (CH2M HILL, 2005)

In order to address the inorganic COCs identified in the HHRA, additional data evaluation and statistical analysis were conducted to further assess the presence and source of arsenic, iron and manganese in SWMUs 2B, 2C, and 2E groundwater. Arsenic in groundwater from SWMUs 2C and 2E was not present at concentrations that pose any individual unacceptable risk to human health. Arsenic was present in SWMU 2B groundwater above EPA's acceptable risk levels (MCLs). Therefore, a statistical analysis was conducted comparing the data for wells upgradient of, downgradient of, and within or alongside the locations of the previous VOC plumes. Based on this evaluation, it was concluded that arsenic concentrations detected downgradient and within the former CERCLA release plume areas at SWMU 2B were unrelated to the release itself and may be naturally occurring. Iron and manganese at the site are within nutrient guidelines and do not pose an unacceptable risk to human health based on central tendency exposure. Therefore, no further action was warranted for metals present in groundwater at SWMUs 2B, 2C, and 2E.

Feasibility Study Addendum (CH2M HILL, 2005)

In order to address the changes in site status as a result of implementing the treatability studies and the information contained in the metals risk management technical memoranda, an addendum to the 2002 FS was completed. The revised Remedial Alternatives were 1) No Action, 2) Institutional Controls and Long Term Monitoring Monitored-Natural Attenuation, and 3) Institutional Controls and Enhanced Bioremediation (this alternative includes LTM). The alternatives were evaluated against seven of the nine evaluation criteria and then compared to one another with respect to their rating under the NCP evaluation criteria. The preferred selected alternative for each site was Alternative 3.

3 Site Characteristics

Most of the ground surface in the vicinity of SWMUs 2B, 2C and 2E is now covered with concrete and asphalt. The limited exposed ground surface between the buildings, parking areas, and tarmac is grassy and is maintained as mowed lawn. SWMU 2B contains a stormwater drainage ditch, surrounded by a band of vegetation, that is used to convey surface runoff from the site to the southeast. Groundwater discharges to this drainage ditch, which maintains a perennial base flow. No submerged aquatic vegetation has been observed in the ditch. A previously existing drainage ditch at SWMU 2C has been filled in and paved over.

3.1 Nature and Extent of Contamination

SWMU 2B

The nature and extent of contamination at SWMU 2B was defined by the results of groundwater, soil, sediment, and surface water sampling events that were conducted as part of the previous investigations. No contamination was detected in SWMU 2B soils. Low concentrations, below EPA action levels, of chlorinated VOCs were detected in surface water in the ditch. SVOC-contaminated sediments in the ditch were excavated in 2000 to a depth of 6 to 18 inches to increase the capacity of the stormwater drainage system. Arsenic, iron, manganese, and VOCs were present in the groundwater at SWMU 2B. However, no source of metals contamination was identified; these sporadic detections are thought to be related to the geochemistry of the groundwater rather than a site source. VOCs are thought to have originated from two source areas, one near Line Shack 134 and another near Line Shack 131. Four compounds were found to be widely distributed in the groundwater during the Phase I and III RFIs: TCE, vinyl chloride, cis-1,2-DCE, and 1,1-DCA. Benzene, toluene, ethylbenzene, and xylene (BTEX) compounds were also identified in the groundwater east of Line Shack 130. No chlorinated VOCs were identified in the deeper (Yorktown Aquifer) groundwater.

SWMU 2C

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The nature and extent of contamination at SWMU 2C was defined by the results of groundwater, soil, sediment, and surface water sampling that were conducted as part of previous investigations. Vinyl chloride is present in groundwater at SWMU 2C at concentrations above the MCL, primarily in locations adjacent to Line Shack 400 and southeast of Building 400. VOCs have been detected at trace concentrations in soil samples. SVOCs were detected in drainage ditch sediment during the Phase II RFI, and were thought to originate from stormwater runoff from the flight-line area operations to the northwest. Because the previous investigations were completed, the entire drainage ditch in which the PAH in sediments were found has been removed and a parking lot installed in its former location.

SWMU 2E

TPH, VOCs, SVOCs, and metals were detected in soils in previous investigations; however, these soils are now covered with asphalt. VOC, metals, BTEX compounds, and TPH are present in groundwater as a result of leaching from soil. Free-phase petroleum identified as diesel fuel was discovered in one shallow groundwater monitoring well and is limited to the area near Building 109. No past or continuing source for the diesel fuel has been identified. Interim remedial measures have been implemented by the Public Works Department of NAS Oceana, including a monthly free product recovery program. The latest groundwater monitoring sampling results indicate that the only remaining chlorinated VOC above the MCL at SWMU 2E is vinyl chloride, and that the extent of this contamination is limited to one monitoring well location separate and over 250 feet away from the area of diesel fuel related contamination. **All of the remaining contaminants are related to the petroleum contamination resulting from the suspected release of diesel fuel and are therefore exempt from CERCLA.**

4 Scope and Role of Response Action

A total of 60 SWMUs were recommended for study in the Draft RCRA Consent Order issued by the USEPA. After reviewing the results of the Interim RFI, the Navy and the USEPA identified 19 SWMUs at NAS Oceana as warranting additional investigation and evaluation in the RFI Final Work Plan. The RFI Final Work Plan also lists and provides the rationale supporting the removal of the other SWMUs that were initially identified in the draft RCRA Consent Order. Due to their proximity to one another, four of the 19 RFA SWMUs identified in the RFI Final Work Plan were combined into two; therefore, 17 SWMUs have been investigated in the NAS Oceana Installation Restoration Program (IRP). These 17 SWMUs and their designations are:

