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FINAL REMEDIAL ACTION PLAN FOR ALLEGHENY PIER 303 SITE 20 NAS PENSACOLA FL
9/27/2002
TETRA TECH NUS

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0902-E341

September 27, 2002

Project Number 0516

Ms. Tracie Vaught
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Technical Review/Federal Facilities
Florida Department of Environmental Protection
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Reference: Clean Contract No. N62467-94-D-0888
Contract Task Order No. 0112

**Subject: Final Remedial Action Plan for Site 20, Allegheny Pier (Pier 303), Naval Air Station Pensacola, Pensacola, Florida**

Dear Ms. Vaught:

Tetra Tech NUS, Inc. is pleased to submit for your review the Final Remedial Action Plan for Site 20 Allegheny Pier (Pier 303), Naval Air Station (NAS) Pensacola, Pensacola, Florida. This document has been prepared for the U.S. Navy Southern Division, Naval Facilities Command under CTO 112 for the Comprehensive Long-term Environmental Action Navy Contract N62467-94-D-0888.

If you have any questions, please call me at (850) 385-9899.

Sincerely yours,

Michael F. Albert for

Gerald Walker, P.G.
Project Manager

GAW/gaw

Enclosure

c: Mr. Byas Glover, SOUTHDIV
Mr. Greg Campbell, NAS Pensacola PWC
Ms. Debbie Wroblewski (Cover letter only)
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Rev. 1
09/27/02

# REMEDIAL ACTION PLAN

# for

# SITE 20

# ALLEGHENY PIER (PIER 303)
# NAVAL AIR STATION PENSACOLA
# PENSACOLA, FLORIDA

## Southern Division
## Naval Facilities Engineering Command
### Contract Number N62467-94-D-0888
### Contract Task Order 0112

**September 2002**

# PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that this document, *Remedial Action Plan for Site 20, Allegheny Pier (Pier 303), Naval Air Station Pensacola, Pensacola, Florida* was prepared under my direct supervision. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.

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Michael F. Albert
9/27/02

# REMEDIAL ACTION PLAN

# FOR

# SITE 20
# ALLEGHENY PIER (PIER 303)
# NAVAL AIR STATION PENSACOLA
# PENSACOLA, FLORIDA

**COMPREHENSIVE LONG-TERM**
**ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:**
**Department of the Navy, Southern Division**
**Naval Facilities Engineering Command**
**2155 Eagle Drive**
**North Charleston, South Carolina 29406**

**Submitted by:**
**Tetra Tech NUS, Inc.**
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**CONTRACT NO. N62467-94-D-0888**
**CONTRACT TASK ORDER 0112**

**SEPTEMBER 2002**


**PREPARED UNDER THE SUPERVISION OF:**

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# ACRONYMS

| | |
|---|---|
| AFVR | aggressive fluid vapor recovery |
| API | American Petroleum Institute |
| bls | below land surface |
| BTOC | below top of casing |
| cfm | cubic feet per minute |
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| COC | chemical of concern |
| COI | chemical of interest |
| COPC | chemical of potential concern |
| CTL | cleanup target level |
| CTO | Contract Task Order |
| DO | dissolved oxygen |
| DOT | Department of Transportation |
| DPT | Direct Push Technology |
| DSCFM | dry standard cubic feet per minute |
| EDB | ethylene dibromide |
| ECUA | Escambia County Utilities Authority |
| F.A.C. | *Florida Administrative Code* |
| FDEP | Florida Department of Environmental Protection |
| FID | flame ionization detector |
| GAC | granular activated carbon |
| GCTLs | groundwater cleanup target level |
| HI | Hazard Index |
| HQ | Hazard Quotient |
| LUC | land use control |
| MSW | marine surface water |
| MTBE | methyl tertiary butyl ether |
| NAS | Naval Air Station |
| Navy | United States Navy |
| NCDENR | North Carolina Department of Environment and Natural Resources |
| NEESA | Navy Energy and Environmental Support Activity |
| NPDES | National Pollutant Discharge Elimination System |
| NPWC | Navy Public Works Center |
| O&M | Operation and Maintenance |
| ORC® | Oxygen Reducing Compound |

| | |
|---|---|
| ORP | oxidation reduction potential |
| OVA | organic vapor analyzer |
| PAHs | polycyclic aromatic hydrocarbon |
| PID | photoionization detector |
| POTW | publicly owned treatment work |
| ppb | parts per billion |
| ppm | parts per million |
| RAP | Remedial Action Plan |
| RPM | Remedial Project Manager |
| SAR | Site Assessment Report |
| SARA | Site Assessment Report Addendum |
| SCTLs | soil cleanup target level |
| STP | standard temperature and pressure |
| T&D | transport and disposal |
| TRPHs | total recoverable petroleum hydrocarbons |
| TtNUS | Tetra Tech NUS, Inc. |
| USEPA | U.S. Environmental Protection Agency |
| VOCs | volatile organic compound |

# EXECUTIVE SUMMARY

The Southern Division, Naval Facilities Engineering Command has completed a Remedial Action Plan (RAP) for Site 20 at the Allegheny Pier, Naval Air Station Pensacola, Pensacola, Florida, in accordance with the requirements of Chapter 62-770, *Florida Administrative Code* (F.A.C.). This plan is being submitted to the Florida Department of Environmental Protection for approval.

The following tasks were performed during preparation of the RAP:

- Reviewed the Site Assessment Report and Site Assessment Report Addendum (NPWC, 1998; TtNUS, 2001).
- Evaluated remedial alternatives to address free product and groundwater contamination.
- Specified a sampling plan to track the remediation status of the site.

The remedial action goals of this RAP are to (1) identify a method to perform free-product recovery and (2) select a remedial action to reduce hydrocarbon and lead concentrations within the groundwater matrix. This RAP identifies a combination of vacuum extraction and absorbent socks as the selected alternative for free-product removal and groundwater extraction by pump and treat with discharge to the publicly owned treatment works as the selected alternative for remediation at Site 20. The remedial alternative was selected because it was determined to be the most effective method for the removal of free product and remediation of groundwater. If implemented, the free-product recovery system will require approximately 3 months to design and construct and 9 months to remove measurable free product. Twelve to 18 months will be required for groundwater recovery system design and construction. Active groundwater remediation will occur for approximately 1 year on a limited basis until free product is removed and than continue for an additional 5 years. Post-remedial action activities specified in Chapter 62-770 F.A.C. will require a minimum of 12 months of monitoring.

# 1.0 INTRODUCTION

## 1.1 PURPOSE AND SCOPE

This Remedial Action Plan (RAP) was prepared by Tetra Tech NUS, Inc. (TtNUS) for the United States Navy (Navy) Southern Division, Naval Facilities Engineering Command under Contract Task Order 0112, for the Comprehensive Long-term Environmental Action Navy (CLEAN), Contract Number N62467-94-D-0888.

In July 1998, a Site Assessment Report (SAR) for Site 20, Allegheny Pier (Pier 303), Naval Air Station (NAS), Pensacola, Florida was submitted by the Navy Public Works Center (NPWC) to the Florida Department of Environmental Protection (FDEP) for review, and a Site Assessment Report Addendum (SARA) (TtNUS, 2001) was submitted to FDEP on May 23, 2001. Following the approval of the SARA, the FDEP requested the preparation and submittal of a RAP to address free-product removal at Site 20.

This RAP contains the identification, evaluation, and selection of the remedial action alternative to remove free product and to remediate groundwater in accordance with the requirements of Chapter 62-770 *Florida Administrative Code* (F.A.C). This RAP provides an evaluation of applicable alternatives that protect human health and the environment, reduce hydrocarbon constituent concentrations within soil and groundwater, and retard further migration of hydrocarbon constituents to downgradient areas. The RAP includes a design for the selected remedial alternative.

## 1.2 SITE DESCRIPTION

NAS Pensacola covers approximately 5,800 acres and is located on a peninsula bounded on the east and south by Pensacola Bay and Big Lagoon and on the north by Bayou Grande. Allegheny Pier (Pier 303) is located within the confines of NAS Pensacola in Section 1, Range 30W, and Township 3S. The site is located approximately ¼ mile south of Chevalier Field. Figures 1-1 and 1-2 illustrate the site location and site vicinity, respectively.

The pier area is situated along the Pensacola Bay shoreline and consists of an approximately 30-foot-wide concrete loading area immediately adjacent to the pier seawall, surrounded by a large asphalt parking lot. Previously there was a 1,300,000-gallon aboveground fuel storage tank (No. 354) with a concrete containment wall adjacent to and west of the pier. Tank No. 354 was removed on November 17, 1993, and not replaced. The site area extended approximately 1,000 feet north of the former storage tank location and interfaces with Buildings 707, 52, 18, and 2573. The site plan is shown on Figure 1-3.

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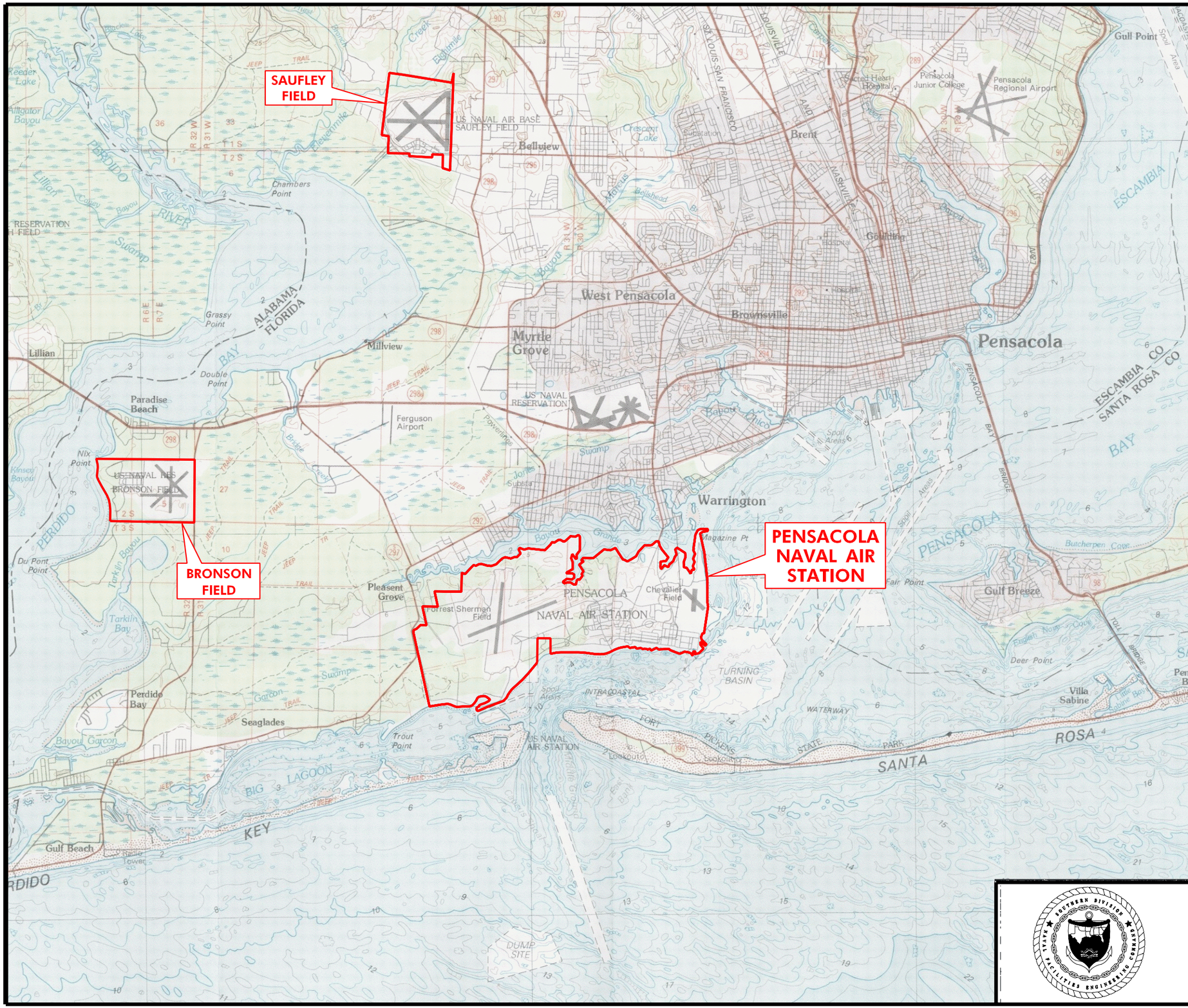

-N-

10000 0 10000
SCALE IN FEET

FIGURE 1-1

SITE LOCATION MAP
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

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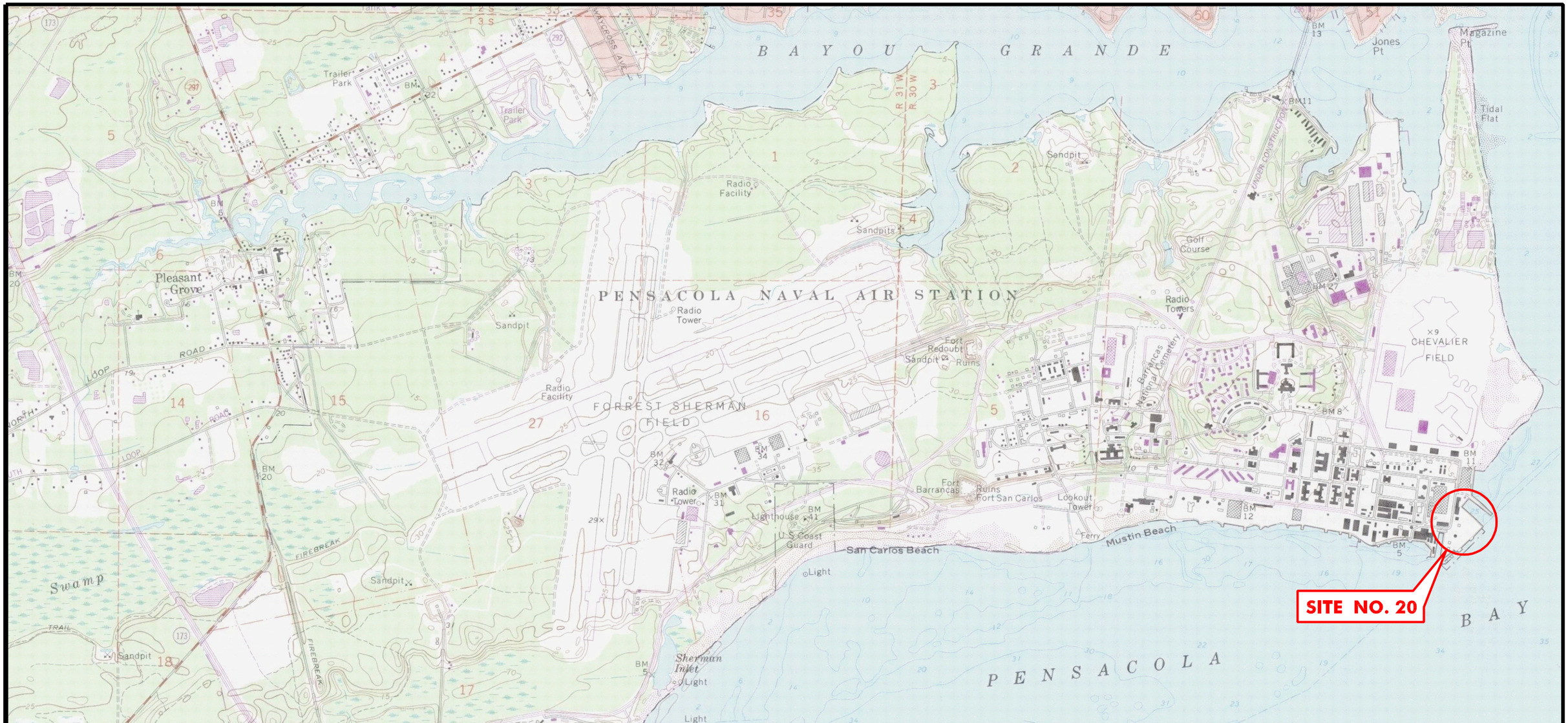


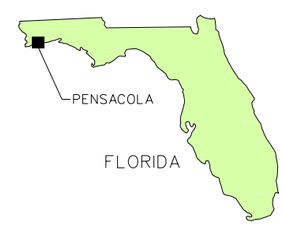


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FORT BARRANCAS, FLORIDA (1970 EDITION - PHOTOREVISED 1987).

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2000 0 2000
SCALE IN FEET

FIGURE 1-2

SITE VICINITY MAP
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n1x17b.dgn

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SOURCE:

LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

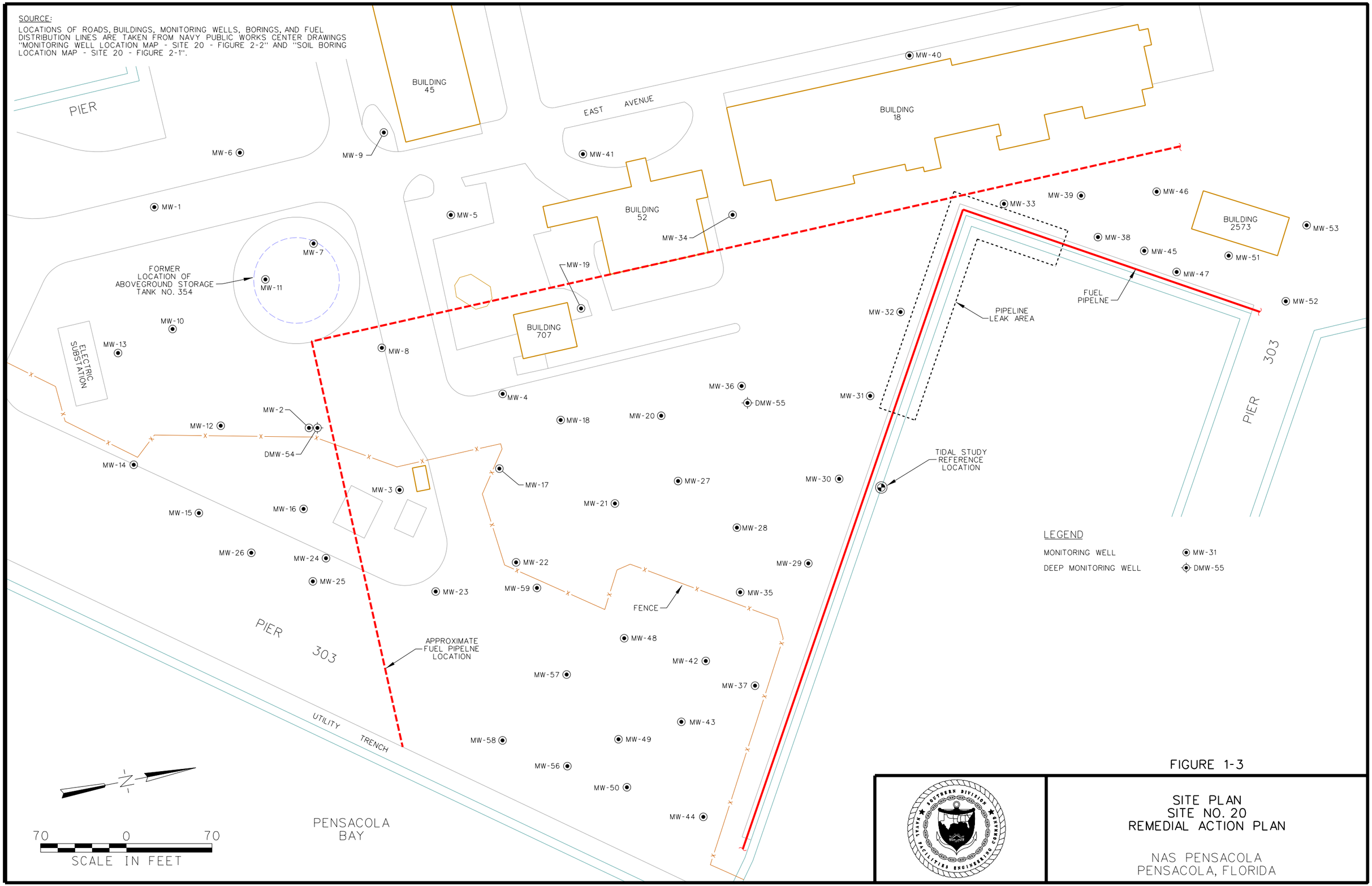


FIGURE 1-3

SITE PLAN
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

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## 1.3 SITE HISTORY

The site is a former "berthing pier area" that has fueling capabilities. The former aboveground storage tank (No. 354) was used to contain Navy Special Fuel Oil, Distillate DFM, and JP-5 Jet Fuel since 1926 (NEESA, 1983). The tank may have been modified or replaced in the past. Pipelines extended from the fuel storage tank, presumably north toward Building 2573 to the berthing pier (structure No. 303) and possibly to other ship fueling areas.

The pipelines were inactive for several years. In 1981, a leak was discovered in the fuel pipeline leading to the berthing pier. Either the lines had broken during the years of usage or the abandoned line was penetrated while a contractor was driving piles. The soil in the area of the leak appeared soaked with fuel oil, reportedly Navy Special Fuel Oil or marine diesel fuels. An unknown volume of soil was removed and properly disposed of in 1981 (NEESA, 1983).

In November 1993, the presence of petroleum constituents at the wastewater treatment plant led to an investigation of the sanitary sewer lines. Oil/fuel was discovered in the lines leading from the berthing pier to the wastewater treatment plant. Possible contamination was thought to have occurred during construction modifications to the pier. The tank was removed in 1993, but the pipelines were not. No closure assessment was performed because the site was on the FDEP/Navy petroleum agreement list for further investigation.