- SWMU 1 - West Woods Oil Disposal Pit (RFA SWMU 57)
- SWMU 2B - Line Shack 130-131 Disposal Area (RFA SWMU 51)
- SWMU 2C - Line Shack 400 Disposal Area (RFA SWMU 52)
- SWMU 2D - Line Shack 125 Disposal Area (RFA SWMU 53)
- SWMU 2E - Line Shack 109 Disposal Area (RFA SWMUs 1 and 54)
- SWMU 11 - Firefighting Training Area (RFA SWMUs 62 and 63)
- SWMU 15 - Abandoned Tank Farm (RFA SWMU 58)
- SWMU 16/16GC - Pesticide Storage Area (RFA SWMU 95)
- SWMU 18 - Hazardous Waste Storage (RFA SWMU 3)
- SWMU 19 - Waste Oil Storage Area, Bldg. 541 (RFA SWMU 71)
- SWMU 20 - Waste Oil Storage Area, Bldg. 543 (RFA SWMU 72)
- SWMU 21 - Transformer Storage Yard (RFA SWMU 97)
- SWMU 22 - Construction Debris Landfill (RFA SWMU 22)
- SWMU 23 - Bowser, Bldg. 830 (RFA SWMU 78)
- SWMU 24 - Bowser, Bldg. 840 (RFA SWMU 79)
- SWMU 25 - Inert Landfill (RFA SWMU 25)
- SWMU 26 - Firefighting Training Area, Bldg. 220 (RFA SWMU 65)

Following the July 1998 agreement between the Navy, the VDEQ and the USEPA to complete the site investigation and remediation activities at NAS Oceana following the procedural and substantive requirements of the CERCLA, the Navy has completed site closure for 12 of the 17 NAS Oceana IRP SWMUs under the following decision documents:

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Final Decision Document SWMUs 2D, 18, 19, 20, and 23, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2001.
Final Decision Document SWMUs 11, 16, 16GC, 21, 22, and 26, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2001
Final Decision Document, SWMU 15, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2003.
Final Decision Document, SWMU 25, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2003)

A Decision Document (DD) for SWMU 1 and 24 is scheduled in 2007. Because SWMUs 2B, 2C, and 2E are the final NAS Oceana IRP SWMUs with action pending, the Navy will document the remedy to close these SWMUs in a CERCLA Record of Decision (ROD) to be executed by the Navy and USEPA, with concurrence by the VDEQ. This ROD will satisfy the requirements of the RCRA 3008 (h) Consent Order. A total of 60 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 concluded that 41 of the SWMUs required no further CERCLA action or should be regulated under other federal and/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. This Proposed Plan encompasses SWMUs 2B, 2C, and 2E. A Decision Document (DD) for SWMU 1 and 24 is scheduled in 2007. The following decision documents have been finalized for other SWMUs at Oceana:

Final Decision Document SWMUs 2D, 18, 19, 20, and 23, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2001.
Final Decision Document SWMUs 11, 16, 16GC, 21, 22, and 26, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2001
Final Decision Document, SWMU 15, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2003.
Final Decision Document, SWMU 25, NAS Oceana, Virginia Beach, Virginia, CH2M HILL, 2003.

A No Further Action Decision Document (DD) for SWMU 1 and 24 is scheduled in 2007. Because SWMUs 2B, 2C, and 2E will be the final SWMUs remaining open under CERCLA, a Decision Document for these SWMUs will satisfy the requirements of the RCRA Consent Order for NAS Oceana. Therefore, this Proposed Plan will serve as the final proposed plan for the base.

Based on the results of the investigations, risk assessments, and treatability studies conducted at SWMUs 2B, 2C, and 2E, continued monitoring of enhanced bioremediation with LUCs is the Preferred Alternative to remediate site groundwater. The Preferred Alternative for SWMUs 2B, 2C, and 2E does not include or directly affect any other sites at NAS Oceana.

5 Summary of Site Risks

A summary of the human health and ecological risks at SWMUs 2B, 2C, and 2E and risk management decisions is provided in the following subsections.

TABLE 1: SWMUs 2B, 2C, and 2E RISK SUMMARY

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

5.1 Human Health Risk Summary

Baseline HHRAs were completed for SWMUs 2B, 2C, and 2E to evaluate potential risks from current and future human exposure to site media. The HHRAs are an estimate of the likelihood of health problems occurring if no

cleanup action is taken. Potential cancer risks and non-cancer hazards were calculated based on conservative reasonable maximum exposure (RME) concentrations, which portray the highest level of human exposure that could be expected to occur. 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 non-cancer hazards was evaluated by comparing an exposure level over a specified time period with reference dose representative concentration that an

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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) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. For non-cancer, an HI value greater than 1 indicates exposures may present an unacceptable risk. A summary of the HHRA results are provided by SWMU below.

SWMU 2B

Potential risks and hazards were calculated for the current and future industrial worker, future construction worker, future trespasser/visitor, and future residential land use. Exposure scenarios evaluated included dermal contact, inhalation, and ingestion of surface soil and groundwater. Subsurface soil data was not collected because of a 15-inch concrete cap had been constructed over much of the site. Potential human health risks associated with exposure to surface water and sediment were not quantified because detected concentrations did not exceed human health screening values. There were no unacceptable risks or hazards associated with exposure to site media by current or future industrial workers, future construction workers, and future trespassers/visitors. Exposure to site soil by future child residents would result in non-cancer hazard above EPA's target threshold. However, no individual target organ effects were found to be greater than 1 and cancer risks due to exposure to site soil are within EPA's acceptable risk range.