## 1.4 REPORT ORGANIZATION

This report is organized into eight sections. Below is a list of the sections and a brief description of their purpose:

Section 1: Introduction. Presents the report's purpose, scope, site information, and report organization.

Section 2: Site Assessment Reports Findings and Conclusions. Reviews the approved SARA and summarizes the SAR and SARA's findings and conclusions.

Section 3: Remedial Action Objectives. Sets the free-product removal and groundwater cleanup objectives.

Section 4: Contaminant Distribution. Estimates the volume of free product at Site 20.

Section 5: Remedial Technologies. Presents the alternatives for remediation, determines the suitability to the site, develops budgetary costs for each, and selects preferred alternative.

Section 6: Remedial System Design. Presents all of the assumptions made and provides the detailed design of the preferred remedial alternative.

Section 7: Monitoring Plan and Project Closeout: Contains procedures for system implementation, routine O&M, and final reporting and monitoring after completion.

Section 8: References. Lists all references used.

# 2.0 SITE ASSESSMENT REPORTS FINDINGS AND CONCLUSIONS

In July 1998, a SAR for Site 20, Allegheny Pier, NAS, Pensacola was submitted by NAS Pensacola NPWC to the FDEP for review and a SARA (TtNUS, 2001) was completed and submitted to FDEP on May 23, 2001. The SAR and SARA were conducted to determine the extent of free product and soil and groundwater contamination at the site. The following is a summary of the findings of the SAR and SARA for Site 20.

## 2.1 LITHOLOGIC FINDINGS

The principal area of concern at the site is the surficial zone of the sand and gravel aquifer. Monitoring wells were installed in the surficial zone to a depth of 25.5 feet during the SAR investigation. The lithology at the site was found to be consistent and generally composed of (1) asphalt and road sub-base from 0-1 feet below land surface (bls); (2) light brown to grey, fine silty sand from 1 to 4 feet bls; (3) white, silty, fine sand from 4 to 6 feet bls; (4) reddish-white, fine to medium, silty sand from 6 to 7 feet bls; (5) tan, fine to medium, silty sand from 7 to 10 feet bls; (6) grey, fine to medium, silty sand from 10 to 18 feet bls; (7) tan, medium to coarse, silty sand from 18 to 25 feet bls. The groundwater table at the site was encountered between 6 and 7 feet bls. Lithological logs describing the soil encountered are located in the SAR and SARA for Site 20.

## 2.2 GROUNDWATER AND AQUIFER CHARACTERISTICS

The SAR indicated that the depth to groundwater ranged from approximately 4.5 to 10 feet bls and, although groundwater flow fluctuated, generally flows to the southeast toward the bay. In December 2000 the measured groundwater table at Site 20 appeared to be relatively flat with slight flow direction to the east and south. Depth to groundwater ranged from approximately 5 to 11 feet bls. Table 2-1 presents the groundwater elevations from December 2000. Figure 2-1 presents the groundwater elevation map from December 2000.

The SAR for Site 20 stated that because the hydrogeology at the site was found to be generally consistent with other sites at NAS Pensacola, slug test information from three other sites at NAS Pensacola could be averaged to provide the aquifer characteristics data for Site 20.

# TABLE 2-1

## GROUNDWATER AND FREE PRODUCT LEVEL DATA ON DECEMBER 6, 2000

## SITE 20, ALLEGHENY PIER (PIER 303) NAS PENSACOLA, PENSACOLA, FLORIDA



| Well Number | Top of Casing Elevation (1) (ft) | Depth to Product BTOC (ft) | Depth to Water BTOC (ft) | Free Product Thickness (ft) | Groundwater Elevation (1) (2) (ft) |
|---|---|---|---|---|---|
| MW-1 | 25.86 | NA | 6.7 | NA | 19.16 |
| MW-2 | 28.51 | 9.29 | 9.63 | 0.34 | 19.19 |
| MW-3 | 28.59 | NA | 9.42 | NA | 19.17 |
| MW-4 | 28.48 | NA | 9.27 | NA | 19.21 |
| MW-5 | 25.97 | NA | 6.69 | NA | 19.28 |
| MW-6 | 25.11 | NA | 6.86 | NA | 18.25 |
| MW-7 | 26.08 | NA | 6.82 | NA | 19.26 |
| MW-8 | 27.93 | 8.70 | 9.25 | 0.55 | 19.18 |
| MW-9 | 26.01 | NA | 6.70 | NA | 19.31 |
| MW-10 | 26.88 | NA | 7.70 | NA | 19.18 |
| MW-11 | 26.39 | 7.17 | 7.21 | 0.04 | 19.22 |
| MW-12 | 28.11 | 8.92 | 9.06 | 0.14 | 19.18 |
| MW-13 | 27.00 | NA | 7.85 | NA | 19.15 |
| MW-14 | 27.87 | NA | 8.74 | NA | 19.13 |
| MW-15 | 28.23 | NA | 9.07 | NA | 19.16 |
| MW-16 | 28.53 | NA | 9.20 | NA | 19.33 |
| MW-17 | 29.41 | NA | 10.21 | NA | 19.20 |
| MW-18 | 29.38 | NA | 10.15 | NA | 19.23 |
| MW-19 | 27.98 | 8.63 | 9.10 | 0.47 | 19.30 |
| MW-20 | 29.42 | NA | 10.21 | NA | 19.21 |
| MW-21 | 29.82 | NA | 10.66 | NA | 19.16 |
| MW-22 | 29.62 | NA | 10.46 | NA | 19.16 |
| MW-23 | 28.76 | NA | 9.60 | NA | 19.16 |
| MW-24 | 28.47 | NA | 9.31 | NA | 19.16 |
| MW-25 | 28.37 | NA | 9.21 | NA | 19.16 |
| MW-26 | 27.97 | NA | 8.80 | NA | 19.17 |
| MW-27 | 29.72 | NA | 10.53 | NA | 19.19 |
| MW-28 | 29.38 | NA | 10.22 | NA | 19.16 |
| MW-29 | 28.28 | NA | 9.13 | NA | 19.15 |
| MW-30 | 28.63 | 9.30 | 10.43 | 1.13 | 19.22 |
| MW-31 | 28.34 | 9.00 | 9.97 | 0.97 | 19.24 |
| MW-32 | 28.02 | 8.64 | 10.04 | 1.40 | 19.24 |
| MW-33 | 27.24 | 8.09 | 8.17 | 0.08 | 19.14 |
| MW-34 | 26.00 | 6.65 | 6.70 | 0.05 | 19.35 |
| MW-35 | 28.72 | NA | 9.59 | NA | 19.13 |
| MW-36 | 28.75 | 9.35 | 10.77 | 1.42 | 19.26 |
| MW-37 | 28.00 | NA | 8.90 | NA | 19.10 |

# TABLE 2-1

## GROUNDWATER AND FREE PRODUCT LEVEL DATA ON DECEMBER 6, 2000

## SITE 20, ALLEGHENY PIER (PIER 303) NAS PENSACOLA, PENSACOLA, FLORIDA



| Well Number | Top of Casing Elevation [1] (ft) | Depth to Product BTOC (ft) | Depth to Water BTOC (ft) | Free Product Thickness (ft) | Groundwater Elevation [1] [2] (ft) |
|---|---|---|---|---|---|
| MW-38 | 27.70 | NA | 8.49 | NA | 19.21 |
| MW-39 | 26.46 | NA | 7.10 | NA | 19.36 |
| MW-40 | 24.38 | NA | 4.87 | NA | 19.51 |
| MW-41 | 25.36 | NL | NL | NA | NA |
| MW-42 | 28.71 | NA | 9.59 | NA | 19.12 |
| MW-43 | 28.50 | NA | 9.40 | NA | 19.10 |
| MW-44 | 28.14 | NA | 9.05 | NA | 19.09 |
| MW-45 | 26.51 | NA | 7.58 | NA | 18.93 |
| MW-46 | 26.94 | NA | 7.08 | NA | 19.86 |
| MW-47 | 27.55 | NA | 8.33 | NA | 19.22 |
| MW-48 | 29.28 | NA | 10.15 | NA | 19.13 |
| MW-49 | 28.26 | NA | 9.15 | NA | 19.11 |
| MW-50 | 27.88 | NA | 8.75 | NA | 19.13 |
| MW-51 | 27.69 | NA | 8.41 | NA | 19.28 |
| MW-52 | 28.13 | NM | NM | NA | NA |
| MW-53 | 27.47 | NA | 8.12 | NA | 19.35 |
| DMW-54 | 28.53 | NA | 9.32 | NA | 19.21 |
| DMW-55 | 28.93 | NA | 9.67 | NA | 19.26 |
| MW-56 | 28.21 | NA | 9.10 | NA | 19.11 |
| MW-57 | 28.71 | NA | 9.57 | NA | 19.14 |
| MW-58 | 28.22 | NA | 9.07 | NA | 19.15 |
| MW-59 | 29.33 | NA | 10.17 | NA | 19.16 |

Notes:

[1] Elevations based upon arbitrary elevation of 30 feet above MSL assigned to the northeast corner of an existing concrete light pole.

[2] A specific gravity of 0.9 (for Bunker "C" oil) used in water level calculations to correct for free product : depth to water - (free product thickness*0.90) = corrected depth to water

BTOC - Below Top of Casing

MSL - Mean Sea Level Datum

NA - not applicable

NL - not located

NM - not measured due to probe refusal at 3.45 feet.

SOURCE:

LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

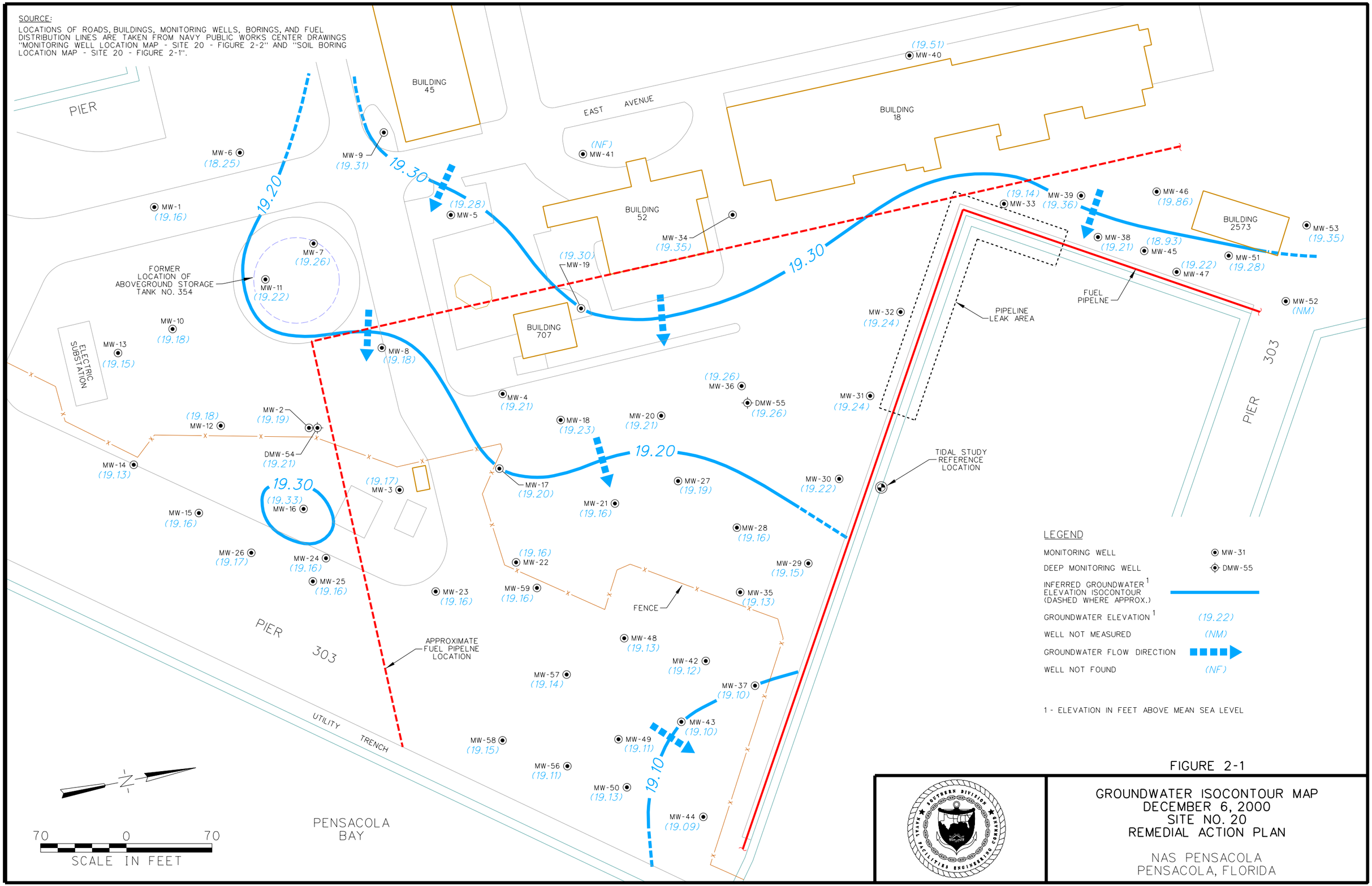



FIGURE 2-1

GROUNDWATER ISOCONTOUR MAP
DECEMBER 6, 2000
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L004.dgn/10-25-01

The following aquifer parameters were estimated in the SAR (NPWC, 1998).

| | | |
|---|---|---|
| Hydraulic conductivity | K = | 48.3 feet per day |
| Flow velocity | V = | 0.037 feet per day |
| Effective porosity | $n_e$ = | 0.25 (unitless) |

## 2.3 SOIL CONTAMINATION ASSESSMENT

The vertical and horizontal extent of petroleum-impacted soil in the vadose zone was assessed through soil vapor analysis performed during the field investigations described in the SAR and SARA for Site 20 (NPWC, 1998; TtNUS, 2001). The SAR soil assessment at Site 20 consisted of screening the soil for petroleum vapors with an organic vapor analyzer (OVA) during the installation of soil borings and monitoring wells. Eighty-five soil borings (SB-1 through SB-85) were installed at the site to a depth of 6 to 7 feet bls in June through October 1996. Fifty-three additional soil borings (BH-1 through BH-53) were installed from September 1996 through February 1997 to a depth of 7 feet bls. Soil samples were collected at each borehole at depths of 1, 4, and 5-7 feet bls intervals and analyzed for volatile organic vapors using an OVA with a flame ionization detector (FID). Soil samples were also collected during the installation of monitoring wells MW-1 through MW-59 at approximately 1-, 4-, and 6-foot intervals bls and analyzed with an OVA for volatile organic compounds (VOCs). Soil analytical results from the SAR are summarized on Table 2-2. Soil boring locations are indicated on Figure 2-2. Areas of excessively contaminated soil are shown on Figures 2-3a through 2-3c.

During the SAR field investigation, the groundwater table was generally encountered at 5 to 8 feet bls. Results of the SAR field investigation stated that the VOC readings taken from three areas of the site (the tank area, Building 18, and monitoring wells) indicated that the areal extent of soil contamination was widespread and extensive.

On August 3, 4, and 8, 2000, 18 soil borings (SB-1 through SB-4, SB-6 through SB-17, SB-19, and SB-20) were completed to depths ranging from 5 to 9 feet bls using Direct Push Technology (DPT). The soil borings were installed to further characterize the site contamination and the extent of free product. During soil boring operations an on-site geologist recorded lithologic descriptions of the soil and identified the presence of free product. These soil boring locations are shown on Figure 2-4.

A single soil sample was collected from each of the 18 soil borings except SB-10 from which a duplicate sample was collected.

**TABLE 2-2**

**SUMMARY OF ANALYTES DETECTED IN SOIL**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

**PAGE 1 OF 4**

| Sample No.<br>Sample Location<br>Collect Date<br>Sample Depth (bls) | Florida Cleanup Levels | NASP20SB-1<br>SB-1<br>8/3/2000<br>6 feet | NASP20SB-2<br>SB-2<br>8/3/2000<br>6 feet | NASP20SB-3<br>SB-3<br>8/4/2000<br>6 feet | NASP20SB-4<br>SB-4<br>8/4/2000<br>6 feet | NASP20SB-6<br>SB-6<br>8/4/2000<br>6-7 feet |
|---|---|---|---|---|---|---|
| | DE1[1]/DE2[2]/LE[3] (mg/kg) | | | | | |
| **Volatile[4] (mg/kg)** | | | | | | |
| Ethylbenzene | 1100/8400/0.6 | -- | 0.252[J] | 0.526 | -- | -- |
| Methylene Chloride | 16/23/0.02 | -- | -- | -- | -- | -- |
| Trichloroethene | 6/8.5/0.03 | -- | -- | -- | -- | -- |
| Total Xylenes | 5900/40000/0.2 | -- | -- | **0.736[J]** | -- | -- |
| **Polycyclic Aromatic Hydrocarbons[5] (mg/kg)** | | | | | | |
| 1-Methylnaphthalene | 68/470/2.2 | **3.69** | **18.2** | **14.2** | **13** | -- |
| 2-Methylnaphthalene | 80/560/6.1 | 3.91 | **24.4** | **17.4** | **17** | -- |
| Benzo(a)anthracene | 1.4/5.0/3.2 | 0.685 | -- | -- | -- | -- |
| Benzo(a)pyrene | 0.1/0.5/8 | 0.397 | -- | -- | -- | -- |
| Benzo(b)fluoranthene | 1.4/4.8/10 | 0.486 | -- | -- | -- | -- |
| Benzo(g,h,i)perylene | 2300/41000/32000 | 0.27[J] | -- | -- | -- | -- |
| Benzo(k)fluoranthene | 15/52/25 | 0.269[J] | -- | -- | -- | -- |
| Chrysene | 140/450/77 | -- | -- | -- | -- | -- |
| Fluorene | 2200/28000/160 | -- | 3.95[J] | 2.82[J] | 2.73[J] | -- |
| Fluoranthene | 2900/48000/1200 | 1.92 | -- | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | 1.5/5.3/28 | 0.445 | -- | -- | -- | -- |
| Naphthalene | 40/270/1.7 | -- | **5.61[J]** | **3.37[J]** | -- | -- |
| Phenanthrene | 2000/30000/250 | 2.34 | 12.5 | 4.91[J] | 4.24[J] | -- |
| Pyrene | 2200/37000/880 | 1.58[J] | -- | -- | -- | -- |
| **Total Recoverable Petroleum Hydrocarbons[6] (mg/kg)** | 340/2500/340 | **10200** | **8520** | **6360** | **4790** | 8.44[J] |

**TABLE 2-2**

**SUMMARY OF ANALYTES DETECTED IN SOIL**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

**PAGE 2 OF 4**

| Sample No.<br>Sample Location<br>Collect Date<br>Sample Depth (bls) | Florida Cleanup Levels | NASP20SB-7<br>SB-7<br>8/4/2000<br>9 feet | NASP20SB-8<br>SB-8<br>8/4/2000<br>8 feet | NASP20SB-9<br>SB-9<br>8/4/2000<br>9 feet | NASP20SB-10<br>SB-10<br>8/4/2000<br>9 feet | NASP20DUP-1<br>SB-10 Duplicate<br>8/4/2000<br>6-7 feet |
|---|---|---|---|---|---|---|
| | DE1[1]/DE2[2]/LE[3] (mg/kg) | | | | | |
| **Volatile[4] (mg/kg)** | | | | | | |
| Ethylbenzene | 1100/8400/0.6 | -- | -- | -- | -- | -- |
| Methylene Chloride | 16/23/0.02 | -- | -- | -- | -- | -- |
| Trichloroethene | 6/8.5/0.03 | -- | -- | -- | -- | -- |
| Total Xylenes | 5900/40000/0.2 | -- | -- | -- | -- | -- |
| **Polycyclic Aromatic Hydrocarbons[5] (mg/kg)** | | | | | | |
| 1-Methylnaphthalene | 68/470/2.2 | 0.24[J] | 0.783 | -- | 0.955[J] | 1.64[J] |
| 2-Methylnaphthalene | 80/560/6.1 | 0.259[J] | 1 | -- | 1.13 | 1.76 |
| Benzo(a)anthracene | 1.4/5.0/3.2 | -- | -- | -- | -- | -- |
| Benzo(a)pyrene | 0.1/0.5/8 | -- | -- | -- | -- | -- |
| Benzo(b)fluoranthene | 1.4/4.8/10 | -- | -- | -- | -- | -- |
| Benzo(g,h,i)perylene | 2300/41000/32000 | -- | -- | -- | -- | -- |
| Benzo(k)fluoranthene | 15/52/25 | -- | -- | -- | -- | -- |
| Chrysene | 140/450/77 | -- | -- | -- | -- | -- |
| Fluorene | 2200/28000/160 | 0.11[J] | -- | -- | -- | -- |
| Fluoranthene | 2900/48000/1200 | -- | -- | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | 1.5/5.3/28 | -- | -- | -- | -- | -- |
| Naphthalene | 40/270/1.7 | -- | -- | -- | -- | -- |
| Phenanthrene | 2000/30000/250 | 0.28[J] | 0.386[J] | -- | 0.385[J] | 0.545[J] |
| Pyrene | 2200/37000/880 | -- | -- | -- | -- | -- |
| **Total Recoverable Petroleum Hydrocarbons[6] (mg/kg)** | 340/2500/340 | 100 | **5140** | 8.86 | **2740[J]** | **1240[J]** |