Future residential use of the shallow groundwater as a potable water supply would result in a non-cancer hazard and a cancer risk above USEPA's acceptable levels. The non-cancer hazard is primarily associated with ingestion of arsenic, iron, and manganese, and the cancer risk is associated with ingestion of vinyl chloride and arsenic. Although individual target organ effects for arsenic iron and manganese are above EPA's acceptable target threshold based on RME and CT exposure calculations for future child residents, there is no discernable plume of arsenic, iron, and manganese. Iron and manganese are essential human nutrients, and the presence of these inorganics is likely related to site geochemistry and not a result of a CERCLA release. ~~Therefore, the Navy and EPA, in consultation with VDEQ, agree that no further action is warranted for inorganics in groundwater.~~ Potential human health risks associated with vinyl chloride in groundwater has been greatly reduced through implementation of the treatability study in September 2004, and continued enhanced bioremediation of TCE and vinyl chloride is expected to occur.

SWMU 2C

Potential risks and hazards were calculated for the future industrial worker, construction worker, trespasser/visitor, and residential land use. Exposure scenarios evaluated included dermal contact, inhalation, and ingestion of surface soil, subsurface soil, and groundwater. Risks and hazards associated with future industrial worker, construction worker, and trespasser/visitor land use are within USEPA's acceptable levels. Additionally, human health risks associated with exposure to site soil by future residents were within EPA's acceptable levels. Future residential use of groundwater as a potable water supply may result in a non cancer hazard and cancer risk above USEPAs acceptable risk levels. The non cancer hazard is associated with ingestion of vinyl chloride, arsenic, iron, and manganese, and the cancer risk is associated with exposure to vinyl chloride and arsenic. There is no discernable plume of arsenic, iron, and manganese. Additionally, there are no individual target organ effects that present a hazard above EPA's acceptable target threshold based on CT exposure to arsenic. Furthermore, iron and manganese are essential human nutrients, and the presence of these inorganics is likely related to site geochemistry and not a result of a CERCLA release. ~~Therefore, the Navy and EPA, in consultation with VDEQ, agree that no further action is warranted for inorganics in groundwater.~~ Potential human health risks associated with vinyl chloride in groundwater has been greatly reduced through implementation of the treatability study in September 2004, and continued enhanced bioremediation of vinyl chloride is expected to occur.

SWMU 2E

Potential risks and hazards were calculated for the current and future industrial worker, future construction worker, future trespasser/visitor, and future residential land use. Exposure scenarios

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evaluated included dermal contact, inhalation, and ingestion of surface soil, subsurface soil, and groundwater. Cancer risks and non-cancer hazards associated with exposure to site soil for all receptors evaluated are within USEPA's acceptable levels. Additionally, exposure to site groundwater by future industrial workers and trespasser/visitor are within EPA's acceptable risk levels. Exposure to groundwater by a future construction worker would result in a non-cancer hazard above EPA's acceptable levels due to pyrene. Future residential use of groundwater may result in a non-cancer hazard as a result of dermal contact with pyrene and ingestion of arsenic, iron, and manganese, and a cancer risk as a result of ingestion of benzo(a)anthracene, arsenic, and vinyl chloride. The presence of benzo(a)anthracene and pyrene are present only in wells containing free floating diesel fuel. Since diesel fuel is composed of 25% PAHs, such as benzo(a)anthracene and pyrene, the presence of these compounds in groundwater is likely a result of the fuel-related contamination which is exempt from action under CERCLA. The free-product diesel fuel at SWMU 2E is currently being addressed under the VDEQ POL/UST Program. Based on additional evaluation of the inorganic data, it was concluded that individual target organ effects from arsenic in groundwater at the CT concentration were acceptable. It was also concluded that CT concentrations of iron and manganese were within human nutrient guidelines. Therefore, inorganics in SWMU 2E groundwater do not pose an unacceptable risk. ~~Therefore, no further action is warranted to address inorganics in groundwater.~~ Vinyl chloride is the only contaminant at SWMU 2E resulting from a CERCLA release that contributes to potential human health risk, and this risk is likely to be reduced to concentrations below the corresponding MCL through implementation of the treatability study in September 2004 and continued natural degradation.

5.2 Ecological Risk Summary

No complete exposure pathways to ecological receptors were identified for SWMUs 2C and 2E. Therefore, no risk was identified and no further action is warranted to protect ecological receptors at these sites.

At SWMU 2B, potentially complete exposure pathways were identified for ecological receptors exposed to surface water and sediment in the ditch southeast of the site and to soils across the site. Based on the spatial distribution of contaminants in the drainage ditch, the continual impacts to the ditch from non-point sources, and the potential ecological damage that could result from removal of ditch sediments, it was concluded that no action was necessary to address ecological risks at SWMU 2B in the drainage ditch.

Based on the recommendations in the ERA, additional surface soil data were subsequently collected to refine the ecological risk evaluation. The results, presented in the FS (CH2M HILL, 2002), indicated that although some small areas may pose risks to ecological receptors, these areas are isolated and not migrating. Therefore, ~~no further~~ action was recommended at SWMU 2B based on ecological considerations.

6 Remedial Action Objectives

The Navy, USEPA, and VDEQ concur that a remedial action is necessary to protect public health, welfare, and the environment from actual or threatened releases of hazardous substances from SWMUs 2B, 2C, and 2E. The reagents injected in support of the 2004 treatability studies are continuing to treat groundwater at the SWMUs. The revised remedial alternatives identified in the FS Addendum were based on chemical concentrations observed following implementation of the treatability studies

TABLE 2: Maximum Contaminant Levels for Chlorinated VOCs

Trichloroethene	5
Cis 1,2-Dichloroethene	70
Vinyl Chloride	2

The site-specific Remedial Action Objective (RAOs) are:

- Prevent exposure to shallow aquifer groundwater at SWMUs 2B, 2C, and 2E until concentrations of VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.
- Reduce concentrations of VOCs in SWMUs 2B, 2C, and 2E groundwater to the remediation goals (MCLs. See Table 2) to the maximum extent practicable within a reasonable amount of time.

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prevent exposure to unacceptable risks to potential human receptors of groundwater. The Preferred Alternative is Continued Enhanced Bioremediation, LTM, and LUCs because it has the likelihood of meeting the RAO, meets the Applicable or Relevant and Appropriate Requirements (ARARs), guards against future risk, and allows for additional treatment if necessary. Continued Enhanced Bioremediation and enforcement of LUCs will continue within the boundaries of these SWMUs until the concentrations of chlorinated VOCs in groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use (Table 2).

7 Summary and Evaluation of Remedial Alternatives

Remedial alternatives to address chlorinated VOCs in groundwater at SWMUs 2B, 2C, and 2E were developed and are detailed in the FS Addendum. These alternatives included: 1) No Action, 2) Institutional Controls and Long Term Monitoring Monitored Natural Attenuation, and 3) Institutional Controls and LTM Enhanced Bioremediation (this remedy includes LTM).

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With the exception of the No-Action Alternative, all alternatives comply with ARARs, have the same RAOs, expected outcome, and anticipated future land use. The No-Action Alternative does not protect human health and the environment, but is presented as a baseline for comparison. A common element of the remaining alternatives evaluated for each SWMU is the use of institutional controls, which restrict exposure to and use of groundwater at the SWMUs, and continued groundwater monitoring until concentrations have been reduced to levels that allow for unrestricted exposure and unlimited land-use. Additionally, operation and maintenance (O&M), present worth cost, and future value O&M costs are similarly ranked for the two active alternatives because of the implementation of Continued Enhanced Bioremediation during the 2004 treatability studies. The most distinguishing feature of the alternatives (except the No-Action) is that although Continued Enhanced Bioremediation has already been implemented at the site, Alternative 3 will use allow additional treatment to further reduce contaminant toxicity, mobility, and volume if necessary. The remedial alternatives were evaluated against seven of the nine evaluation criteria. A comparison of the alternatives is shown in Table 3. Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Decision Document for these SWMUs. State involvement has been solicited throughout the CERCLA process and proposed remedy selection. The State supports the Preferred Alternative, and its final concurrence will be solicited following community review of this Proposed Plan and receipt of comments during the public comment period.

8 Preferred Alternative

Alternative 3, Continued Enhanced Bioremediation, LTM, and LUCs, is proposed as the Preferred Alternative to address chlorinated VOCs in groundwater at SWMUs 2B, 2C, and 2E. The initial component of the Preferred Alternative was implemented as part of the 2004 treatability studies; therefore, monitoring of the treatment effectiveness will continue and LUCs will remain in place until concentrations are reduced to acceptable levels for unlimited use and unrestricted exposure. Additional injection of anaerobic and aerobic bioremediation substrates to support continued enhanced anaerobic or aerobic compounds for continued enhanced bioremediation will take place if necessary to reduce contaminant mobility, toxicity, or volume. During each five year review, data will be evaluated to determine whether the concentrations in wells at SWMUs 2B, 2C, and 2E are declining. If concentrations in wells have not met RAOs and have not shown a decline between year one and year five, additional injections will be completed. Based on this information, the Navy and USEPA, in consultation with VDEQ, believe the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives considered with respect to balancing and modifying criteria. The Navy expects the Preferred Alternative to satisfy the following requirements of CERCLA: 1) it is protective of human health and the environment, 2) it complies with ARARs, 3) it is cost-effective, 4) it uses permanent solutions and alternative treatment technologies to the maximum extent practicable, and 5) it satisfies the preference for treatment.

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9 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 2B, 2C, and 2E and environmental actions at NAS Oceana. The public comment period for this Proposed Plan is from XXXX, 2006 through XXXX, 2006. A public meeting will be held on XXXX, 2006 at 7:00 pm (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 **Decision Document (DD)** and will also be included in the Administrative Record file.

Glossary

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

Aerobic: Life or processes that require, or are not destroyed by, the presence of oxygen.

Anaerobic: A life or process that occurs in, or is not destroyed by, the absence of oxygen.

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 affected 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.~~

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 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.

Chemicals of Concern: Specific constituents that are identified for evaluation in the risk assessment process.

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

Chemical Constituent 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 signed by the Navy 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.

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

Enhanced bioremediation: Enhanced bioremediation is a process in which indigenous or inoculated microorganisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or groundwater, converting them to innocuous end products. Nutrients, oxygen, or other amendments may be used to enhance bioremediation and contaminant desorption from subsurface materials.

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

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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 1 indicates that the human population is not likely to experience adverse effects.

Hazard Quotient (HQ): HQs are used to evaluate noncarcinogenic health effects and ecological risks. A value equal to or less than 1 indicates that the human or ecological population is not likely to experience adverse effects.

Hydrogen Release Compound (HRC®): Controlled release, electron donor material, that when hydrated is specifically designed to produce a controlled release of lactic acid. The lactic acid in turn produces hydrogen to fuel anaerobic biodegradation processes in soil and groundwater.

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

Installation Restoration Program (IRP): The process by which Department of Defense CERCLA sites are identified, evaluated, and cleaned up.