**TABLE 2-2**

**SUMMARY OF ANALYTES DETECTED IN SOIL**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

**PAGE 3 OF 4**

| Sample No.<br>Sample Location<br>Collect Date<br>Sample Depth (bls) | Florida Cleanup Levels | NASP20SB-11<br>SB-11<br>8/4/2000<br>8 feet | NASP20SB-12<br>SB-12<br>8/7/2000<br>8 feet | NASP20SB-13<br>SB-13<br>8/7/2000<br>8 feet | NASP20SB-14<br>SB-14<br>8/7/2000<br>8 feet | NASP20SB-15<br>SB-15<br>8/7/2000<br>8 feet |
|---|---|---|---|---|---|---|
| | DE1[1]/DE2[2]/LE[3] (mg/kg) | | | | | |
| **Volatile[4] (mg/kg)** | | | | | | |
| Ethylbenzene | 1100/8400/0.6 | -- | -- | -- | -- | -- |
| Methylene Chloride | 16/23/0.02 | -- | -- | -- | 0.0121 | -- |
| Trichloroethene | 6/8.5/0.03 | -- | -- | -- | -- | -- |
| Total Xylenes | 5900/40000/0.2 | -- | -- | -- | -- | -- |
| **Polycyclic Aromatic Hydrocarbons[5] (mg/kg)** | | | | | | |
| 1-Methylnaphthalene | 68/470/2.2 | **12.1** | **24.2** | -- | -- | 1.55 |
| 2-Methylnaphthalene | 80/560/6.1 | **17.2** | **32.6** | -- | -- | 1.77 |
| Benzo(a)anthracene | 1.4/5.0/3.2 | -- | -- | -- | -- | 0.576 |
| Benzo(a)pyrene | 0.1/0.5/8 | -- | -- | -- | -- | **1.04** |
| Benzo(b)fluoranthene | 1.4/4.8/10 | -- | -- | -- | -- | 0.763 |
| Benzo(g,h,i)perylene | 2300/41000/32000 | -- | -- | -- | -- | 0.594 |
| Benzo(k)fluoranthene | 15/52/25 | -- | -- | -- | -- | 0.434 |
| Chrysene | 140/450/77 | -- | -- | -- | -- | 0.555[J] |
| Fluorene | 2200/28000/160 | 2.96[J] | 3.4[J] | -- | -- | -- |
| Fluoranthene | 2900/48000/1200 | -- | -- | -- | -- | 0.784[J] |
| Indeno(1,2,3-cd)pyrene | 1.5/5.3/28 | -- | -- | -- | -- | 0.819 |
| Naphthalene | 40/270/1.7 | -- | -- | -- | -- | -- |
| Phenanthrene | 2000/30000/250 | 6.64[J] | 6.93[J] | -- | -- | -- |
| Pyrene | 2200/37000/880 | -- | -- | -- | -- | 0.66[J] |
| **Total Recoverable Petroleum Hydrocarbons[6] (mg/kg)** | 340/2500/340 | **5040** | **12400** | -- | -- | **1100** |

**TABLE 2-2**

**SUMMARY OF ANALYTES DETECTED IN SOIL**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

**PAGE 4 OF 4**

| Sample No.<br>Sample Location<br>Collect Date<br>Sample Depth (bls) | Florida Cleanup Levels | NASP20SB-16<br>SB-16<br>8/7/2000<br>7 feet | NASP20SB-17<br>SB-17<br>8/8/2000<br>8-9 feet | NASP20SB-19<br>SB-19<br>8/8/2000<br>5-6.5 feet | NASP20SB-20<br>SB-20<br>8/8/2000<br>6-7 feet |
|---|---|---|---|---|---|
| | DE1[1]/DE2[2]/LE[3] (mg/kg) | | | | |
| **Volatile[4] (mg/kg)** | | | | | |
| Ethylbenzene | 1100/8400/0.6 | -- | -- | -- | -- |
| Methylene Chloride | 16/23/0.02 | **1.18** | -- | **0.736** | -- |
| Trichloroethene | 6/8.5/0.03 | **0.179[J]** | -- | -- | -- |
| Total Xylenes | 5900/40000/0.2 | -- | -- | -- | -- |
| **Polycyclic Aromatic Hydrocarbons[5] (mg/kg)** | | | | | |
| 1-Methylnaphthalene | 68/470/2.2 | **14** | **4.63** | **19.9** | **48.8** |
| 2-Methylnaphthalene | 80/560/6.1 | **18.7** | 4.48 | **28.6** | **71.8** |
| Benzo(a)anthracene | 1.4/5.0/3.2 | -- | 1.14 | -- | -- |
| Benzo(a)pyrene | 0.1/0.5/8 | -- | **0.898** | -- | -- |
| Benzo(b)fluoranthene | 1.4/4.8/10 | -- | 1.03 | -- | -- |
| Benzo(g,h,i)perylene | 2300/41000/32000 | -- | 0.395[J] | -- | -- |
| Benzo(k)fluoranthene | 15/52/25 | -- | 0.42[J] | -- | -- |
| Chrysene | 140/450/77 | -- | 1.28[J] | -- | -- |
| Fluorene | 2200/28000/160 | -- | -- | -- | -- |
| Fluoranthene | 2900/48000/1200 | -- | 3.27[J] | -- | -- |
| Indeno(1,2,3-cd)pyrene | 1.5/5.3/28 | -- | 0.44[J] | -- | -- |
| Naphthalene | 40/270/1.7 | **2.79[J]** | -- | -- | **6.56[J]** |
| Phenanthrene | 2000/30000/250 | -- | 1.82[J] | -- | -- |
| Pyrene | 2200/37000/880 | -- | 2.78[J] | -- | -- |
| **Total Recoverable Petroleum Hydrocarbons[6] (mg/kg)** | 340/2500/340 | **3580** | **8120** | **4100** | **7720** |

[1] DE1 = Direct Exposure limit for residential area from Chapter 62-777, F.A.C.
[2] DE2 = Direct Exposure limit for industrial area from Chapter 62-777, F.A.C.
[3] LE = Leachability for groundwater limit from Chapter 62-777, F.A.C.
[4] SW-846 8260B
[5] SW-846 8310
[6] FDEP FL-PRO
[J] Indicates the presence of a chemical at an estimated concentration.
-- indicates analyte not detected.
**Bold** indicates an exceedance of regulatory limits.

SOURCE:

LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

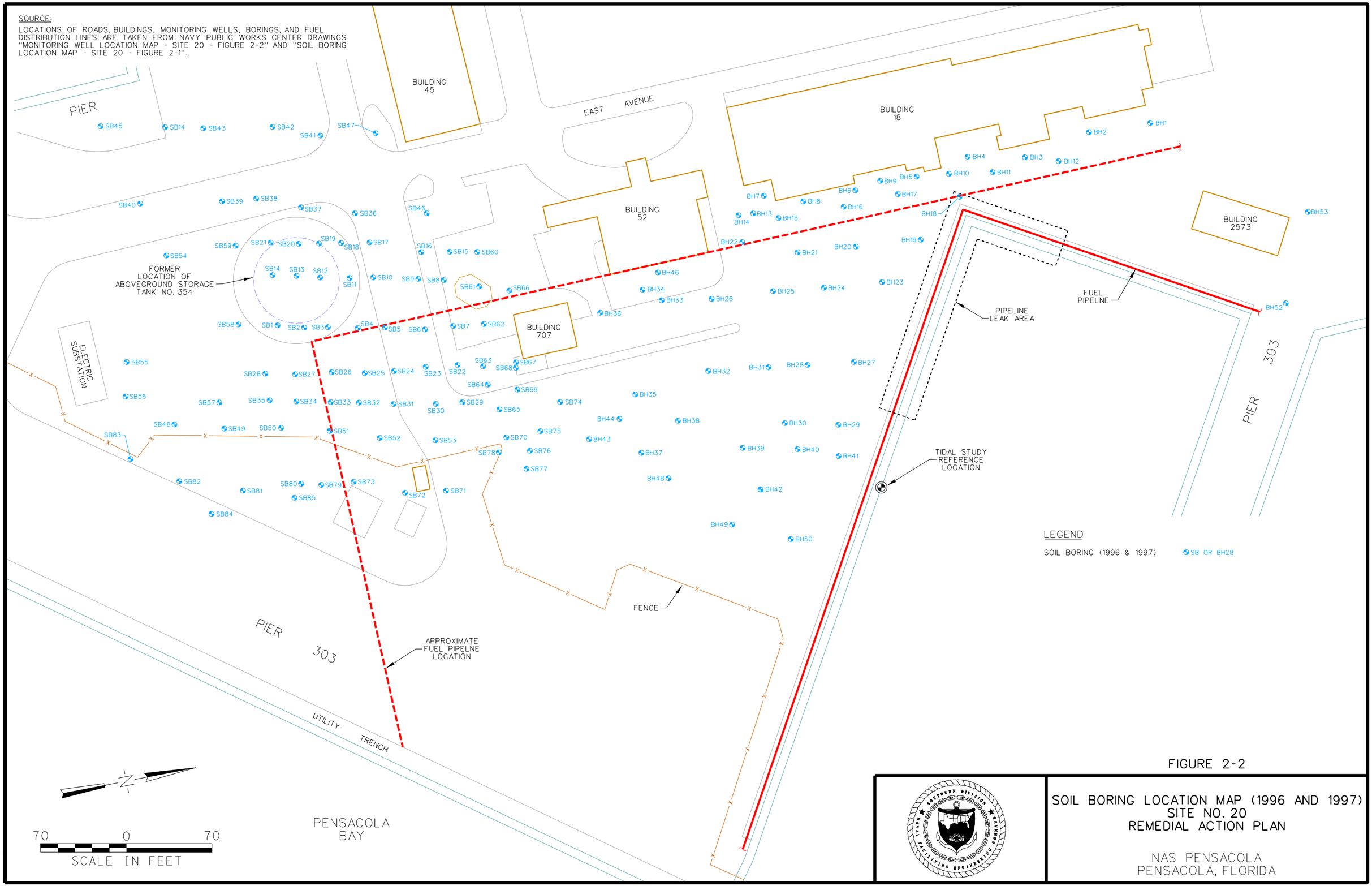



FIGURE 2-2

SOIL BORING LOCATION MAP (1996 AND 1997)
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401l\ 0401L005.dgn/10-25-01

SOURCE:
LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

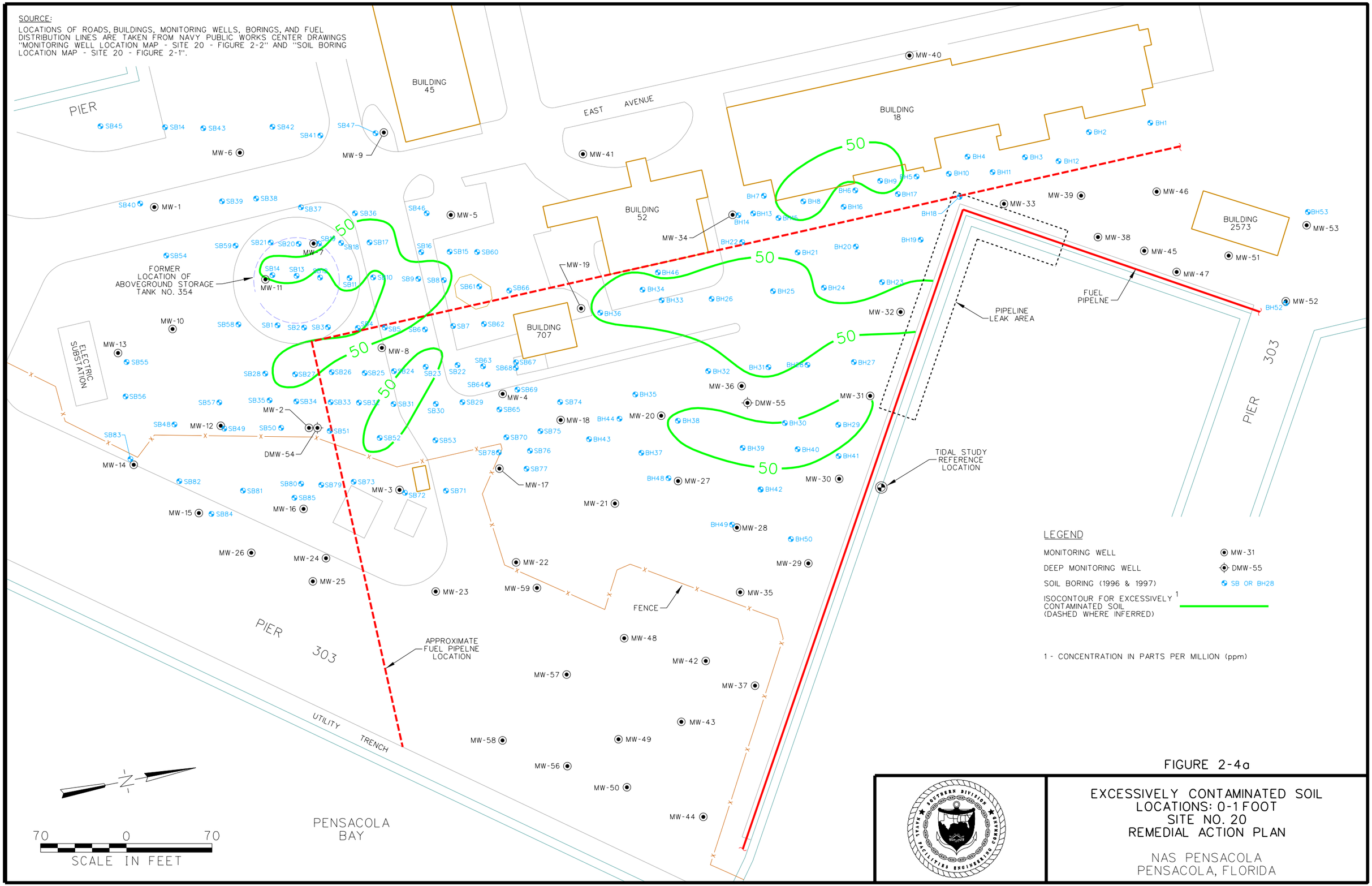



FIGURE 2-4a

EXCESSIVELY CONTAMINATED SOIL
LOCATIONS: 0-1 FOOT
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L007.dgn/10-25-01

SOURCE:

LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

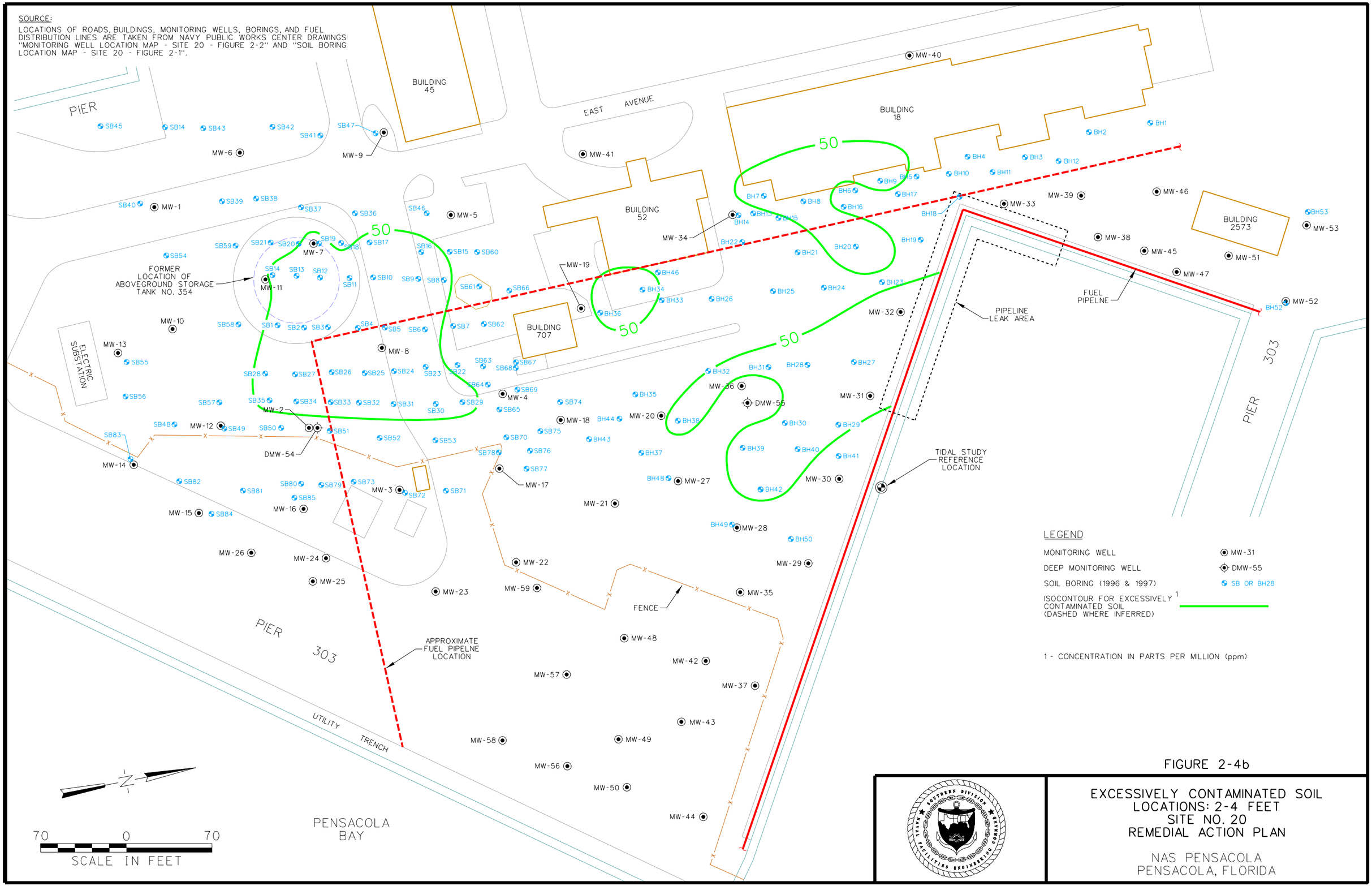



FIGURE 2-4b

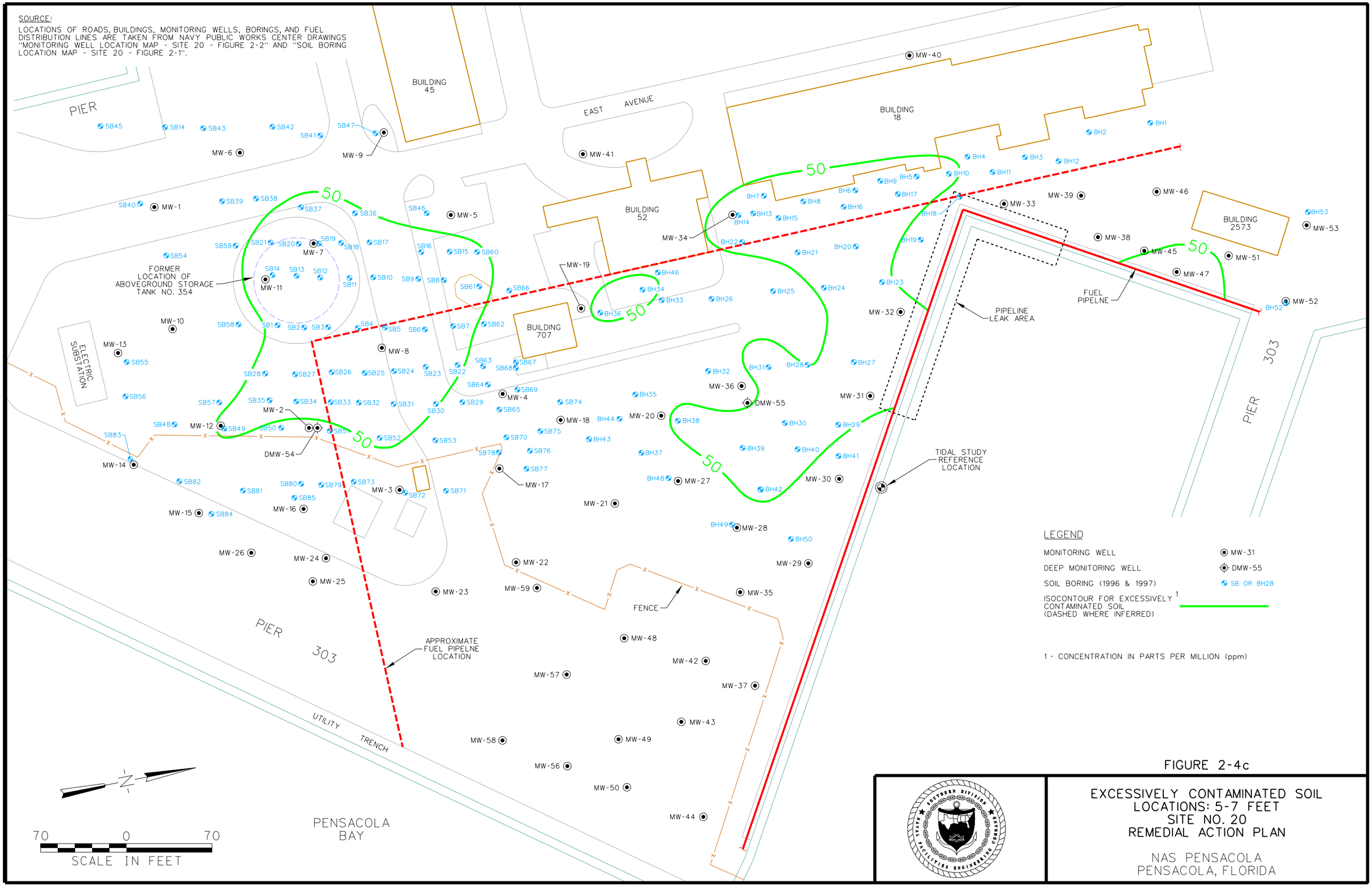
EXCESSIVELY CONTAMINATED SOIL LOCATIONS: 2-4 FEET
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L008.dgn/10-25-01

SOURCE:
LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".