Institutional Controls: Measures, such as access restrictions and deed restrictions that separate people from the source of contamination. More than one institutional control may be used at a site.

Land Use Controls (LUCs): Legal and administrative measures to protect human health and the environment when the selected remedy allows residual contamination to be contained on site temporarily or permanently. LUCs limit human exposure by restricting activity, use, and access to properties with residual contamination.

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

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

Nine Evaluation Criteria:

- **Overall Protection of Human Health and the Environment** - Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- **Compliance with ARARs** - Addresses whether a remedy will meet all of the ARARs of other federal and state environmental laws and/or justifies a waiver of the requirements.
- **Long-Term Effectiveness and Permanence** - Addresses the expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, and Volume Through Treatment** - Discusses the anticipated performance of the treatment technologies a remedy may employ.
- **Short-Term Effectiveness** - Considers the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.
- **Implementability** - Evaluates the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement an option.
- **Cost** - Compares the estimated capital, operations and maintenance, and present-worth costs of a remediation alternative.

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- **State Acceptance** - Considers the state support agency comments on the Proposed Remedial Action Plan.

- **Community Acceptance** - Provides the public's general response to the alternatives described in the Proposed Plan, RI, and FS Reports. The specific responses to the public comments are addressed in the Responsiveness Summary section of the ROD.

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Non-Cancer Hazard: Non-cancer hazards (or risk) are expressed as a quotient that compares the existing level of exposure to the acceptable level of exposure. There is a level of exposure (the reference dose) below which it is unlikely for even a sensitive population to experience adverse health effects. 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 non-cancer effects.

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Oxygen Release Compound (ORC®): Proprietary formulation of phosphate-intercalated magnesium peroxide that, when hydrated, produces a controlled release of oxygen for periods of up to 12 months on a single application. Adding oxygen to the subsurface can accelerate aerobic biodegradation and enhance the rates of natural attenuation of contaminants.

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

Preliminary Remediation Goals: Concentration levels set for individual chemicals that, for carcinogens corresponds to a specific cancer risk level of 1 in 1 million and for noncarcinogens corresponds to a Hazard Quotient of 1. PRGs are generally selected when ARARs are not available.

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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.

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

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

Resource Conservation and Recovery Act (RCRA): A federal law, passed in 1976, which ensures that wastes are managed in a manner that protects human health and the environment, reduces or eliminates the amount of waste generated, and conserves energy and natural resources through waste recycling and recovery.

Solid Waste Management Unit (SWMU): Of or related to the area of the facility where a hazardous substance, hazardous waste, hazardous constituent, pollutant, or contaminant from the facility has been deposited, stored, disposed of, placed, migrated, or 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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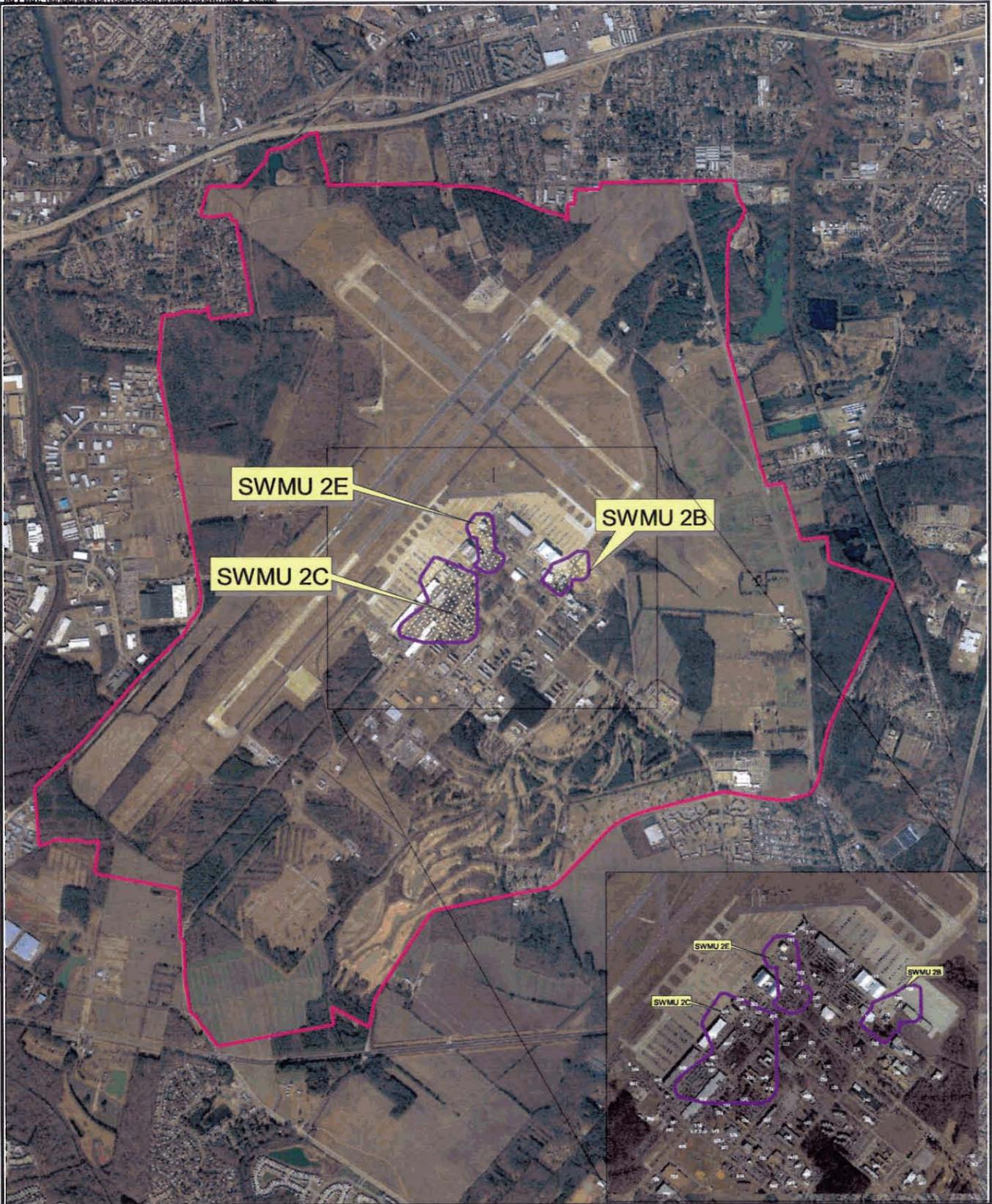
Mr. Tim Reisch
NAVFAC MID LANT
9742 Maryland Avenue
Norfolk, VA 23511-3095