LEGEND

| | |
|---|---|
| MONITORING WELL | MW-31 |
| DEEP MONITORING WELL | DMW-55 |
| SOIL BORING (1996 & 1997) | SB OR BH28 |
| ISOCONTOUR FOR EXCESSIVELY CONTAMINATED SOIL (DASHED WHERE INFERRED) [1] | |

1 - CONCENTRATION IN PARTS PER MILLION (ppm)

FIGURE 2-4c

EXCESSIVELY CONTAMINATED SOIL
LOCATIONS: 5-7 FEET
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L009.dgn/10-25-01

SOURCE:

LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

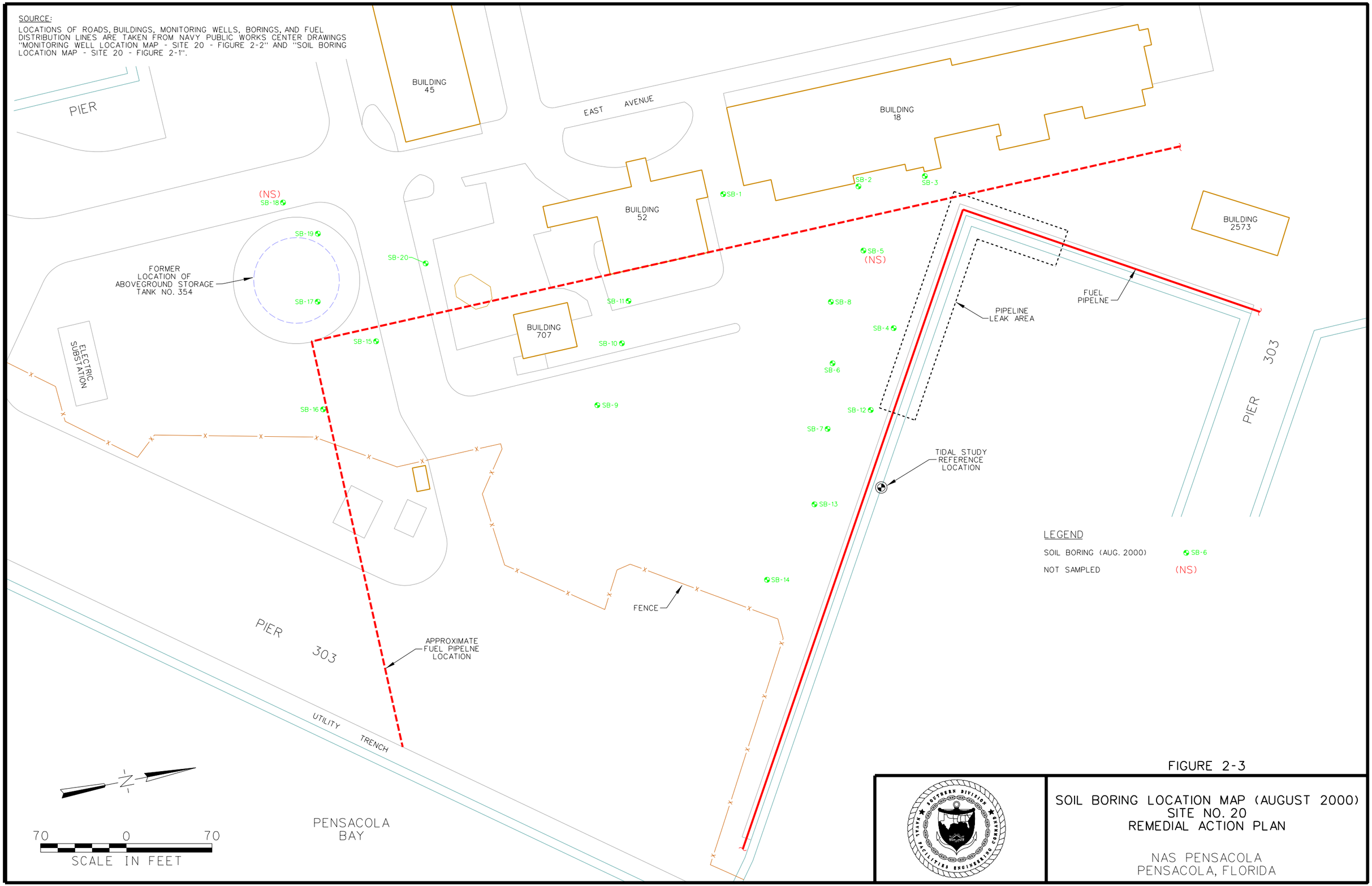



FIGURE 2-3

SOIL BORING LOCATION MAP (AUGUST 2000)
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L006.dgn/10-25-01

The soil samples were analyzed for compounds specified in the gasoline and kerosene analytical groups. Soil sampling field forms and soil boring log sheets are included in the SARA. The analytical results for the soil samples are summarized in Table 2-2.

Four VOCs (ethylbenzene, methylene chloride, trichloroethene, and total xylenes), were detected in the soil samples. Three of the VOCs [methylene chloride (soil borings SB-16, 1.18 mg/kg and SB-19, 0.736 mg/kg), trichloroethane (soil boring SB-16, 0.179 mg/kg estimated), and total xylenes (soil boring SB-3, 0.736 mg/kg estimated)] were detected at concentrations exceeding leachability limits for groundwater of 0.02 mg/kg, 0.03 mg/kg, and 0.2 mg/kg, respectively, from Chapter 62-777, F.A.C.

Fourteen polycyclic aromatic hydrocarbons (PAHs) were detected in the soil samples collected from Site 20. Three of the PAHs (1-methylnaphthalene, 2-methylnaphthalene, and naphthalene) were detected in several soil samples at concentrations exceeding the leachability for groundwater limits of 2.2 mg/kg, 6.1 mg/kg, and 1.7 mg/kg, respectively, from Chapter 62-777, F.A.C. Table 2-2 summarizes these findings.

Benzo(a)pyrene was detected in soil boring samples SB-15 (1.04 mg/kg) and SB-17 (0.898 mg/kg) at concentrations exceeding the direct exposure limits for both residential and industrial areas, 0.1 mg/kg and 0.5 mg/kg, respectively, from Chapter 62-777, F.A.C. However, it should be noted that, although direct exposure and leachability limits were exceeded, actual exposure and leachability are limited because the majority of the site is asphalt or concrete covered.

The soil samples were also analyzed for total recoverable petroleum hydrocarbons (TRPH). Concentrations of TRPH were detected in soil samples from 16 of the 18 (all but SB-13 and SB-14) soil borings. Thirteen of the 16 (all but SB-6, SB-7, and SB-9) detected TRPH concentrations exceeded both the direct residential exposure limit (340 mg/kg) and the leachability limit for groundwater (340 mg/kg) from Chapter 62-777, F.A.C. Twelve of the 13 (all but SB-15) also exceeded the direct industrial exposure limit (2,500 mg/kg).

A soil vapor table summarizing samples exceeding concentrations of 50 ppm is included in the SAR. Table 2-2 summarizes the analytes detected in soil samples from the SARA and the soil boring locations are shown on Figure 2-3. The analytical results indicate the presence of petroleum-impacted soil that exceed the FDEP target levels.

### 2.3.1 Identification and Selection of Soil COPCs

The first step in selecting soil chemicals of concern (COCs) was adjusting the soil cleanup target levels (SCTLs) for direct contact to account for the presence of multiple carcinogens or noncarcinogens that affect the same target organ/system in the list of chemicals of potential concern (COPCs). Six chemicals of interest (COIs) in soil were detected at maximum concentrations that exceeded the SCTL. Table 2-3 presents the initial screening process; lists all chemicals detected in soil, their maximum concentration, the State of Florida SCTL for industrial setting; and identifies the COPCs. COIs whose maximum concentration did not exceed the minimum SCTL were eliminated from further evaluation as COPCs.

As shown in Table 2-4, multiple carcinogens or noncarcinogens affecting the same target organ/system were adjusted by dividing the SCTL by the number of carcinogens or noncarcinogens that affect the same target organ or system to account for additive effects.

## 2.4 GROUNDWATER CONTAMINATION ASSESSMENT

Fifty-nine groundwater monitoring wells were installed during the SAR investigation (NPWC, 1998). Groundwater samples were collected from monitoring wells in 1996 and 1997 in support of the SAR. The groundwater samples were analyzed for VOCs, PAHs, TRPHs, ethylene dibromide (EDB), and lead using U.S. Environmental Protection Agency (USEPA) methods 8260, 8270A, FLPRO, 504, and 7421, respectively. A summary of analytes detected in groundwater is presented in Table 2-3.

Free product was discovered in monitoring wells MW-2, MW-8, MW-11, MW-12, MW-19, MW-29 through MW-34, MW-36, and MW-47. These monitoring wells were not sampled with the exception of monitoring wells MW-29 and MW-30, which were sampled for lead using the quiescent sampling method in September 1997.

The laboratory analysis of groundwater samples indicated one exceedance of benzene in DMW-55 at a concentration of 2 ppb, which is above the FDEP groundwater cleanup target level (GCTL) of 1 ppb. Vinyl chloride was detected in wells MW-7, MW-27, and MW-28 at concentrations of 37 ppb, 1 ppb, and 2 ppb, respectively, which are equal to or exceed the FDEP GCTL of 1 ppb. The FDEP GCTL of 20 ppb for total xylenes was exceeded in monitoring well DMW-54 at a concentration of 29 ppb. Other VOC parameters that were detected but did not exceed their respective FDEP GCTLs included trans-1,2-dichloroethene, toluene, trichloroethene, and methyl-tert-butyl-ether.

TABLE 2-3

SELECTION OF SOIL COCs

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA

| COI [1] | Max Conc. (mg/kg) | SCTL Industrial (mg/kg)[2] | Adj. SCTL Industrial (mg/kg)[3] | SCTL Leach I (mg/kg) [4] | Exceeds Adj. Direct Contact | Initial Criteria (mg/kg)[5] | Target System/Organ |
|---|---|---|---|---|---|---|---|
| **Volatile Organics** | | | | | | | |
| Ethylbenzene | 0.526 | 8,400 | 700 | 0.6 | NO | 0.60 | Developmental - Kidney - Liver |
| Methylene Chloride | 0.736 | 23 | 3 | 0.02 | NO | 0.02 | Carcinogen -Liver |
| Trichloroethene | 0.179 | 9 | 1 | 0.03 | NO | 0.03 | Carcinogen |
| Xylenes, Total | 0.736 | 40,000 | 3,333 | 0.2 | NO | 0.20 | Body Weight -Mortality -Neurological |
| **Semivolatile Organics** | | | | | | | |
| 1-Methylnaphthalene | 48.8 | 470 | 39 | 2.2 | YES | 2.20 | Body Weight -Nasal |
| 2-Methylnaphthalene | 71.8 | 560 | 47 | 6.1 | YES | 6.10 | Body Weight -Nasal |
| Benzo(a)anthracene | 1.14 | 5 | 1 | 3.2 | YES | 0.63 | Carcinogen |
| Benzo(a)pyrene | 1.04 | 1 | 0.06 | 8 | YES | 0.06 | Carcinogen |
| Benzo(b)fluoranthene | 1.03 | 4.8 | 1 | 10 | YES | 0.60 | Carcinogen |
| Benzo(g,h,i)perylene | 0.594 | 41,000 | 3,417 | 32000 | NO | 3,417 | Neurological |
| Benzo(k)fluoranthene | 0.434 | 52 | 7 | 25 | NO | 6.50 | Carcinogen |
| Chrysene | 1.28 | 450 | 56 | 77 | NO | 56.25 | Carcinogen |
| Fluorene | 3.95 | 28,000 | 2,333 | 160 | NO | 160 | Blood |
| Fluoranthene | 3.27 | 48,000 | 4,000 | 1200 | NO | 1,200 | Blood -Kidney -Liver |
| Indeno(1,2,3-cd)pyrene | 0.445 | 5.3 | 1 | 28 | NO | 0.66 | Carcinogen |
| Naphthalene | 6.56 | 270 | 23 | 1.7 | NO | 1.70 | Body Weight -Nasal |
| Phenanthrene | 12.5 | 30,000 | 2,500 | 250 | NO | 250 | Kidney |
| Pyrene | 2.78 | 37,000 | 3,083 | 880 | NO | 880 | Kidney |
| TPH | 12,400 | 2,500 | 208 | 340 | YES | 208 | Multiple Endpoints Mixed Contaminants |

[1] COI - chemical of interest is any chemical detected in the media of concern
[2] SCTL for direct contact with soil in an industrial setting, from F.A.C. Chapter 62-777, Table 2, dated May 1999.
[3] Initial human health screening criteria is the SCTL for direct contact divided by 10 to account for multiple chemical effect for carcinogens and noncarcinogens.
[4] Leach I - soil leaching to groundwater, from F.A.C. Chapter 62-777, Table 2, dated May 1999.
[5] The initial screening criteria is the lowest of the adjusted direct contact SCTL or the leaching to groundwater or surface water SCTLs.

TABLE 2-4

SOIL FINAL COPCs

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA

| COI [1] | Max Conc. (mg/kg) | SCTL Industrial (mg/kg)[2] | Target System/Organ | Cumulative Cancer or Target Organ/System Analysis[3] | | | | Adj. SCTL Industrial (mg/kg)[4] | SCTL Leach I (mg/kg)[5] | Minimum SCTL (mg/kg)[6] | Final COPCs [7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Carcinogen | Body Weight | Nasal | Adj. Factor | | | | |
| **Semivolatile Organics** | | | | | | | | | | | |
| 1-Methylnaphthalene | 48.8 | 470 | Body Weight -Nasal | | 0.10 | 17.80 | 3 | 156.67 | 2.2 | 2.20 | YES |
| 2-Methylnaphthalene | 71.8 | 560 | Body Weight -Nasal | | 0.13 | 7.65 | 3 | 186.67 | 6.1 | 6.10 | YES |
| Benzo(a)anthracene | 1.14 | 5 | Carcinogen | 0.23 | | | 3 | 1.67 | 3.2 | 1.67 | NO |
| Benzo(a)pyrene | 1.04 | 1 | Carcinogen | 2.08 | | | 3 | 0.17 | 8 | 0.17 | YES |
| Benzo(b)fluoranthene | 1.03 | 4.8 | Carcinogen | 0.21 | | | 3 | 1.60 | 10 | 1.60 | NO |
| TPH | 12,400 | 2,500 | Multiple Endpoints Mixed Contaminants | | 4.96 | | 3 | 833.33 | 340 | 340 | YES |
| | | | Cumulative Sum = | 2.52 | 5.19 | 25.45 | | | | | |

[1] COI - chemical of interest.
[2] SCTL for direct contact with soil in an industrial setting, from F.A.C. Chapter 62-777, Table 2, dated May 1999.
[3] The ratio of the maximum detected concentration to the SCTL is shown for each COPC; a ratio or sum of ratios greater than 1 for carcinogens or for any organ/system indicates an exceedance of FDEP guidance (ratios only shown for COIs that exceed direct contact during initial screen).
[4] The SCTL for direct contact with soil in an industrial setting taken from F.A.C. Chapter 62-777, Table 2, was divided by the number (i.e., adj. factor) of carcinogenic COPCs or noncarcinogenic COPCs that affect the same target organ/system to account for cumulative affects.
[5] Leach I - soil leaching to groundwater, per F.A.C. Chapter 62-777, Table 2.
[6] The final screening criteria is the minimum of the following: (a) the adjusted SCTL for industrial soils, (b) the SCTL for leaching to groundwater, (or c) the SCTL for leaching to surface water (where applicable).
[7] A COI is selected as a final COPC if the maximum concentration of that chemical exceeds the minimum SCTL..

Groundwater samples at Site 20 did not exceed FDEP GCTLs for acenaphthene, anthracene, fluoranthene, fluorene, phenanthrene, pyrene, and chrysene. The FDEP GCTL (20 ppb) for naphthalene was exceeded in wells MW-4 (330 ppb), MW-7 (225 ppb), MW-18 (320 ppb), and DMW-54 (4700 ppb). TRPH was detected in 22 monitoring wells and exceeded the FDEP GCTL of 5,000 ppb in 7 of the monitoring wells (MW-4 at 5,400 ppb, MW-7 at 11,000 ppb, MW-17 at 47,000, MW-18 at 10,000 ppb, MW-38 at 82,000 ppb, MW-52 at 14,000 ppb, and DMW-54 at 9,700 ppb). Lead was also detected in 17 wells and exceeded the FDEP GCTL of 0.015 ppm for lead in 6 of these wells (MW-4 at 0.31 ppm, MW-5 at 0.41 ppm, MW-13 at 0.22 ppm, MW-39 at 0.144 ppm, MW-45 at 0.62 ppm, and MW-56 at 0.20 ppm). Groundwater analytical results from the SAR are summarized on Table 2-5.

In July 2000, in preparation of the SARA, 18 of the 59 site monitoring wells were resampled. VOCs were not detected. Eight PAHs were detected. Acenaphthalene was detected in two wells, MW-37 (44.1 ppb) and MW-48 (67.7 ppb), at concentrations exceeding the FDEP GCTL of 20 ppb. TRPH was detected in 13 monitoring wells, but exceeded the GCTL of 5,000 ppb only in the sample collected from MW-18 (10,900 ppb). Lead was detected only in well MW-46 (115 ppb) and exceeded the GCTL of 15 ppb. Table 2-5 summarizes the July 2000 groundwater analytical results.

### 2.4.1 Identification and Selection of Groundwater COPCs

The COC screening process identified 12 COIs in groundwater whose maximum detected concentrations exceeded the GCTLs. Because groundwater discharges to surface water (i.e., Pensacola Bay), groundwater discharging to marine surface water (MSW) was evaluated. Table 2-6 presents the initial screening process; lists all chemicals detected in groundwater, their maximum concentration, the State of Florida GCTL for drinking water and for MSW; and identifies the COPCs. COIs whose maximum concentration did not exceed the minimum GCTL or MSW CTL were eliminated from further evaluation as COPCs.

As shown in Table 2-7, multiple carcinogens or noncarcinogens affecting the same target organ/system, without primary or secondary standards, were adjusted by dividing the GCTL by the number of carcinogens or noncarcinogens that affect the same target organ or system to account for additive effects.