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Table 3			
Analysis of Remedial Alternatives for Groundwater at SWMUs 2B, 2C, and 2E			
Evaluation Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls with LTM	Alternative 3 Enhanced Bioremediation and Institutional Controls (includes LTM)
Overall Protection of Human Health and Environment			
Prevention of unacceptable risks to potential receptors to the groundwater	Potential risk to receptors from the water table aquifer is posed by current conditions at the site if the groundwater is used as a potable supply. However, potable use if groundwater is restored to drinking water standards of the groundwater is unlikely (although no measures would be in place to prevent it).	Potential risk to receptors from the water table aquifer is posed by current conditions at the site if groundwater is used as potable water supply. However, potable use if of groundwater is unlikely and institutional controls would prevent potable use until groundwater is restored to drinking water standards. LTM will detect any change in current groundwater concentrations and determine how well the treatability study response actions are working. However, if concentrations did not decline, no treatment to drinking water standards would take place, therefore this remedy is not protective.	Potential risk to receptors from the water table aquifer is posed by current conditions at the site if groundwater is used as potable water supply. However, potable use of the groundwater is unlikely and institutional controls would prevent potable use until groundwater is restored to drinking water standards. Monitoring will detect any change in groundwater concentrations.
Compliance with ARARs			
Chemical-Specific ARARs	There would be no action involved, therefore, no chemical-specific ARARs would be triggered	This alternative is capable of achieving RAOs over the long term. LTM would track changes in groundwater quality.	This alternative is capable of achieving RAOs.
Action-Specific ARARs	There would be no action involved, therefore, no action-specific ARARs would be triggered	Long-term groundwater monitoring provided.	Underground Injection Control regulations under SDWA for injection into an aquifer would be followed. Long-term groundwater monitoring provided.
Location-Specific ARARs	Not applicable.	Not applicable.	Not applicable.
Long-Term Effectiveness and Permanence			
Risks	Possible risk posed by potable use of groundwater still exists. No permanent means to prevent future use of site in a manner that would result in unacceptable risk from groundwater.	NAS Oceana is expected to remain an active Base for the foreseeable future, so institutional controls will provide long-term protection of human health on-Base.	NAS Oceana is expected to remain an active Base for the foreseeable future, so institutional controls will provide long-term protection of human health on-Base..
Reliability of Controls	Unknown. No mechanism to prevent exposure to groundwater or to monitor the groundwater conditions.	Institutional controls as enforced by NAS Oceana are considered extremely reliable. Five year site reviews will be required until RAOs are met.	Institutional controls as enforced by NAS Oceana are considered extremely reliable. Five year site reviews will be required until RAOs are met.
Reduction of Toxicity, Mobility, or Volume			
Reduction of Toxicity, Mobility, and Volume through Treatment	Not applicable.	Toxicity associated with contaminated media would be reduced due to continued long-term natural degradation of CVOCs.	Toxicity associated with contaminated media would be reduced due to enhanced biodegradation and natural degradation of CVOCs. There is no reduction in contaminant mobility.
Type and Quantity of Residuals Remaining After Remediation	Not applicable.	No residues generated. VOC degradation products generated and degraded as part of the long-term process.	No residues generated. VOC degradation products generated and degraded as part of the long-term process.
Short-Term Effectiveness			
Treatment Process and Permanence	Not applicable.	No additional treatment process would be provided. Natural attenuation would continue with long-term monitoring to confirm reduction of the concentration of contaminants.	Additional treatment process would be provided. Natural attenuation would continue with long-term monitoring to confirm reduction of the concentration of contaminants. Bioremediation results in the permanent removal of contaminants through irreversible processes.
Protection of the Community and Workers During Remedial Action	Because there would be no action there is no short term impact to the community or workers.	Remedy implementation does not add to risk.	Remedy implementation does not add to risk.
Time Until Action is Complete	Not applicable.	Remediation goals are likely to be achieved within ten years.	Remediation goals are likely to be achieved within two to four years following treatment.
Environmental Impact	None	Minimal disturbance from long-term monitoring activities.	Minimal disturbance from long-term monitoring activities. Environmental impacts related to additional injections are minimal.
Implementability			
Ability to Construct and Operate	Not applicable.	No construction necessary. Operation would consist of LTM to track contaminant degradation. Groundwater-use restrictions would require consent from base command.	Any additional treatment would be performed using traditional direct push methods. Operations would consist of injection and long term monitoring. Groundwater use restrictions would require consent from base command.
Ease of Implementing Additional Action if Needed	Not applicable.	Very easy to implement additional action.	Easy to implement additional action.
Ability to Monitor Effectiveness	Not applicable.	Easily monitored during five-year site reviews. LTM will also be used to evaluate the groundwater quality.	Easily monitored during five-year site reviews. Monitoring will also be used to evaluate the groundwater quality.
Cost			
Present-Worth	\$18,672	\$56,016	\$56,016



- Base Boundary
- SWMU Boundary

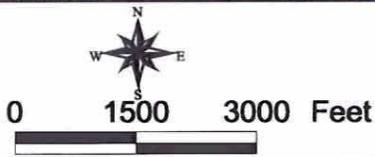
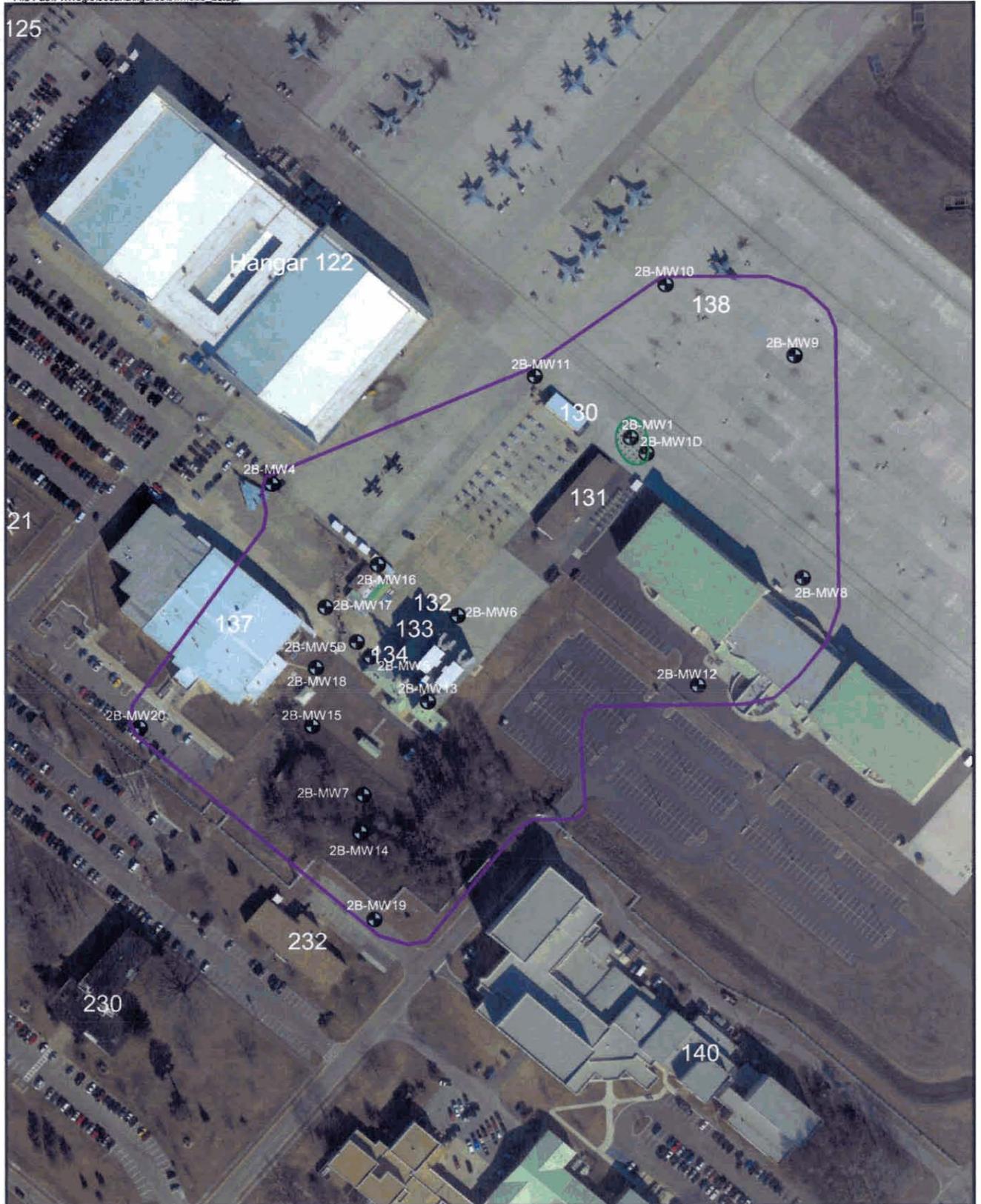


Figure 1
SWMU Location Map
NAS Oceana, Virginia Beach, Virginia



- Existing Monitoring Wells
- Groundwater VOC concentrations exceeding the MCL



0 100 200 Feet

Figure 2
Detailed View - SWMU 2B
NAS Oceana, Virginia Beach, Virginia



- Monitoring Well Locations
- SWMU 2C Boundary
- ⊙ Groundwater VOC concentrations exceeding the MCL

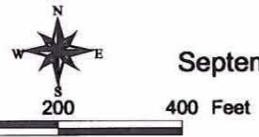


Figure 3
September 2005 Vinyl Chloride Plume - SWMU 2C
NAS Oceana, Virginia Beach, Virginia