## 2.5 FREE-PRODUCT RECOVERY

On December 6, 2000, a free-product assessment was performed during the SARA (TtNUS, 2001). The free product encountered was described as a very viscous material similar to Bunker C oil. Free-product

# TABLE 2-5

## SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Benzene | trans-1,2-Dichloroethene | Toluene | Trichloroethene | Vinyl Chloride | Xylenes (Total) | MTBE | Acenaphthene | Anthracene | Chrysene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 1 | 100 | 40 | 3 | 1 | 20 | 50 | 20 | 2100 | 4.8 |
| SAR | | | | | | | | | | | |
| MW-1 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-3 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-4 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| MW-5 | 9/18/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-7 | 9/10/1996 | -- | 2 | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-9 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-13 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-14 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-16 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 6 | -- | -- |
| MW-17 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 4 | -- | -- |
| MW-18 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 16 | 5 | -- |
| MW-21 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | | 2 | -- |
| MW-22 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 7 | -- | -- |
| MW-23 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | | 17 | |
| MW-25 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 6 | -- | -- |
| MW-26 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 4 | -- | -- |
| MW-27 | 2/27/1997 | -- | -- | -- | -- | 1 | -- | -- | -- | -- | -- |
| MW-28 | 2/27/1997 | -- | -- | -- | -- | | -- | -- | -- | -- | -- |
| MW-30 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-35 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | 7 | | -- |
| MW-37 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-38 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| MW-39 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 |
| MW-40 | 3/27/1997 | -- | -- | -- | 2 | -- | -- | -- | -- | -- | -- |
| MW-41 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-42 | 5/2/1997 | -- | -- | 1 | -- | -- | -- | -- | | -- | -- |
| MW-43 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-44 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | 8 | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-45 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-49 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-50 | 5/21/1997 | -- | -- | -- | -- | -- | 2 | -- | 18 | -- | -- |
| MW-52 | 5/21/1997 | -- | -- | 2 | -- | -- | -- | -- | -- | -- | -- |
| DMW-54 | 5/30/1997 | -- | -- | 2 | -- | -- | 29 | -- | | 28 | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Benzene | trans-1,2-Dichloroethene | Toluene | Trichloroethene | Vinyl Chloride | Xylenes (Total) | MTBE | Acenaphthene | Anthracene | Chrysene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 1 | 100 | 40 | 3 | 1 | 20 | 50 | 20 | 2100 | 4.8 |
| SAR (Continued) | | | | | | | | | | | |
| DMW-55 | 5/30/1997 | | -- | -- | -- | -- | 2 | 1 | 3 | -- | -- |
| MW-56 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 15 | -- | -- |
| MW-57 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 11 | -- | -- |
| MW-58 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 3 | -- | -- |
| MW-59 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 16 | -- | -- |
| SARA | | | | | | | | | | | |
| MW-07 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-09 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 dup | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-15 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-18 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 10.5 | -- | -- |
| MW-18 dup | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 8.3 | -- | -- |
| MW-23 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 13.6 | -- | -- |
| MW-27 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-28 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-29 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 2.4 | -- | -- |
| MW-37 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-38 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-40 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-47 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-54 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-55 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-58 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Fluoranthene | Fluorene | 1-Methyl Naphthalene | 2-Methyl Naphthalene | Naphthalene | Phenanthrene | Pyrene | TRPH | Lead |
|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 280 | 280 | 20 | 20 | 20 | 210 | 210 | 5000 | 15 |
| SAR | | | | | | | | | | |
| MW-1 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 6 |
| MW-3 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-4 | 9/10/1996 | 8 | 14 | [redacted] | [redacted] | [redacted] | 11 | 10 | [redacted] | [redacted] |
| MW-5 | 9/18/1996 | -- | -- | -- | -- | -- | -- | -- | -- | [redacted] |
| MW-7 | 9/10/1996 | -- | 5 | [redacted] | [redacted] | [redacted] | -- | -- | [redacted] | 4 |
| MW-9 | 9/10/1996 | -- | -- | [redacted] | [redacted] | -- | -- | -- | 600 | -- |
| MW-10 | 9/10/1996 | -- | -- | 7 | -- | -- | -- | -- | -- | 8 |
| MW-13 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | [redacted] |
| MW-14 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 8 |
| MW-16 | 11/6/1996 | -- | -- | 4 | 3 | -- | -- | -- | 660 | -- |
| MW-17 | 11/6/1996 | -- | 2 | [redacted] | [redacted] | -- | -- | -- | [redacted] | -- |
| MW-18 | 11/6/1996 | 7 | 16 | [redacted] | [redacted] | [redacted] | 14 | 7 | [redacted] | -- |
| MW-21 | 2/11/1997 | -- | 18 | 11 | 7 | -- | 4 | -- | 330 | -- |
| MW-22 | 2/11/1997 | -- | 2 | -- | -- | -- | -- | -- | 270 | -- |
| MW-23 | 2/11/1997 | 7 | 86 | [redacted] | [redacted] | [redacted] | 81 | 4 | 1130 | -- |
| MW-25 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-26 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 370 | -- |
| MW-27 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-28 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | 250 | -- |
| MW-30 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-35 | 3/27/1997 | -- | -- | -- | -- | 14 | -- | 3 | 2900 | -- |
| MW-37 | 3/27/1997 | -- | 6 | 3 | -- | 4 | 2 | 2 | -- | -- |
| MW-38 | 3/27/1997 | 5 | -- | 13 | 9 | -- | -- | 7 | [redacted] | -- |
| MW-39 | 3/27/1997 | 5 | -- | -- | -- | -- | 5 | 5 | -- | [redacted] |
| MW-40 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 8 |
| MW-41 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 14 |
| MW-42 | 5/2/1997 | -- | 4 | 6 | -- | -- | -- | -- | 970 | -- |
| MW-43 | 5/2/1997 | -- | -- | | -- | -- | -- | -- | -- | -- |
| | 9/18/1997 | -- | 15 | 6 | -- | -- | -- | -- | -- | -- |
| MW-44 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-45 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | [redacted] |
| MW-46 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-48 | 5/21/1997 | -- | -- | 4 | -- | -- | 3 | -- | 310 | -- |
| MW-49 | 5/21/1997 | -- | 25 | 17 | -- | -- | 6 | -- | 360 | -- |
| MW-50 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | 390 | 6 |
| MW-52 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | [redacted] | -- |
| DMW-54 | 5/30/1997 | 15 | 124 | [redacted] | [redacted] | [redacted] | 118 | 10 | [redacted] | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Fluoranthene | Fluorene | 1-Methyl Naphthalene | 2-Methyl Naphthalene | Naphthalene | Phenanthrene | Pyrene | TRPH | Lead |
|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 280 | 280 | 20 | 20 | 20 | 210 | 210 | 5000 | 15 |
| SAR (Continued) | | | | | | | | | | |
| DMW-55 | 5/30/1997 | -- | -- | [illegible] | [illegible] | 9 | -- | -- | 1000 | -- |
| MW-56 | 5/30/1997 | -- | -- | 3 | -- | 2 | -- | -- | -- | [illegible] |
| MW-57 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 550 | -- |
| MW-58 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 5 |
| MW-59 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 1100 | -- |
| SARA | | | | | | | | | | |
| MW-07 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 2040 | -- |
| MW-09 | 7/24/2000 | -- | -- | 3.7 | 3.6 | -- | -- | -- | 303 | -- |
| MW-10 | 7/24/2000 | -- | -- | 2.9 | -- | -- | -- | -- | 1450 | -- |
| MW-10 dup | 7/24/2000 | -- | -- | 2.5 | -- | -- | -- | -- | 1400 | -- |
| MW-15 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 1940 | -- |
| MW-18 | 7/20/2000 | 2.7 | 2.4 | 6.6 | 4.3 | -- | -- | 2.7 | [illegible] | -- |
| MW-18 dup | 7/20/2000 | 2.5 | 2 J | 2.4 | 2.3 | -- | -- | 2.7 | [illegible] | -- |
| MW-23 | 7/24/2000 | 2.1 | -- | -- | -- | -- | 2.4 | -- | 3280 | -- |
| MW-27 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 520 | -- |
| MW-28 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 447 | -- |
| MW-29 | 7/24/2000 | -- | 2.4 | -- | 2.1J | -- | -- | -- | 1400 | -- |
| MW-37 | 7/20/2000 | -- | 12.4 | -- | -- | -- | -- | -- | 1450 | -- |
| MW-38 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 280 | -- |
| MW-40 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 250 | [illegible] |
| MW-47 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 7/20/2000 | -- | 24.8 | 13 | 3.8 | -- | -- | -- | -- | -- |
| MW-54 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-55 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-58 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 1530 | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Benzene | trans-1,2-Dichloroethene | Toluene | Trichloroethene | Vinyl Chloride | Xylenes (Total) | MTBE | Acenaphthene | Anthracene | Chrysene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 1 | 100 | 40 | 3 | 1 | 20 | 50 | 20 | 2100 | 4.8 |
| SAR | | | | | | | | | | | |
| MW-1 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-3 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-4 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| MW-5 | 9/18/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-7 | 9/10/1996 | -- | 2 | -- | -- | | -- | -- | -- | -- | -- |
| MW-9 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-13 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-14 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-16 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 6 | -- | -- |
| MW-17 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 4 | -- | -- |
| MW-18 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | 16 | 5 | -- |
| MW-21 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | | 2 | -- |
| MW-22 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 7 | -- | -- |
| MW-23 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | | 17 | |
| MW-25 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 6 | -- | -- |
| MW-26 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 4 | -- | -- |
| MW-27 | 2/27/1997 | -- | -- | -- | -- | 1 | -- | -- | -- | -- | -- |
| MW-28 | 2/27/1997 | -- | -- | -- | -- | | -- | -- | -- | -- | -- |
| MW-30 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-35 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | 7 | | -- |
| MW-37 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-38 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| MW-39 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2 |
| MW-40 | 3/27/1997 | -- | -- | -- | 2 | -- | -- | -- | -- | -- | -- |
| MW-41 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-42 | 5/2/1997 | -- | -- | 1 | -- | -- | -- | -- | | -- | -- |
| MW-43 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-44 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | 8 | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-45 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-49 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-50 | 5/21/1997 | -- | -- | -- | -- | -- | 2 | -- | 18 | -- | -- |
| MW-52 | 5/21/1997 | -- | -- | 2 | -- | -- | -- | -- | -- | -- | -- |
| DMW-54 | 5/30/1997 | -- | -- | 2 | -- | -- | 29 | -- | 287 | 28 | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Benzene | trans-1,2-Dichloroethene | Toluene | Trichloroethene | Vinyl Chloride | Xylenes (Total) | MTBE | Acenaphthene | Anthracene | Chrysene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 1 | 100 | 40 | 3 | 1 | 20 | 50 | 20 | 2100 | 4.8 |
| SAR (Continued) | | | | | | | | | | | |
| DMW-55 | 5/30/1997 | | -- | -- | -- | -- | 2 | 1 | 3 | -- | -- |
| MW-56 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 15 | -- | -- |
| MW-57 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 11 | -- | -- |
| MW-58 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 3 | -- | -- |
| MW-59 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 16 | -- | -- |
| SARA | | | | | | | | | | | |
| MW-07 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-09 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-10 dup | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-15 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-18 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 10.5 | -- | -- |
| MW-18 dup | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 8.3 | -- | -- |
| MW-23 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 13.6 | -- | -- |
| MW-27 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-28 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-29 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 2.4 | -- | -- |
| MW-37 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-38 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-40 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-47 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | | -- | -- |
| MW-54 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-55 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-58 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Fluoranthene | Fluorene | 1-Methyl Naphthalene | 2-Methyl Naphthalene | Naphthalene | Phenanthrene | Pyrene | TRPH | Lead |
|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 280 | 280 | 20 | 20 | 20 | 210 | 210 | 5000 | 15 |
| SAR | | | | | | | | | | |
| MW-1 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 6 |
| MW-3 | 9/10/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-4 | 9/10/1996 | 8 | 14 | | | | 11 | 10 | | 31 |
| MW-5 | 9/18/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 41 |
| MW-7 | 9/10/1996 | -- | 5 | | | | -- | -- | | 4 |
| MW-9 | 9/10/1996 | -- | -- | | | -- | -- | -- | 600 | -- |
| MW-10 | 9/10/1996 | -- | -- | 7 | -- | -- | -- | -- | -- | 8 |
| MW-13 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 22 |
| MW-14 | 11/6/1996 | -- | -- | -- | -- | -- | -- | -- | -- | 8 |
| MW-16 | 11/6/1996 | -- | -- | 4 | 3 | -- | -- | -- | 660 | -- |
| MW-17 | 11/6/1996 | -- | 2 | | | -- | -- | -- | | -- |
| MW-18 | 11/6/1996 | 7 | 16 | | | | 14 | 7 | | -- |
| MW-21 | 2/11/1997 | -- | 18 | 11 | 7 | -- | 4 | -- | 330 | -- |
| MW-22 | 2/11/1997 | -- | 2 | -- | -- | -- | -- | -- | 270 | -- |
| MW-23 | 2/11/1997 | 7 | 86 | | | | 81 | 4 | 1130 | -- |
| MW-25 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-26 | 2/11/1997 | -- | -- | -- | -- | -- | -- | -- | 370 | -- |
| MW-27 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-28 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | 250 | -- |
| MW-30 | 2/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-35 | 3/27/1997 | -- | -- | -- | -- | 14 | -- | 3 | 2900 | -- |
| MW-37 | 3/27/1997 | -- | 6 | 3 | -- | 4 | 2 | 2 | -- | -- |
| MW-38 | 3/27/1997 | 5 | -- | 13 | 9 | -- | -- | 7 | | -- |
| MW-39 | 3/27/1997 | 5 | -- | -- | -- | -- | 5 | 5 | -- | 144 |
| MW-40 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 8 |
| MW-41 | 3/27/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 14 |
| MW-42 | 5/2/1997 | -- | 4 | 6 | -- | -- | -- | -- | 970 | -- |
| MW-43 | 5/2/1997 | -- | -- | | -- | -- | -- | -- | -- | -- |
| | 9/18/1997 | -- | 15 | 6 | -- | -- | -- | -- | -- | -- |
| MW-44 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 9/18/1997 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-45 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 62 |
| MW-46 | 5/2/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 4 |
| MW-48 | 5/21/1997 | -- | -- | 4 | -- | -- | 3 | -- | 310 | -- |
| MW-49 | 5/21/1997 | -- | 25 | 17 | -- | -- | 6 | -- | 360 | -- |
| MW-50 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | 390 | 6 |
| MW-52 | 5/21/1997 | -- | -- | -- | -- | -- | -- | -- | | -- |
| DMW-54 | 5/30/1997 | 15 | 124 | | | | 118 | 10 | | -- |

TABLE 2-5

SUMMARY OF ANALYTES DETECTED IN GROUNDWATER

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA



| Well | Date | Fluoranthene | Fluorene | 1-Methyl Naphthalene | 2-Methyl Naphthalene | Naphthalene | Phenanthrene | Pyrene | TRPH | Lead |
|---|---|---|---|---|---|---|---|---|---|---|
| GCTL | | 280 | 280 | 20 | 20 | 20 | 210 | 210 | 5000 | 15 |
| SAR (Continued) | | | | | | | | | | |
| DMW-55 | 5/30/1997 | -- | -- | 42 | 28 | 9 | -- | -- | 1000 | -- |
| MW-56 | 5/30/1997 | -- | -- | 3 | -- | 2 | -- | -- | -- | 20 |
| MW-57 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 550 | -- |
| MW-58 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | -- | 5 |
| MW-59 | 5/30/1997 | -- | -- | -- | -- | -- | -- | -- | 1100 | -- |
| SARA | | | | | | | | | | |
| MW-07 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | 2040 | -- |
| MW-09 | 7/24/2000 | -- | -- | 3.7 | 3.6 | -- | -- | -- | 303 | -- |
| MW-10 | 7/24/2000 | -- | -- | 2.9 | -- | -- | -- | -- | 1450 | -- |
| MW-10 dup | 7/24/2000 | -- | -- | 2.5 | -- | -- | -- | -- | 1400 | -- |
| MW-15 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 1940 | -- |
| MW-18 | 7/20/2000 | 2.7 | 2.4 | 6.6 | 4.3 | -- | -- | 2.7 | [illegible] | -- |
| MW-18 dup | 7/20/2000 | 2.5 | 2 J | 2.4 | 2.3 | -- | -- | 2.7 | [illegible] | -- |
| MW-23 | 7/24/2000 | 2.1 | -- | -- | -- | -- | 2.4 | -- | 3280 | -- |
| MW-27 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 520 | -- |
| MW-28 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 447 | -- |
| MW-29 | 7/24/2000 | -- | 2.4 | -- | 2.1J | -- | -- | -- | 1400 | -- |
| MW-37 | 7/20/2000 | -- | 12.4 | -- | -- | -- | -- | -- | 1450 | -- |
| MW-38 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 280 | -- |
| MW-40 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-46 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | 250 | [illegible] |
| MW-47 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-48 | 7/20/2000 | -- | 24.8 | 13 | 3.8 | -- | -- | -- | -- | -- |
| MW-54 | 7/20/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-55 | 7/19/2000 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MW-58 | 7/24/2000 | -- | -- | -- | -- | -- | -- | -- | 1530 | -- |

Notes:
All concentrations in micrograms per liter ($\mu$g/L).
Groundwater Cleanup Criteria as provided in Chapter 62-777, F.A.C.
"J" indicates the presence of a chemical at an estimated concentration.
Shaded cells indicate exceedance of GCTLs as provided in Chapter 62-777, F.A.C.
-- Entry indicates analyte not detected above method detection limit.

# TABLE 2-6

## SELECTION OF GROUNDWATER COCs

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

| COI [1] | Max Conc. (µg/L) | GW CTL (µg/L) | Adjusted GCTL for GW (µg/l)[2] | MSW CTL (µg/L)[3] | Exceeds Direct Contact | Initial Screening Criteria (µg/L)[4] | Criteria Type[5] | Target System/Organ |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organics** | | | | | | | | |
| benzene | 2 | 1 | 1 | 71.28 | YES | 1 | P | Carcinogen |
| trans-1,2-Dichloroethene | 2 | 100 | 100 | 11000 | NO | 100.00 | P | Blood -Liver |
| toluene | 2 | 40 | 40 | 475 | NO | 40.00 | S | Kidney -Liver -Neurological |
| trichloroethene | 2 | 3 | 3 | 80.7 | NO | 3.00 | P | Carcinogen |
| vinyl chloride | 37 | 1 | 1 | NA | YES | 1.00 | P | Carcinogen |
| xylenes, total | 29 | 20 | 20 | 370 | YES | 20.00 | S | Body Weight -Mortality -Neurological |
| methyl tert-butyl ether | 1 | 50 | 12.5 | 33600 | NO | 12.50 | | Eye -Kidney -Liver |
| **Semivolatile Organics** | | | | | | | | |
| acenaphthene | 207 | 20 | 6.7 | 3 | YES | 3.00 | | Liver |
| anthracene | 28 | 2100 | 2100 | 0.3 | NO | 0.3 | | None Specified |
| chrysene | 2 | 4.8 | 4.8 | 0.031 | NO | 0.031 | | Carcinogen |
| fluoranthene | 15 | 280 | 70 | 0.3 | NO | 0.3 | | Blood -Kidney -Liver |
| fluorene | 124 | 280 | 140 | 30 | NO | 30.00 | | Blood |
| 1-methylnaphthalene | 540 | 20 | 6.7 | 95 | YES | 6.7 | | Body Weight -Nasal |
| 2-methylnaphthalene | 580 | 20 | 6.7 | 30 | YES | 6.7 | | Body Weight -Nasal |
| naphthalene | 4700 | 20 | 6.7 | 26 | YES | 6.7 | | Body Weight -Nasal |
| phenanthrene | 118 | 210 | 52.5 | 0.031 | YES | 0.031 | | Kidney |
| pyrene | 10 | 210 | 52.5 | 0.3 | NO | 0.3 | | Kidney |
| TRPH | 82000 | 5000 | 5000 | 5000 | YES | 5000 | | Multiple Endpoints Mixed Contaminants |
| **Inorganics** | | | | | | | | |
| Lead | 144 | 15 | 15 | 5.6 | YES | 5.6 | P | Neurological |

1 COI - chemical of interest
2 GCTLs based on Primary and Secondary Standards were not adjusted. The derived GCTLs for ingestion of groundwater taken from F.A.C. Chapter 62-777, Table 1, were divided by the number of carcinogens or noncarcinogens that affect the same target organ or system to account for additive effects.
3 The CTL for protection of marine surface water (MSW), per F.A.C. Chapter 62-777, Table 1, dated May 1999.
4 The initial screening criteria is the minimum of the GCTL, the adjusted GCTL, or the CTL to protect marine surface water.
5 P - primary drinking water standard; S - secondary drinking water standard; per F.A.C. Chapter 62-550 and Chapter 62-777, Table 1.

TABLE 2-7

GROUNDWATER FINAL COPCs

SITE 20, ALLEGHENY PIER (PIER 303)
NAS PENSACOLA, PENSACOLA, FLORIDA

| COI [1] | Max Conc. (ug/L) | GW CTL (ug/L) | Criteria Type[2] | Target System/Organ | Cumulative Cancer or Target Organ/System Analysis [3] | | | | | | | | | Adj. GCTL (ug/L)[4] | MSW CTL (ug/L)[5] | Minimum GCTL (ug/L)[6] | Final COPCs[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Carcinogen | Body Weight | Nasal | Kidney | Liver | Blood | Mortality | Neurological | Adj. Factor | | | | |
| **Volatile Organics** | | | | | | | | | | | | | | | | | |
| Benzene | 2 | 1 | P | Carcinogen | 2 | | | | | | | | | 1 | 71.28 | 1 | YES |
| Vinyl Chloride | 37 | 1 | P | Carcinogen | 37 | | | | | | | | | 1 | NA | 1 | YES |
| Xylenes, Total | 29 | 20 | S | Body Weight -Mortality -Neurologica | | 1.45 | | | | | 1.45 | 1.45 | | 20 | 370 | 20 | YES |
| **Semivolatile Organics** | | | | | | | | | | | | | | | | | |
| Acenaphthene | 207 | 20 | | Liver | | | | | 10.35 | | | | 1 | 20 | 3 | 3 | YES |
| Chrysene | 2 | 4.8 | | Carcinogen | 0.417 | | | | | | | | 1 | 4.8 | 0.031 | 0.03 | YES |
| Fluorene | 124 | 280 | | Blood | | | | | | 0.443 | | | 1 | 280 | 30 | 30 | YES |
| 1-methylnaphthalene | 540 | 20 | | Body Weight -Nasal | | 27 | 27 | | | | | | 3 | 6.7 | 95 | 6.7 | YES |
| 2-methylnaphthalene | 580 | 20 | | Body Weight -Nasal | | 29 | 29 | | | | | | 3 | 6.7 | 30 | 6.7 | YES |
| Naphthalene | 4700 | 20 | | Body Weight -Nasal | | 235 | 235 | | | | | | 3 | 6.7 | 26 | 6.7 | YES |
| Phenanthrene | 118 | 210 | | Kidney | | | | 0.562 | | | | | 1 | 210.0 | 0.031 | 0.03 | YES |
| TPH | 82000 | 5000 | | Multiple Endpoints Mixed Contaminant: | | | | | | | | | 1 | 5000 | 5000 | 5000 | YES |
| **Inorganics** | | | | | | | | | | | | | | | | | |
| Lead | 144 | 15 | P | Neurological | | | | | | | | 9.6 | | 15 | 5.6 | 5.6 | YES |
| | | | | Cumulative Sum = | 39.4 | 292.5 | 291.0 | 0.6 | 10.4 | 0.4 | 1.5 | 11.1 | | | | | |

[1] COI - chemical of interest

[2] P - primary drinking water standard; S - secondary drinking water standard; per F.A.C. Chapter 62-550 and Chapter 62-777, Table 1.

[3] The ratio of the maximum detected concentration to the GCTL is shown for each COPC; a ratio or sum of ratios greater than 1 for carcinogens or for any organ/system indicates an exceedance of FDEP guidance (ratios only shown for COIs that exceed direct contact during initial screen).

[4] GCTLs based on Primary (P) or Secondary (S) Standards were not adjusted. The derived GCTLs for ingestion of groundwater taken from F.A.C 62-777, Table 1, were divided by the number of carcinogens or noncarcinogens that affect the same target organ or system to account for additive effects.

[5] The CTL for protection of marine surface water (MSW), per F.A.C. Chapter 62-777, Table 1, dated May 1999.