- Existing Monitoring Wells
- Groundwater VOC concentrations exceeding the MCL

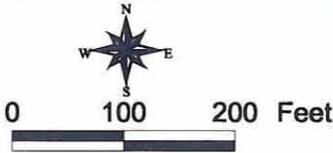
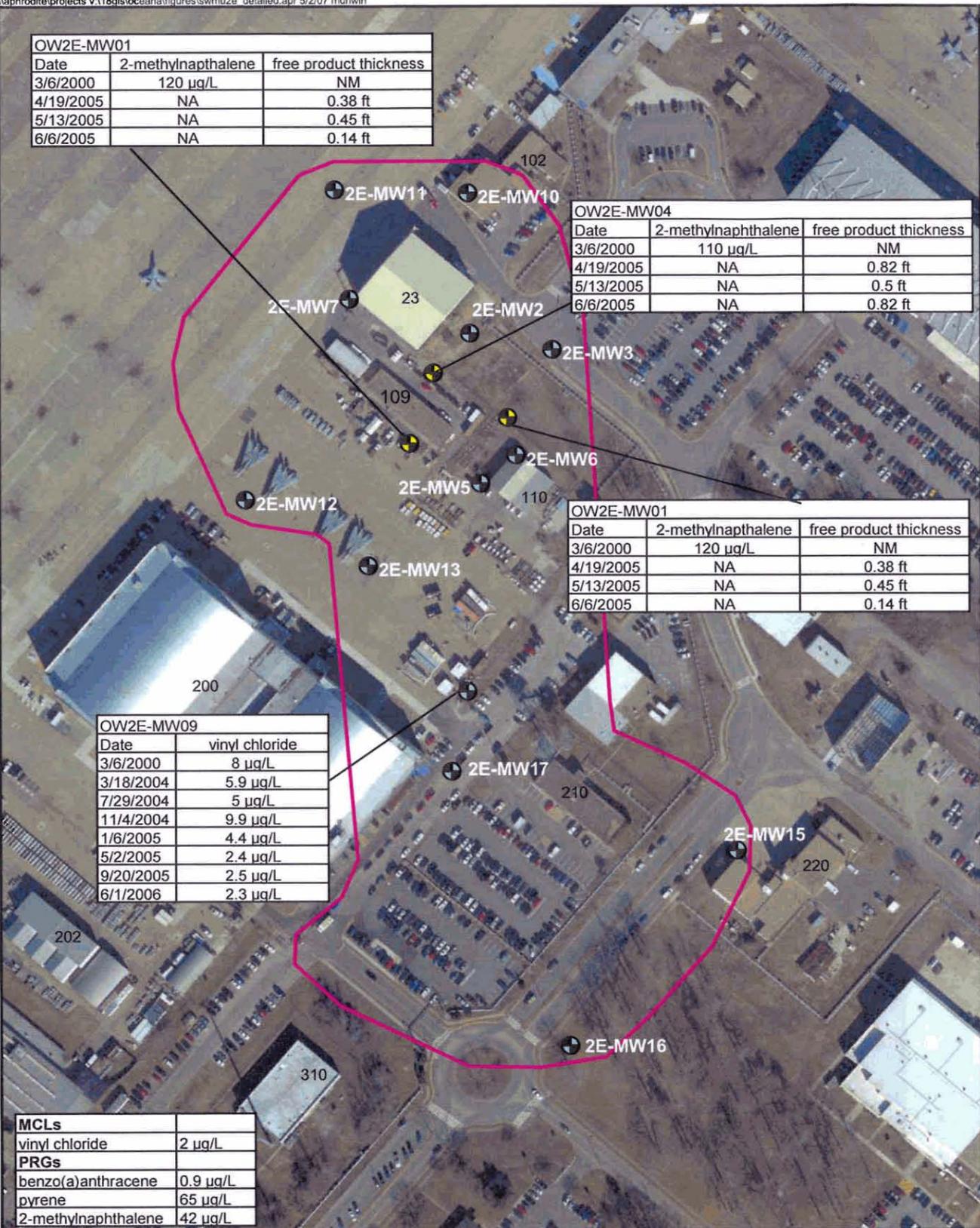


Figure 4
Detailed View - SWMU 2E
NAS Oceana, Virginia Beach, Virginia



OW2E-MW01		
Date	2-methylnaphthalene	free product thickness
3/6/2000	120 µg/L	NM
4/19/2005	NA	0.38 ft
5/13/2005	NA	0.45 ft
6/6/2005	NA	0.14 ft

OW2E-MW04		
Date	2-methylnaphthalene	free product thickness
3/6/2000	110 µg/L	NM
4/19/2005	NA	0.82 ft
5/13/2005	NA	0.5 ft
6/6/2005	NA	0.82 ft

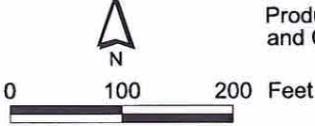
OW2E-MW01		
Date	2-methylnaphthalene	free product thickness
3/6/2000	120 µg/L	NM
4/19/2005	NA	0.38 ft
5/13/2005	NA	0.45 ft
6/6/2005	NA	0.14 ft

OW2E-MW09	
Date	vinyl chloride
3/6/2000	8 µg/L
3/18/2004	5.9 µg/L
7/29/2004	5 µg/L
11/4/2004	9.9 µg/L
1/6/2005	4.4 µg/L
5/2/2005	2.4 µg/L
9/20/2005	2.5 µg/L
6/1/2006	2.3 µg/L

MCLs	
vinyl chloride	2 µg/L
PRGs	
benzo(a)anthracene	0.9 µg/L
pyrene	65 µg/L
2-methylnaphthalene	42 µg/L

LEGEND

- Monitoring Wells
- Contains free product and is currently included in VDEQ product recovery and monitoring program
- SWMU 2E Boundary



Attachment 1
 Product Thickness, Polycyclic Aromatic Hydrocarbons
 and Chlorinated Volatiles Exceeding PRGs and MCLs
 SWMU 2E
 NAS Oceana
 Virginia Beach, Virginia