[6] The minimum screening criteria is the minimum of the GCTL, the adjusted GCTL, or the CTL to protect marine surface water.

[7] A COI is selected as an final COPC if the maximum concentration exceeds the minimum screening critiera.

measurements recorded during the survey indicated 11 monitoring wells contained free product ranging in thickness from 0.04 foot to 1.42 feet. Free product and water level measurements are summarized in Table 2-1. The estimated extent of free product present at the site, as indicated in the SARA (TtNUS, 2001), is presented on Figure 2-5.

## 2.6 SITE ASSESSMENT REPORT ADDENDUM (SARA) CONCLUSIONS

The most recent investigative data for the site from the SARA (TtNUS, 2001) concluded the following:

- A Bunker C oil type free-product plume is present at the site over an approximately 102,000 square foot area with a thickness up to 1.42 feet.

- Current and historic groundwater flow data indicate that flow is typically stagnant in the study area.

- Groundwater samples collected from on-site monitoring wells MW-18, MW-37, MW-46, and MW-48 contained analytes at concentrations exceeding FDEP's GCTLs.

  Soil samples from 13 on-site soil borings (SB-1, SB-2, SB-3, SB-4, SB-8, SB-10, SB-11, SB-12, SB-15, SB-16, SB-17, SB-19, and SB-20) contained analytes that exceeded FDEP's leachability for groundwater limits and direct exposure limits from Chapter 62-777, F. A. C. Because the soil samples were collected from depths of 5 to 9 feet bls and the majority of the site is asphalt or concrete covered, a direct exposure is unlikely to occur. Leaching to groundwater is also limited due to the asphalt or concrete cover.

- Benzo(a)pyrene was detected in a soil sample from one soil boring (SB-15) at a concentration that exceeded the FDEP's direct exposure limits for both residential (0.1 mg/kg) and industrial areas (0.5 mg/kg) from Chapter 62-777, F.A.C. However, given that the soil sample was collected from a depth of 8 feet bls and the majority of the site is covered, a direct exposure is unlikely to occur.

- A reevaluation of the SAR and SARA data found the estimated average hydraulic gradient to be 0.00052 feet/foot. Using a hydraulic conductivity of $3.123 \times 10^{-4}$ feet/second and porosity of 0.15, the estimated groundwater seepage velocity is 34.1 feet/year. This site is tidally influenced; therefore, the hydraulic gradient is likely a result, to some degree, of this influence.

- The SARA recommended preparing a RAP for free product for the site.

SOURCE:
LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

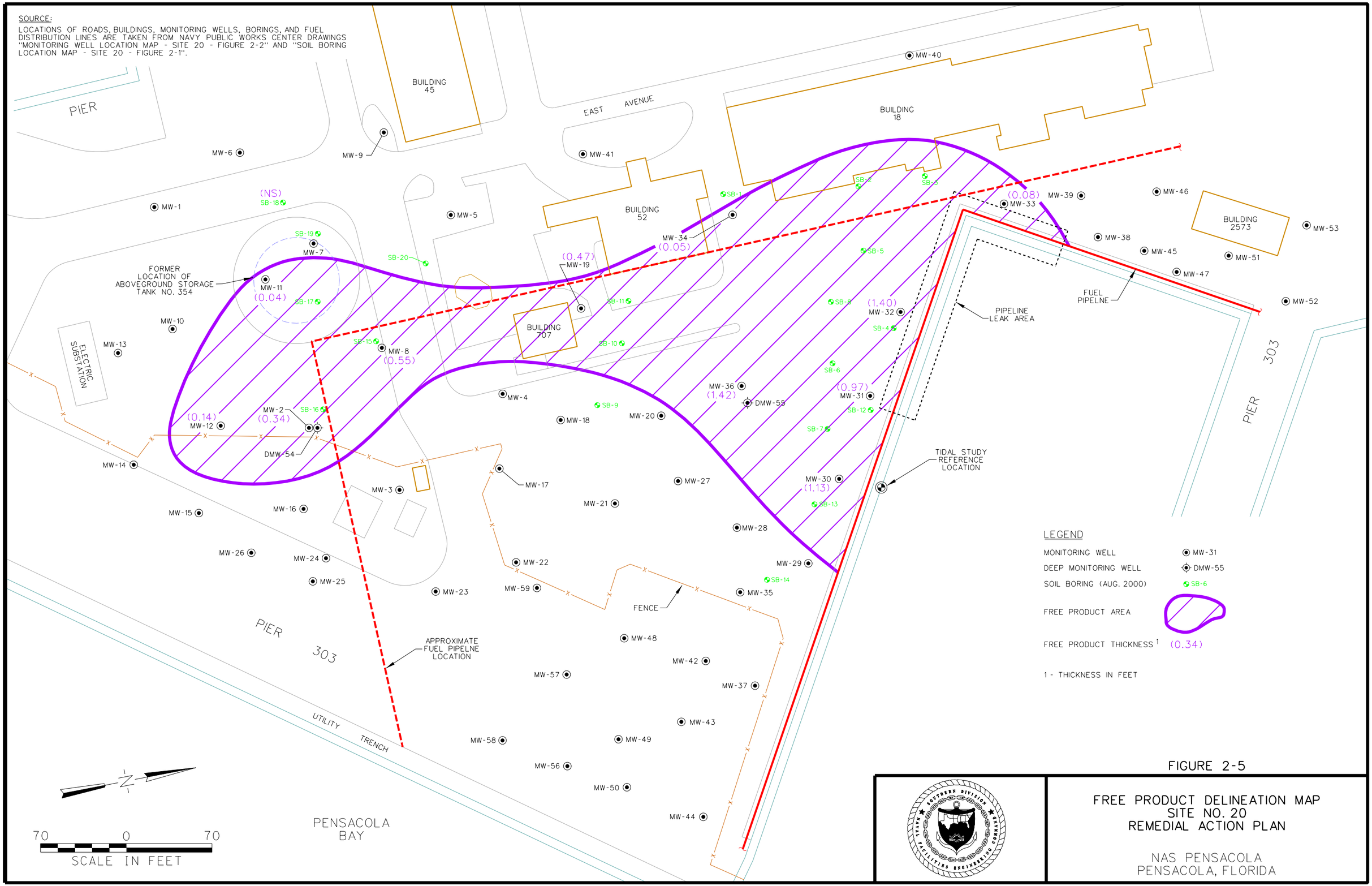



FIGURE 2-5

FREE PRODUCT DELINEATION MAP
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

n11x17b.dgn

CAD FILE NO./DATE: k:\dgn\navy\pensacola\ 0401L\ 0401L010.dgn/10-25-01

## 2.7 SAR AND SARA FINDINGS FOR REMEDIAL ACTION CONSIDERATION

The SAR for Site 20 stated that the fuel released at the site was Bunker C fuel oil. Bunker C fuel oil is a sticky, black liquid similar in appearance and smell to asphalt sealing compounds and has been used to generally describe thick and sticky residual fuel (Environment Canada, 1996).

At 50° F, Bunker C fuel oil has a consistency of liquid honey or corn syrup; at 32° F, it barely flows. Bunker C fuel oil, in addition to being used in the majority of large marine diesel engines, is used in power generating stations, industrial boilers and furnaces, and pumping plants. Because Bunker C fuel oil is less dense than water, fresh Bunker C fuel oil will float in water. As the oil ages or "weathers," it becomes heavier, but it will still float under most conditions. When the oil comes into contact with sediment, sand, or other soil materials, it may adhere together forming lumps or tar balls.

It is expected that due to the age of the tank (1920s) and the chemical properties of Bunker C fuel oil, the weathered fuel is affixed to the soil and, as a result, a minimal groundwater plume is prevalent at the site. The findings of the SAR and SARA support this assumption. In addition, the stained soil samples collected and analyzed during the investigations determined that although some volatile and semivolatile compounds were detected above residential and leachability SCTLs, the primary contaminant was TRPH, which was detected at concentrations exceeding the direct exposure and leachability limits for TRPH. However, because the majority of the site is asphalt or concrete covered, a direct exposure is unlikely to occur and leaching to groundwater is also limited.

# 3.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives are aimed at protecting human health and the environment and are expressed for each medium of concern. At Site 20, the media of concern include groundwater, surface soil, and subsurface soil. All exposure scenarios for human health receptors used the State of Florida Chapter 62-777 F.A.C. cleanup target levels (CTL's) criteria. The current and future use of the property at Site 20 is industrial. Based on the current and future use receptors, the following remedial action objectives were developed for Site 20.

**Groundwater**

1. Prevent ingestion of aquifer groundwater containing carcinogens in excess of State of Florida GCTLs (Chapter 62-777, F.A.C.) for groundwater criteria.

2. Prevent ingestion of aquifer groundwater containing noncarcinogens in excess of the State of Florida GCTLs (Chapter 62-777, F.A.C.) groundwater criteria. The Hazard Quotient (HQ) for each chemical shall not exceed 1.0 for the residential/industrial exposure to groundwater. The Hazard Index (HI)(which is the sum of HQs) shall not exceed 1.0 for the residential/industrial exposure to groundwater.

3. Restore the groundwater aquifer to the State of Florida GCTLs (Chapter 62-777, F.A.C.) for groundwater criteria.

**Surface and Subsurface Soil**

1. Protect human health from carcinogenic and noncarcinogenic risks associated with incidental ingestion of, inhalation of, and contact with contaminated soil in excess of the State of Florida soil SCTLs (Chapter 62-777, F.A.C.) for commercial/industrial criteria.

2. Prevent leaching of chemicals from soil that would result in groundwater concentrations or marine surface water concentrations that do not meet the remedial action objectives for groundwater.

3. Protect the environment from excessively contaminated soil as defined in Chapter 62-770.200, F.A.C.

## 3.1 FREE- PRODUCT TARGET LEVELS

Chapter 62-770, F.A.C. defines free product as petroleum or petroleum product in excess of 0.01 foot in thickness, measured at its thickest point, floating on surface water or groundwater. As a result of this definition, the remedial action goal for free-product removal at Site 20 will be to remove free product in excess of 0.01 foot.

## 3.2 RESTRICTIVE SITE CHARACTERISTICS

Site 20 is located along the Pensacola Bay shoreline and includes a loading area adjacent to the pier seawall. The remaining area of Site 20 consists of a busy parking lot and several buildings with numerous utilities. These restrictions may reduce the remedial options available for Site 20.

# 4.0 CONTAMINANT DISTRIBUTION

## 4.1 ESTIMATED AMOUNT OF FREE PRODUCT

Site 20 is the location of a former 1,300,000-gallon aboveground storage tank that contained Navy Special fuel, Marine Diesel fuel, and JP-5 fuel. A leak was discovered in 1981 in the fuel pipeline leading from the tank to the berthing pier while a contractor was driving piles for the pier. The pipelines appear to have been inactive for several years, and either the lines were broken during the years of usage or the abandoned lines contained product when penetrated by the piles. In either event, an unknown quantity of fuel was released. Chapter 62-770, F.A.C. requires the removal of free product in excess of 0.01 foot.

Lateral limits of the free-product plume have been defined through previous investigations as depicted in Figure 2-5. The lateral limits are based on the product release location and the free product located in monitoring wells. Based on the estimated lateral limits of the free-product plume and specific site characteristics, the total volume of free product is estimated at approximately 5,700 gallons based on the de Pastrovich method (USEPA, 1996). Free-product volume calculations are provided in Appendix A.

Calculating the volume of free product in the subsurface is an estimate, and actual product volumes can vary significantly. The contaminant distribution estimate is based on data obtained during the SARA. Estimating the volume of product in the subsurface from product thickness in monitoring wells has several limitations. These limitations include the observed change in free-product thickness due to water table fluctuation, even if the actual volume of free product has not changed. This method does not account for residual and trapped petroleum hydrocarbons of which a portion can be returned to the free-product fraction with water table fluctuations, and the method does not account for spatial variability of aquifer parameters which are rarely represented adequately by “average” properties. However, despite these limitations, this method of estimation is widely used in practice (USEPA, 1996).

## 4.2 ESTIMATED VOLUME OF SOIL CONTAMINATION

Estimates of contaminated media volumes are made by identifying the areas exceeding the commercial/industrial target levels (CTLs). Soil analysis data were compared with the corresponding CTLs and contaminated soil area maps were prepared. Field investigations conducted as part of the SAR and SARA included soil samples collected at depths ranging from 0 to 1 foot bls constituting surface soil, 2 to 4 feet bls representing subsurface soil, and at 5 to 7 feet bls as saturated zone soil. The estimated area of contaminated surface soil is approximately 78,400 $ft^2$. The volume estimate indicates a total of approximately 2,900 $yd^3$ of surface soil that is impacted above SCTLs. The estimated area of

contaminated subsurface soil is approximately 78,400 $ft^2$. The volume estimate indicates a total of approximately 5,800 $yd^3$ of subsurface soil that is impacted above SCTLs. Soil samples collected within the water table are considered a groundwater contamination. The estimated area of contaminated saturated soil is approximately 95,550 $ft^2$, which indicates a volume of approximately 7,080 $yd^3$ of saturated soil that is impacted above SCTLs.

TRPH is the only contaminant found at Site 20 that exceeds the industrial direct exposure limit. The site is primarily covered by asphalt and concrete significantly reducing the likelihood of a direct exposure. Land use controls (LUCs) will be implemented as part of the remedial actions taken at Site 20. The LUCs will ensure that appropriate restrictions on land use are implemented and posting of signs will inform anyone who may need to do intrusive work in the area of appropriate required personal protective equipment. No active remedial action will be evaluated to address contaminated soil at Site 20.

## 4.3 ESTIMATED MASS OF GROUNDWATER AND CONTAMINANTS

The vertical and horizontal extents of contaminated groundwater are estimated from monitoring well measurements and analytical results from the SAR and SARA. The estimated lateral extent of 153,000 $ft^2$ is depicted in Figure 4-1. The vertical extent or thickness of contaminated groundwater was assumed to be 11.5 feet, based on the absence of contaminants in the deep monitoring wells DMW-54 and DWM-55. The estimated volume of contaminated groundwater is 3,948,318 gallons. The estimated dissolved mass of TRPH and total lead in the groundwater plume, as defined by the estimated vertical and horizontal extents, are 221.8 pounds and 0.72 pounds, respectively. Calculations are presented in Appendix B.

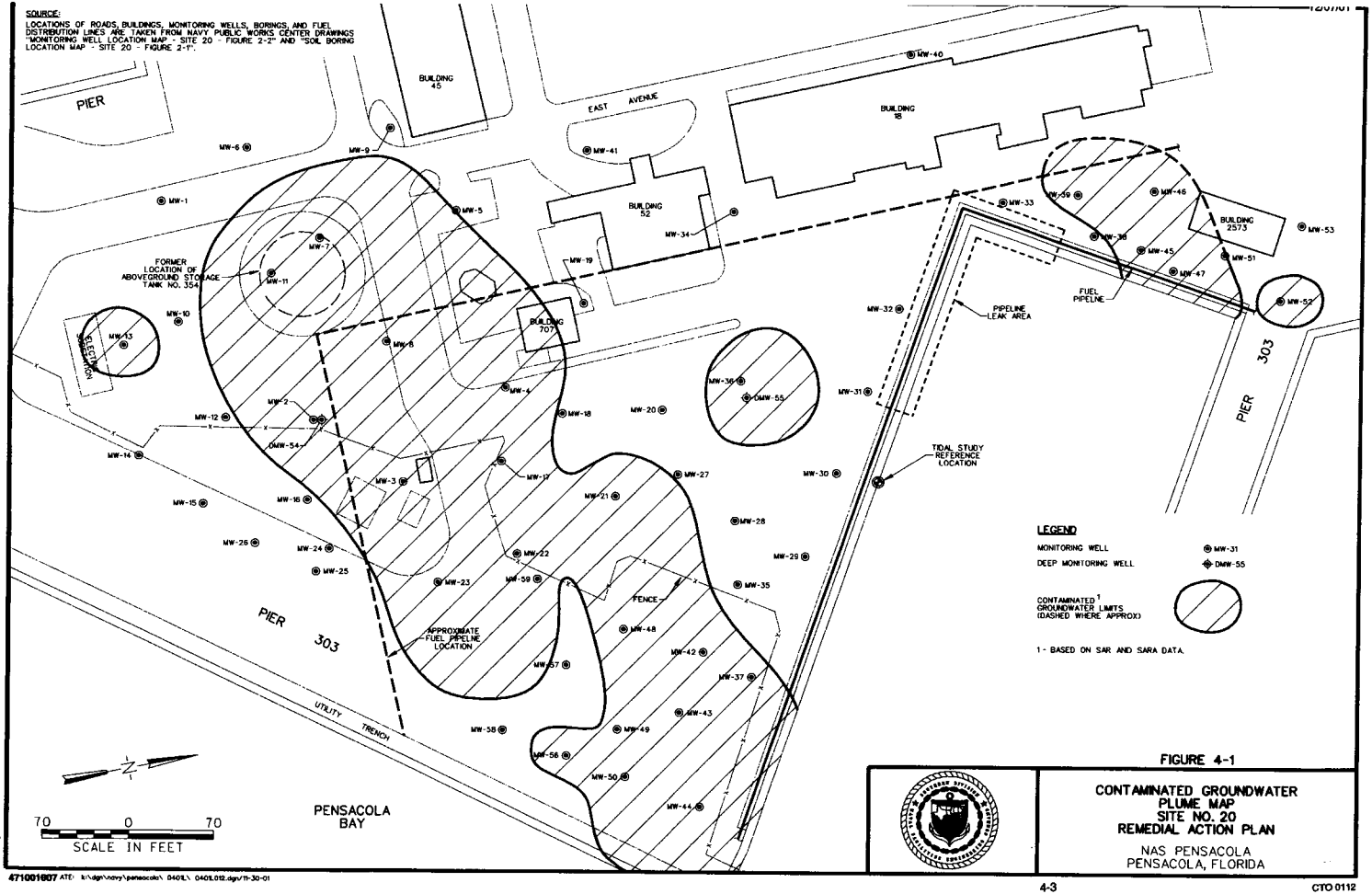



FIGURE 4-1

CONTAMINATED GROUNDWATER PLUME MAP
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

# 5.0 REMEDIAL TECHNOLOGIES

## 5.1 IDENTIFICATION AND SCREENING OF FREE-PRODUCT REMOVAL REMEDIAL TECHNOLOGIES

The concerns for Site 20 include free product, surface soil, subsurface soil, and groundwater. Technologies are identified that address the concerns for the site. Each technology is screened based on effectiveness, implementability, cost, and site and contaminant characteristics.

Table 5-1 presents free-product remedial technologies that are potentially applicable for addressing free product at Site 20. This table also presents the results of the screening of those technologies. The technology screening process reduces the number of potentially applicable technologies by evaluating of each technology with regard to effectiveness, implementability, and cost. Technologies deemed ineffective or not implementable were eliminated from further consideration.

### 5.1.1 Free-Product Removal Using Skimming Systems

Although skimming systems are most efficient when applied to open excavations such as trenches, the location of utilities in the area would make the installation of a trench difficult. Therefore, implementation of a skimming system at Site 20 would be accomplished by utilizing existing site monitoring wells and/or new free-product recovery wells.

Due to the low thickness of free product measured in 8 of the 11 wells containing free product, a mechanical skimming system would be inefficient because it would operate for a short period of time before shutting down and then activate again several hours later. This cycle would result in a very small amount of time when the system would actively be removing the free product. The viscosity of the Bunker C fuel may also make a mechanical skimming system problematic due to clogging of screens or intake valves.

A passive skimming system utilizing filter canisters would encounter problems with clogging screens due to the viscosity of the product. Therefore, a passive system utilizing absorbent socks is the most viable skimming system device.

### 5.1.2 Free-Product Recovery with Water Table Depression

This method of recovery creates a depression in the water table so that free product is directed toward pumping wells within the plume area. Both free product and groundwater are extracted during recovery

# TABLE 5-1

## PRELIMINARY SCREENING OF REMEDIAL ACTION TECHNOLOGIES

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

| Remedial Goal | General Remedial Action | Remedial Action Technology | Technology | Description | General Screening Comments |
|---|---|---|---|---|---|
| Free-Product Recovery | Institutional Controls | Access Restrictions | Land Use Controls (LUCs) | Zoning regulations in the area of free product would involve restrictions on groundwater use and installation of new wells. | Retained: LUCs are viable and will be considered where no active remediation is required due to limited contamination or in combination with any technology where contaminants exceeding RAP objectives remain in place. |
| | Monitoring | Monitoring | Free product measurements | Periodic measurements of free-product thickness in the area of potential free-product contamination. | Retained: Monitoring is viable for addressing the effectiveness of containment measures during and following implementation of remedial actions. |
| | Removal | Free-Product Extraction | Passive skimming | Undissolved liquid phase organics are removed from subsurface formation using filter canisters or absorbent socks. | Retained: Passive skimmers are effective for removing limited quantities of free product. |
| | | | Mechanical skimming | Free product is removed using pneumatic pumps. | Eliminated because of low free-product thickness over much of the site and the viscosity of the product. |
| | | | Water Table Depression | Free product is recovered from a well or trench along with groundwater. Groundwater is pumped to create a cone of depression in water table to expand area of influence. | Retained. |
| | | | Aggressive Fluid Vapor Recovery | Vacuum is applied to well(s) above water table to recover vapor phase and residual hydrocarbons. Both liquids and vapors are recovered from the same well. Groundwater production is minimized and water table is stabilized. | Retained. |
| Groundwater Remediation | Natural Attenuation | Natural Attenuation | Natural Attenuation | Groundwater monitoring of natural attenuation parameters and COCs. | Eliminated as a stand-alone option, but could become viable following free-product recovery. |
| | In situ Bioremediation | In situ Bioremediation | ORC Injection | Use DPT to inject ORC® into subsurface. | Eliminated. Lead is not biodegradable, but may become viable following lead removal. |
| | Pump and Treat | Groundwater Extraction | Groundwater Extraction from wells | Install groundwater extraction wells housing conventional pumps. Extract groundwater for treatment and disposal. | Retained. |

operations as the pump removes free product and water from the subsurface. The design of these systems is constrained by the need to minimize drawdown of the water table because minimizing drawdown will reduce both the volume of co-produced water as well as the smearing of free product along the drawdown surface.

Product recovery systems using water table depressions are most applicable when hydraulic control of the hydrocarbon plume is necessary. These systems can operate in a wide range of permeability values and geologic media. Typically, free-product recovery with water table depression is used in long-term operations of greater than 1 year (USEPA, 1996).

To accomplish free-product removal with groundwater depression, a specialized pump would be installed in recovery wells. The free product and groundwater would be removed from recovery wells, where the free product would be stored in drums on-site and the groundwater treated and discharged. Free-product recovery using groundwater depression can generate large quantities of co-produced groundwater. Two options for the disposal of recovered groundwater include publicly owned treatment work (POTW) discharge or treatment and recharge to the water-bearing geologic formation. Because of the cost of treating contaminated groundwater, discharging it to the POTW is preferred (provided the facility will accept discharges). Some pretreatment, such as phase separation, may be required before discharging to the sanitary sewer.

### 5.1.3 Free-Product Recovery With Aggressive Fluid Vapor Recovery

The approach of aggressive fluid vapor recovery (AFVR) is to extract free product and vapor by vacuum enhanced pumping techniques. Dual-phase systems recover free product and facilitate vapor-based unsaturated zone cleanup through each well point (USEPA, 1996). This approach has several benefits compared to other free-product recovery methods. A cone of depression is not formed at the air/oil interface or the air/water interface; therefore, smearing of the free-product zone is minimized. Vapor-phase hydrocarbons and mobile free product are collected simultaneously.

There are two main conceptual approaches to dual-phase recovery, although they differ only in the vertical positioning of the pump intake: (1) recovery of free product and water by a single vacuum/liquids pump and (2) extraction of free product, air, and water with a single pump and a vacuum extraction point set at the air/product interface (commonly referred to as “bioslurping”).

Dual-phase extraction can be applied using either an in situ system or via specialized mobile vacuum trucks. The use of mobile vacuum trucks is a variation of multi-phase/dual-phase extraction and is also

known as AFVR, mobile multi-phase extraction, or mobile dual-phase extraction. For the RAP this technology will be referred to as AFVR. Permanent dual-phase extraction systems typically involve large capital costs for equipment and installation. Permanent dual-phase recovery systems are also typically used for long-term operations. AFVR allows sites with small amounts of free product to be remediated via dual-phase extraction with low capital cost. A mobile vacuum truck equipped for AFVR would eliminate the need for an on-site remedial system for free-product removal. An AFVR contractor reported that the radius of influence for sites could range from 20 to 200 feet. However, with the site conditions and type of product present at Site 20 the radius of influence would most likely range from 25 to 50 feet from the extraction point.

Dual-phase recovery systems are most applicable in medium to low permeability media or thin (less than 0.5 foot) saturated thickness, with water table depths of 5 to 20 feet, settings in which conventional pumping approaches or trenches are inappropriate or ineffective, and free-product plumes are located under paved or sealed surfaces (USEPA, 1996).

## 5.2 DEVELOPMENT OF FREE-PRODUCT REMOVAL ALTERNATIVES

The technologies that passed the preliminary screening are selected to represent a typical general remedial action and are assembled into alternatives representing a range of treatment combinations, as appropriate. The purpose of providing a range of alternatives is to ensure that all reasonable general remedial actions are represented and evaluated. The technologies that are selected to represent alternatives for free-product removal are presented in Table 5-2. The assembly of these technologies into alternatives for free-product removal are presented in Table 5-3.

**TABLE 5-2**

**REPRESENTATIVE FREE-PRODUCT RECOVERY REMEDIAL ACTION TECHNOLOGIES**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| General Remedial Action | Remedial Action Technology | Technology | Representative Technology |
|---|---|---|---|
| Institutional Controls | Access Restrictions | LUCs | LUCs |
| Monitoring | Free-Product Measurements | Free-Product Measurements | Free-Product Measurements |
| Removal | Free-Product Removal | Passive Skimming<br>Water Table Depression<br>AFVR | Passive Skimming<br>Pneumatic Pumps<br>Mobile Vacuum Truck |

**TABLE 5-3**

**ASSEMBLY OF FREE-PRODUCT REMOVAL ALTERNATIVES**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| Alternative | Alternative Type | Representative Technologies Combined into Alternatives | Alternative Description |
|---|---|---|---|
| Alternative 1: Land Use Controls, Free-Product Removal by Passive Skimming, and Monitoring | Containment/Limited Action – No or limited treatment | LUCs, Passive Skimming, and Monitoring | ▪ LUCs<br>▪ Skimming free product from 11 existing site monitoring wells using absorbent socks<br>▪ Periodic free-product measurements<br>▪ Posting of warning signs<br>▪ Five-year site reviews |
| Alternative 2: Land Use Controls, Free-Product Removal by Water Table Depression, and Monitoring | Containment/Limited Action – No or limited treatment | LUCs, Water Table Depression, and Monitoring | ▪ LUCs<br>▪ Installation of extraction wells to remove free product and groundwater<br>▪ Treatment and disposal of groundwater<br>▪ Periodic free-product measurements<br>▪ Posting of warning signs<br>▪ Five-year site reviews |
| Alternative 3: Land Use Controls, Free-Product Removal by AFVR, Passive Skimming and Monitoring | Containment/Limited Action – No or limited treatment | LUCs, AFVR, Passive skimming, and Monitoring | ▪ LUCs<br>▪ Installation of recovery wells<br>▪ Periodic AFVR vacuum events<br>▪ Passive skimming from 11 existing wells using absorbent socks<br>▪ Periodic free-product measurements<br>▪ Posting of warning signs<br>▪ Five-year site reviews |

## 5.3 REMEDIAL ALTERNATIVES FOR FREE-PRODUCT REMOVAL

Three alternatives were developed to address free-product removal at Site 20. The alternatives are as follows and pertinent details of the alternatives are presented in Table 5-3.

Free-Product Removal Alternative 1: LUCs, Passive Skimming, and Monitoring
Free-Product Removal Alternative 2: LUCs, Water Table Depression, and Monitoring
Free-Product Removal Alternative 3: LUCs, AFVR, Passive Skimming, and Monitoring

### 5.3.1 Free-Product Removal Alternative No. 1: LUCs, Passive Skimming, and Monitoring

LUCs are rules, directives, policies, and other measures (e.g., preventing the usage of groundwater and drilling new wells, and posting signs) adopted by the appropriate authorities in a manner consistent with applicable Federal, state, and local laws. Land use at Site 20 is to remain industrial. LUCs would be

implemented to ensure that access to the site is restricted during cleanup and to ensure appropriate future land use (e.g., restrictions on groundwater wells) once the remediation is complete.

Free product is present in 11 site monitoring wells ranging in thickness from 0.04 foot to 1.42 feet. Passive skimming systems do not actively pump free product; instead they slowly accumulate it over time by collecting free product that naturally flows to the passive skimmer devices. Absorbent socks are simple skimming devices that are suspended in the well across the surface of the free-product layer. Attached material absorbs product from the water surface and must be periodically removed and disposed. An absorbent sock skimming device would be placed in each of the 11 existing site monitoring wells for the removal of free product and in an additional 10 free-product recovery wells field located to intercept the free-product plume.

Monitoring consists of ensuring that LUCs remain in place, passive skimming is progressing, and that free-product measurements are performed periodically.

### 5.3.2 Free-Product Removal Alternative No. 2: LUCs, Water Table Depression, and Monitoring

Free-product removal alternative 2 would address free-product removal through groundwater extraction creating a cone of depression. Four extraction wells would be installed and equipped with pumps. Free product and groundwater would be recovered from the extraction wells by pumping. Groundwater would be treated and discharged to the POTW. LUCs would be implemented as described in Section 5.3.1. Monitoring for this alternative would involve ensuring that LUCs remain in place, that a cone of depression is created by pumping, and that periodic measurements of free-product thickness are performed.

### 5.3.3 Free-Product Removal Alternative No. 3: LUCs, AFVR, Passive Skimming, and Monitoring

This alternative combines the technologies of AFVR and absorbent socks for free-product removal. Four recovery wells would be installed for use during AFVR events. Proposed recovery well locations are shown on Figure 5-1. Experienced mobile vacuum contractors can connect to multiple wells simultaneously during an AFVR event. Absorbent socks would be placed in each of the 11 existing site monitoring wells that contain free product. LUCs and monitoring would be implemented as described in Section 5.3.1.

SOURCE:
LOCATIONS OF ROADS, BUILDINGS, MONITORING WELLS, BORINGS, AND FUEL DISTRIBUTION LINES ARE TAKEN FROM NAVY PUBLIC WORKS CENTER DRAWINGS "MONITORING WELL LOCATION MAP - SITE 20 - FIGURE 2-2" AND "SOIL BORING LOCATION MAP - SITE 20 - FIGURE 2-1".

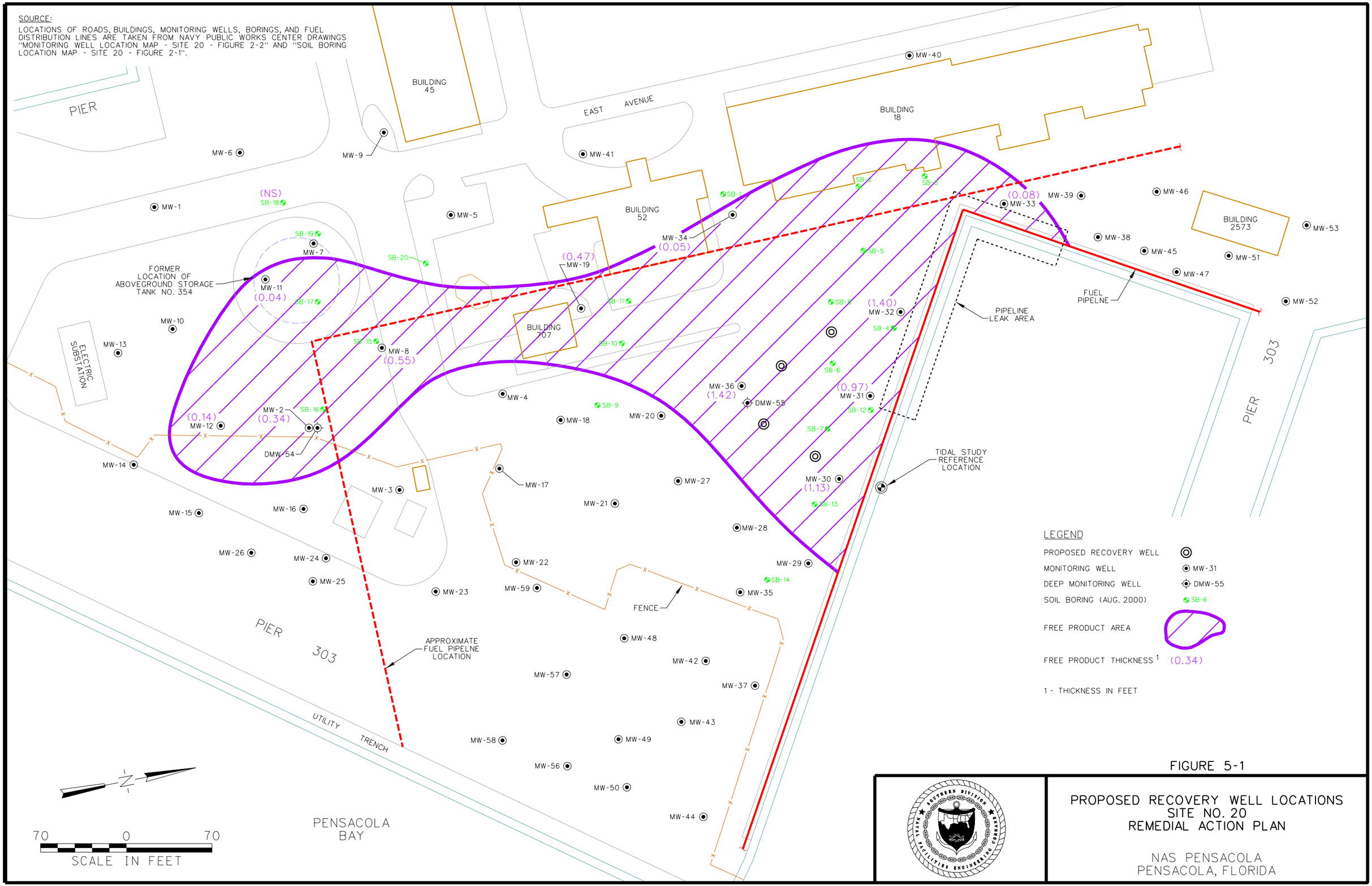



FIGURE 5-1

PROPOSED RECOVERY WELL LOCATIONS
SITE NO. 20
REMEDIAL ACTION PLAN

NAS PENSACOLA
PENSACOLA, FLORIDA

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## 5.4 EVALUATION OF REMEDIAL ACTION ALTERNATIVES

The identified remedial action alternatives are evaluated using the criteria in Chapter 62-770.700, F.A.C. The alternatives are evaluated against the standards listed below.

1. Long-term and short-term human health and environmental impacts.
2. Implementability, which may include ease of construction, site access, and necessity for permits.
3. Operation and maintenance (O&M) requirements.
4. Reliability.
5. Feasibility.
6. Estimated time to achieve cleanup.
7. Cost-effectiveness of installation, and operation and maintenance, when compared to other site remediation alternatives.

**Long-term and Short-term Human Health and Environmental Impacts**

Remedial action remedies must be protective of human health and the environment. Remedies may include those measures that are needed to be protective, but are not directly related to media cleanup, source control, or management of wastes. A discussion of what types of long-term and short-term remedies are appropriate for the site and how various remedial action measure alternatives meet this standard will be presented.

**Implementability**

Implementability will often be a determining variable in shaping remedies. Some technologies will require state or local approvals prior to construction, and there may be some restrictions or concerns for some remedial approaches. Typical factors to be considered include administrative activities (e.g., permits, right of way, off-site approvals) and the length of time these activities will take; constructability of the remedial measure and time for beneficial results; availability of off-site treatment, disposal, and storage facility services; and availability of prospective technology.

**Operation and Maintenance Requirements**

Some technologies will require excess or more complicated O&M than others. Typical factors to be considered include level of expertise of personnel required to maintain the system, routine maintenance frequency, ease of replacement of parts when needed, and availability of parts and labor.

**Reliability**

Demonstrated and expected reliability is a way of assessing the risk and effect of failure. It may be considered whether the technology or a combination of technologies have been used effectively under analogous site conditions, whether failure of any one technology in the alternative would have an immediate impact on receptors, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rain storms, earthquakes). Each remedial action measure alternative should be evaluated in terms of the projected useful life of the overall alternative and of its component technologies.

**Feasibility**

Only technologies with proven effectiveness in similar site conditions and contaminant concentrations are considered. The likelihood that the technology would be successful once implemented will be determined.

**Estimated Time to Achieve Cleanup**

The estimated time to achieve cleanup is a vital consideration. Many technologies will require decades to achieve remedial action goals. The time to achieve cleanup for each alternative will be estimated and evaluated in comparison with other acceptable alternatives.

**Cost Effectiveness**

The relative cost of a remedy may be an appropriate consideration, especially in those situations where several different technical alternatives to remediation will offer equivalent protection of human health and the environment. Cost estimates could include costs for engineering, site preparation, construction, materials, labor, sampling/analysis, waste management/disposal, permitting, health and safety measures, training, O&M, etc.

## 5.5 EVALUATION OF REMEDIAL ALTERNATIVES FOR FREE-PRODUCT REMOVAL

### 5.5.1 Free-Product Removal Alternative No. 1: LUCs, Passive Skimming, and Monitoring

**Long-term and Short-term Human Health and Environmental Impacts**

LUCs would effectively prevent direct human contact with contaminated groundwater by controlling site access and preventing the withdrawal of contaminated groundwater from the ground. Passive skimming

would remove the floating free product and eliminate one source of contamination. Monitoring would assess the progress of passive skimming and make sure the restrictions on land use are in place, and monitor the progress of free-product removal and natural attenuation. Over a period of time the concentrations of COCs in groundwater would reach levels that are protective to human health and the environment.

**Implementability**

This alternative would be readily implementable. Materials and labor are readily available for installing absorbent socks. Monitoring requires periodic checking of each well for the progress of free-product skimming. Materials and labor required for monitoring are readily available. This alternative may require permits. Administrative issues and coordination with other agencies or acquiring permits are easily achievable.

**Operation and Maintenance Requirements**

O&M requirements for this alternative include site visits every 2 weeks during active remediation to check the condition of absorbent socks and to measure the thickness of free product and depth to water in all monitoring wells. The absorbent socks need to be removed, inspected, and replaced as necessary.

**Reliability**

The alternative is fairly reliable because skimming would indicate the presence and removal of a free-product layer.

**Feasibility**

Passive skimming using absorbent socks is feasible; however, free-product yields may be low increasing the time to achieve cleanup.

**Estimated Time to Achieve Cleanup**

Experience with passive skimming systems at sites with similar lithology and similar fuel oil contaminants indicates that adsorbed petroleum hydrocarbons within saturated zone soil continually leach into groundwater, prolonging remedial time periods. This leaching process cannot be predicted accurately. Therefore, an estimated remedial time period for the passive skimming system is 10 years.

**Cost Effectiveness**

The estimated capital cost of implementing Alternative 1 is $59,672. The annual O&M cost would be $21,870. Present worth cost over a period of 10 years would be $274,594. An estimated cost for installation of a passive skimming system and 10 years of operation is presented in Table 5-4 and Appendix C.

### 5.5.2 Free-Product Removal Alternative No. 2: LUCs, Water Table Depression, and Monitoring

**Long-term and Short-term Human Health and Environmental Impacts**

This alternative would remove free product from the saturated medium and would extract contaminated groundwater for treatment prior to disposal. Aspects of LUCs and monitoring are presented in Section 5.5.1. This alternative would provide a high degree of protection to human health and the environment because the source of contamination would be removed and contaminated groundwater would be treated.

**Implementability**

This alternative would be implementable. Extraction wells and treatment units could be readily installed. Limited manpower and materials are necessary to install collection and treatment systems. This alternative may require permits. Administrative issues and coordination with other agencies or acquiring permits are easily achievable.

**Operation and Maintenance Requirements**

This alternative involves mechanical equipment including pumps and treatment equipment that would require periodic maintenance and repair. Monitoring would require water level and free-product thickness measurements and treatment units would require sampling and laboratory analysis.

**Reliability**

Water table depression using extraction wells is a proven and established technology. The long-term reliability and effectiveness of the pump and treat system is proven. Once the system is properly designed and installed, the alternative would be reliable and effective.

## TABLE 5-4

## FREE-PRODUCT REMEDIAL ALTERNATIVES COST SUMMARY

### SITE 20, ALLEGHENY PIER (PIER 303)
### NAS PENSACOLA, PENSACOLA, FLORIDA

| ALTERNATIVE | CAPITAL COST | ANNUAL O&M | ESTIMATED YEARS OF OPERATION | O&M PRESENT WORTH | TOTAL PRESENT WORTH |
|---|---|---|---|---|---|
| Passive Skimming | $59,672 | $21,870 | 10 | $214,922 | $274,594 |
| Free Product Recovery with Groundwater Depression | $66,452 | $37,560 | 3 | $80,304 | $146,756 |
| AFVR with absorbent socks | $63,496 | $33,425 | 1 | $33,425 | $96,921 |

Note: See Appendix C for detailed cost estimates for the free-product remediation alternatives.

**Feasibility**

A properly designed water table depression system could be successful at free-product removal from the subsurface. However, the site is tidally influenced, making design to minimize drawdown more complicated.

**Estimated Time to Achieve Cleanup**

Operational time to remediation using groundwater depression was estimated at 3 years. An operational time of 3 years was used for cost purposes only, due to the uncertainties associated with the actual free-product concentrations that may be present. Actual removal times may vary significantly.

**Cost Effectiveness**

The estimated capital cost of implementing Alternative 2 is $66,452. The annual O&M cost would be $37,560. Present worth cost over a period of 3 years would be $146,756. A summary of costs is presented in Table 5-4 and detailed cost estimates are provided in Appendix C.

### 5.5.3 Free-Product Removal Alternative No. 3: LUCs, AFVR, Passive Skimming, and Monitoring

**Long-term and Short-term Human Health and Environmental Impacts**

This alternative would add AFVR to Alternative 1. Aspects of LUCs, passive skimming, and monitoring are presented in Section 5.5.1. Passive skimming and AFVR would the remove contaminant source in saturated medium. AFVR would aid aerobic biodegradation that would treat COCs in groundwater much faster than natural attenuation and would protect human health and the environment. This alternative does not require water to be pumped out of the ground. There would be no releases to air impacting human health or the environment. Free product collected through passive skimming and AFVR events would be disposed of following applicable standards and would not impact human health and the environment. LUCs would prevent access to contaminated water.

**Implementability**

This alternative would be readily implementable. Materials and labor are readily available for installing absorbent socks. Monitoring requires periodic checking of each well for the progress of free-product skimming. Materials and labor required for monitoring are readily available. Mobile vacuum contractors

with experience in AFVR methods are available. This alternative may require permits. Administrative issues and coordination with other agencies or acquiring permits are easily achievable.

**Operation and Maintenance Requirements**

O&M requirements for this alternative include site visits every 2 weeks during active remediation to check the condition of absorbent socks and to measure the thickness of free product and depth to water in all monitoring wells. The absorbent socks need to be removed, inspected, and replaced as necessary.

**Reliability**

Dual-phase extraction is a reliable and proven technology. The use of mobile vacuum trucks rather than permanent treatment systems has also proven to be a reliable and cost-effective alternative.

**Feasibility**

Vacuum extraction of free product using AFVR is likely to be successful in removing free product from the subsurface while promoting aerobic biodegradation. Passive skimming is intended to remove relatively low volume thickness of free product as the devices are designed to do.

**Estimated Time to Achieve Cleanup**

Based on the use of AFVR at similar sites in Florida and moderate free-product levels, it is estimated that free-product recovery may be achieved with six or fewer AFVR events. The time duration of this remedial technology was estimated at 12 months.

**Cost Effectiveness**

The estimated capital cost of implementing Alternative 3 is $63,496. The annual O&M cost would be $33,425. Present worth cost over a period of 1 year would be $96,921. A summary of costs is presented in Table 5-4 and detailed cost estimates are provided in Appendix C.

## 5.6 RECOMMENDATION OF FREE-PRODUCT REMOVAL REMEDIAL ACTION

The goal of the remedial system is to remove free product from the site. The free-product plume at the site was estimated at 102,000 square feet, with a total volume of 5,700 gallons.

The primary advantage of using a passive skimmer system is the low capital cost. The disadvantage with passive skimming systems is that only free product that naturally comes in contact with the skimming device is collected.

The primary advantages of free-product recovery with water table depression are the shorter duration compared to passive skimming and it treats both free product and contaminants in groundwater. The main disadvantage with water table depression is that the technique causes a smear zone of free product. Additionally, the free product has a high viscosity and will take longer to remove than most free-product plumes. The high viscosity free product will result in a prolonged remedial time and large quantities of groundwater that require treatment and disposal. This alternative is eliminated from further consideration due to these concerns, higher costs, and permitting associated with discharging the generated water.

The primary advantage of AFVR is that there is no permanent treatment system required, resulting in much lower capital and O&M costs. AFVR also makes disposal of extracted free product and groundwater uncomplicated because the recovered material is extracted into a mobile vacuum truck. A comparison of the estimated cost of removing free product using each evaluated alternative is provided in Table 5-4. Based on a review of the advantages, disadvantages, and costs, the preferred alternative is AFVR in conjunction with absorbent socks to remediate the free product at this site.

Past uses of AFVR have provided a high degree of overall protection to human health and the environment by providing quick reductions of free-product volumes. AFVR will promote in situ biodegradation and volatilization of hydrocarbon constituents within the soil matrix. The equipment and controls needed for AFVR are reliable, easily operated, and commonly available; and systems typically require low capital and minimal O&M cost. Minimal permitting may be required for the implementation and operation of AFVR. Similar to other vapor extraction technologies, AFVR is most effective when free-product plumes are located under paved or sealed surfaces, which reduces the possibility of “short circuiting” the high vacuum pressure. The area where AFVR would be performed is covered with asphalt and concrete and the water table ranges from approximately 5 to 11 feet bls. These conditions are most conducive to successful AFVR events.

The use of AFVR is a preferred alternative based on (1) low capital and O&M costs, (2) low impact on surrounding site conditions, (3) proven effectiveness, and (4) the expectation that AFVR will also provide a shorter duration to achieve cleanup standards and goals compared to the other alternatives. Table 5-5 summarizes the advantages and disadvantages of each remedial alternative.

**TABLE 5-5**

**SUMMARY OF REMEDIAL ALTERNATIVES**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| Alternative | Advantages | Disadvantages |
|---|---|---|
| Alternative No. 1:<br>LUCs, Passive Skimming, and Monitoring | ▪ Focused on free product<br>▪ Low capital costs<br>▪ Small disposal quantities | ▪ Not active<br>▪ Longer time duration |
| Alternative No. 2:<br>LUCs, Water Table Depression, and Monitoring | ▪ Controls dissolved plume<br>▪ Large radius of influence | ▪ High capital costs<br>▪ Requires continuous water treatment and disposal<br>▪ On-site system required<br>▪ Groundwater depressed which smears the free product |
| Alternative No. 3:<br>LUCs, AFVR, Passive Skimming, and Monitoring | ▪ Low O&M and capital costs<br>▪ Permanent system installation not required<br>▪ Large radius of influence<br>▪ Vapor phase and mobile free product removed simultaneously | ▪ Disposal of removed product and groundwater<br>▪ Multiple events required |

## 5.7 IDENTIFICATION AND SCREENING OF GROUNDWATER REMEDIAL TECHNOLOGIES

Based on the SAR and SARA data, the total volume of groundwater contaminant concentrations in excess of FDEP GCTLs is approximately 4 million gallons. The following technologies were identified for remediation of groundwater and were screened:

- Natural Attenuation
- In Situ Bioremediation
- Pump and Treat

The following technologies were eliminated based on effectiveness concerns:

- In situ bioremediation was eliminated from further screening because lead is not readily biodegradable. Once lead is removed, an in situ bioremediation technology may prove effective in remediating the site.

- Natural attenuation was eliminated from further screening because it would not be protective of human health and the environment at this time. Once free product and lead are removed, monitored natural attenuation may prove effective.

### 5.7.1 Groundwater Pump and Treat

Pump and treat is one of the most widely used groundwater remediation technologies. Conventional pump and treat methods involve pumping contaminated groundwater to the surface for treatment. Variations and enhancements of conventional pump and treat include hydraulic fracturing as well as chemical and biological enhancements. Pump and treat systems are used primarily to accomplish hydraulic containment—to control the movement of contaminated groundwater, preventing the expansion of the contaminated groundwater zone and/or treatment—to reduce the dissolved contaminant concentrations in groundwater sufficiently that the aquifer complies with cleanup standards.

### 5.7.2 Groundwater Extraction, Treatment, and Discharge

Remediation for Site 20 will consist of a phased approach. Initial remedial actions will focus on free-product removal as described previously. Concurrent with aggressive free-product recovery efforts, groundwater extraction will be implemented on a limited basis. Although the intention is to implement groundwater recovery only in areas absent of free product, the possibility exists for free product to be recovered with extracted groundwater. Therefore, an oil/water separator will be required for phase separation. Once separated, free product would be collected for removal and disposal. The remaining liquid could require additional treatment prior to discharge. Other options for phase separation, such as dissolved air flotation, are considerably higher in capital and O&M costs and normally are only used under special conditions.

**Hydrocarbon Treatment**

Granular activated carbon (GAC) adsorption has been used successfully for the treatment of gasoline and kerosene range fuel contaminated groundwater. Adsorption occurs when molecules adhere to the internal walls of pores in carbon particles produced by thermal activation. Extracted groundwater would be pumped to an equalization tank from which it would be pumped through a carbon column.

Pre-treatment for iron may be needed to prevent plugging of the column. The activated carbon would adsorb naphthalene and TRPH compounds from water.

**Lead Treatment**

Ex situ groundwater treatment for lead can be accomplished by ion exchange, chemical precipitation, and specialized media adsorption/absorption. These options are discussed further below. Specialized media are typically required for lead concentrations significantly higher than those present at Site 20.

**Ion Exchange**

Ion exchange is a process in which ions held by electrostatic forces on the surface of a porous solid are exchanged for ions similar in charge in a solution in which the porous solid is immersed. By this means specific constituents can be removed from a solution that contains multiple constituents. Exchange is accomplished by passing the solution through porous solid materials, usually minerals of the zeolite group or specially prepared synthetic resins (plastics) containing large complex molecules. Certain ions in the solution replace ions or groups of ions in the resin or zeolite from which they can then be washed out. By controlling the acidity, strength, and composition of the solution and the nature of the resin, ions in solution are selectively exchanged for the exchangeable ions that are in the resin. Ion exchange media must be periodically regenerated. Regeneration requires a backwash subsystem and creates a sludge that requires handling and disposal.

Ion exchange units can be designed to remove 99 percent of selected ionic contaminants. Due to the low extraction rate and the relatively low contaminant concentrations expected, the cost for ion exchange is considered moderately high.

**Chemical Precipitation**

Groundwater treatment with chemical precipitation involves the addition of chemicals to alter the physical state of dissolved and suspended solids and facilitate their removal. Sedimentation and filtration are then used to remove precipitated particles. Chemical precipitation requires the addition of a coagulating agent and creates significant sludge that requires additional handling and disposal. Chemical precipitation capital and O&M costs are high. Therefore, chemical precipitation is eliminated from further consideration based on high cost.

### 5.7.3 Groundwater Extraction and Discharge

The discharge options screened below are effective for the discharge of extracted groundwater.

**Discharge to POTW or Base IWTP**

Discharge to an existing sewer system (POTW or Base industrial waste treatment plant) consists of pretreatment and transference to an existing sewer system. The Escambia County Utilities Authority (ECUA) now accepts wastewater from NAS Pensacola. A discussion with the ECUA Coordinator of Pretreatment indicated that extracted groundwater with free product removed would be acceptable without further pretreatment. In addition, permitting issues should be minor. The cost of connecting to the existing sewer system will require a capital investment for a dedicated force main from the site to an existing force main at NAS Pensacola's north boundary. Costs from discharge fees would be a regular expense based on flow rate and are considered moderate.

**Discharge to Surface Water**

Treated groundwater could be discharged to the surface at the site. Surface discharge would require on-site treatment to acceptable levels for a National Pollutant Discharge Elimination System (NPDES) permit. Additionally, groundwater laboratory analysis would be required to demonstrate compliance with the permit. Surface discharge normally involves low capital investment and O&M costs.

## 5.8 DEVELOPMENT OF GROUNDWATER REMEDIAL ALTERNATIVES

The technologies that passed the preliminary screening are selected to represent a typical general remedial action and are assembled into alternatives representing a range of treatment combinations, as appropriate. The purpose of providing a range of alternatives is to ensure that all reasonable general remedial actions are represented and evaluated. The technologies that are selected to represent alternatives for groundwater remediation are presented in Table 5-6. The assembly of these technologies into alternatives for groundwater remediation are presented in Table 5-7.

**TABLE 5-6**

**REPRESENTATIVE GROUNDWATER REMEDIAL ACTION TECHNOLOGIES**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| General Remedial Action | Remedial Action Technology | Technology | Representative Technology |
|---|---|---|---|
| Natural Attenuation | Natural Attenuation | Natural Attenuation | Groundwater Monitoring |
| In Situ Bioremediation | In Situ Bioremediation | ORC® Injection | DPT to inject ORC |
| Pump and Treat | Groundwater Extraction | Groundwater Extraction | Groundwater Extraction using recovery wells |

**TABLE 5-7**

**ASSEMBLY OF GROUNDWATER REMEDIAL ALTERNATIVES**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| Alternative | Alternative Type | Representative Technologies Combined into Alternatives | Alternative Description |
|---|---|---|---|
| Alternative 1: Groundwater Extraction, Oil/Water Separation with Discharge to POTW | Pump and Treat | Groundwater Extraction with pretreatment | ▪ Installation of recovery wells<br>▪ Installation of in-well pumps and piping system<br>▪ Installation of oil/water separator<br>▪ Connection to existing POTW<br>▪ Periodic groundwater monitoring<br>▪ Five-year site review |
| Alternative 2: Groundwater Extraction, Treatment with Discharge to Surface Water | Pump and Treat | Groundwater Extraction with on-site treatment | ▪ Installation of recovery wells<br>▪ Installation of in-well pumps and piping system<br>▪ Installation of on-site groundwater treatment system<br>▪ Obtain NPDES permit<br>▪ Periodic groundwater monitoring<br>▪ System O&M<br>▪ Five-year site review |

The remedial technology options for groundwater remediation have been identified and screened based on effectiveness, implementability, and cost. A summary of reasons for retention or elimination of technology options is presented in Table 5-1. Based on the screening results, two alternatives for groundwater remediation exist.

### 5.8.1 Groundwater Alternative No. 1: Groundwater Extraction, Oil/Water Separator with Discharge to POTW

Groundwater Alternative No. 1 consists of groundwater remediation by groundwater extraction with oil/water separator pretreatment and discharge to a POTW. The pretreatment will include phase separation in an oil/water separator. Separated free product will be collected and taken off-site for disposal.

This alternative would involve the installation of a minimum of ten groundwater extraction wells. The locations of the wells will be field determined following a comprehensive groundwater monitoring event to evaluate current groundwater contamination. Five years of natural attenuation monitoring would follow active groundwater remediation.

### 5.8.2 Groundwater Alternative No. 2: Groundwater Extraction and Treatment With Discharge to Surface Water

This alternative would consist of the installation of a minimum of 10 groundwater extraction wells, each equipped with a pump for the extraction of contaminated groundwater. Groundwater would be treated on-site with phase separation, TRPH removal with GAC, and lead removal with ion exchange. Separated free product would be collected and taken off-site for disposal. Five years of natural attenuation monitoring would follow active groundwater remediation.

## 5.9 EVALUATION OF REMEDIAL ALTERNATIVES FOR GROUNDWATER

**Long-term and Short-term Human Health and Environmental Impacts**

Both alternatives would reduce long-term human health and environmental impacts by the use of free product and treatment of contaminated groundwater from the subsurface at Site 20. Short-term impacts could be minimized by eliminating contact with contaminants through engineering controls and proper handling and disposal of residuals produced during construction and O&M. However, disposal of extracted groundwater to the POTW would provide more protection because discharge to the surface could potentially create exposure risks.

**Implementability**

Both alternatives are implementable with utilities available in reasonable proximity to the site, including potable water, electricity, communications, and sewer. However, discharge to the POTW would be more easily implemented because the treatment system would be much less extensive and no NPDES permit would be required.

**O&M Requirements**

Groundwater Alternative No. 2 would have substantially higher O&M requirements for GAC and ion exchange. Groundwater Alternative No. 2's increased complexity would increase downtime for routine O&M, optimization, and nonpreventable malfunction. Ion exchange media regeneration and sludge handling constitute the majority of this increased effort.

**Reliability**

Both systems consist of conventional components with proven reliability if they are operated and maintained properly. Groundwater Alternative No. 2 is the more complex system; therefore, it would be less reliable than Groundwater Alternative No. 1, due to increased downtime for routine maintenance and nonpreventable malfunction.

**Feasibility**

Both alternatives are technically feasible. The expertise for design, construction, and operation is regionally (if not locally) available. All components are conventional "off-the-shelf" equipment, readily available from multiple vendors.

**Estimated Time to Achieve Cleanup**

Both alternatives would have the same duration of operation because the basic remedial processes for the extraction of groundwater are the same. The alternatives only differ in the level of treatment and the discharge option. The estimated time to achieve cleanup is 11 years of active groundwater remediation followed by 5 years of natural attenuation monitoring.

**Cost**

Detailed cost estimates for both alternatives are presented in Appendix C. The estimated present worth costs for Groundwater Alternatives No. 1 and No. 2 are $1,335,399 and $1,535,282, respectively. The differential in cost consists of Groundwater Alternative 2's higher capital and O&M costs.

## 5.10 RECOMMENDATION OF GROUNDWATER REMEDIAL ACTION

Groundwater Alternative No. 1, Groundwater Remediation with discharge to POTW is the preferred alternative based on: (1) more protective of human health and the environment, (2) more easily implementable, (3) less complicated system making the alternative more reliable and less O&M intensive, and (4) lower cost.

# 6.0 REMEDIAL SYSTEM DESIGN

Remediation for Site 20 will involve a phased approach. Initial remedial activities will focus on free-product removal followed by groundwater remediation. Limited groundwater collection may be implemented outside of the free-product plume during free-product recovery activities. The preferred remedial alternatives for free-product removal and groundwater remediation presented in this RAP were selected based on low capital and O&M costs, low impact on surrounding site conditions, proven effectiveness, and time to achieve cleanup. The potential remedial technologies and process options for free-product removal and groundwater remediation were identified and screened, and the results were presented in Section 5.0. The selected alternative for free-product removal is dual-phase extraction by AFVR in conjunction with placement of absorbent socks in site monitoring wells. The selected alternative for groundwater remediation is groundwater extraction by pump and treat with discharge to the POTW.

## 6.1 BASIS OF DESIGN

The following design is based on the findings of the preceding sections and assumptions made from literature and engineering judgment. A summary of design criteria follows.

### 6.1.1 Design Information

- The selected alternative for free-product removal is dual phase extraction by AFVR in conjunction with placement of absorbent socks in site monitoring wells. The selected alternative for groundwater remediation is groundwater extraction by pump and treat with discharge to the POTW.
- Groundwater remediation is required for TRPH and total lead.
- The free-product volume is estimated to be 5,700 gallons.
- Contaminated groundwater volume is estimated to be 3,948,318 gallons.
- A reduction of groundwater concentrations for the COCs below GCTLs is required.
- Liquids extracted during pump and treat operations will be pretreated with phase separation and discharged to the POTW.

### 6.1.2 Assumptions

- A reasonable and technically feasible goal for free-product recovery is six AFVR events.
- A maximum of 50 percent of the free product is recoverable.

## 6.2 TECHNOLOGY DESCRIPTION AND SYSTEM DESIGN

Major components of the selected remedial alternative will include the following:

- Pre-design engineering data
- Free-product recovery
- Groundwater remediation
- Remedial system O&M
- Remedial system termination criteria
- Site restoration

### 6.2.1 Collection of Engineering Design Data

An additional round of groundwater sampling and analysis will be performed in accordance with Chapter 62-770.700(3)(c), F.A.C., because the analyses in the SARA are more than 270 days old. A comprehensive sampling round is recommended for predesign evaluation of current site conditions.

### 6.2.2 General Requirements Prior to the Beginning of Construction Activities

- A utility clearance will be required.
- All operators must be certified to be in compliance with 29 *Code of Federal Regulations* 1910.120 health and safety requirements.
- The locations of the groundwater collection wells, the routes of the collection piping, and the limits of the pretreatment plant and related areas will be surveyed and staked in the field.
- The contractor will prepare all required planning documents, such as an Erosion and Sediment Control Plan, Health and Safety Plan, Removal Action Plan, and Waste Management Plan and also obtain all necessary permits.
- Erosion and sediment controls will be implemented prior to and during site activities.

### 6.2.3 Recovery System Description

The conceptual groundwater collection system will consist of ten 4-inch-diameter polyvinyl chloride extraction wells placed at depths from 15 to 25 feet. The locations of the wells will be field determined after evaluation of predesign groundwater analytical data. The wells will have 10-foot screen lengths positioned to intercept the water table.

The extracted fluid will be collected by a system of underground pipelines and transferred to an oil/water separator. All collection and manifold piping will be 2-inch- or 4-inch-diameter polyvinyl chloride Schedule 40 pipe. The collection piping trench backfill will be placed in 12-inch lifts and compacted to 90 percent Modified Proctor Density. The separated extracted groundwater will be transferred to the POTW. The collected free product will periodically be removed from the oil/water separator and disposed.

## 6.3 AFVR DESIGN

### 6.3.1 Design Specification

AFVR is a technology that is used for rapid recovery of free product and is often the most cost-effective approach for product recovery (NCDENR, 1998). AFVR uses a vacuum to recover both fluids (groundwater/free product) and vapor-phase hydrocarbons from monitoring/recovery wells. AFVR uses vacuum trucks that will generate high vacuum and airflow rates.

The application of AFVR for the site was chosen based on knowledge of site lithology and soil permeability and based on AFVR applications at other sites with similar soil conditions. Based on discussions with AFVR vendors and the use of this technology at other sites in Florida, it is expected that six AFVR events will remove free product from the site. AFVR guidance material indicates that each AFVR event should be performed for 8 to 12 hours, or until the vacuum truck is full.

The vacuum truck should meet the following specifications. These specifications are taken from the North Carolina Department of Environment and Natural Resources (NCDENR) guidance, due to the absence of FDEP guidance, and have been accepted by the FDEP at other sites:

- The vacuum truck tank should have a minimum storage capacity of 2,000 gallons.

- The vacuum tank should meet all requirements of Section VII Division 1 of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. Design pressure should be 25 pounds per square inch and registered with the National Board. The tank should be designed and constructed in full compliance with Department of Transportation (DOT) Specification DOT 407/DOT 412.

- The vacuum pump or blower shall be capable of running continuously for 8 to 12 hours without overheating.

- The pump or blower of the vacuum truck shall be capable of operating continuously at vacuum pressures between 24 and 27 inches of mercury (Hg) and the airflow at those vacuum pressures shall be at least 400 cfm (i.e., 400 cfm @ 24 inches of Hg). "Free Air" specifications shall not be accepted. High vacuum pressures increase recovery of hydrocarbons. High flow rates (cfm) will likely result in quicker recovery of free product and fewer site visits. Request pump curves for the vacuum truck (preferably from the pump manufacturer) to verify capacity.

- According to the American Petroleum Institute's (API) Publication 2219*, Safe Operating Guidelines for Vacuum Trucks in Petroleum Service* (1986), it is stated that "pneumatic-conveyor (blower) equipment operates on a high-airflow principle and is not suitable for hydrocarbon service." It is strongly recommended that the safety guidelines presented in the API Publication 2219 are followed. Examples of some of these safety measures include placing the exhaust stack downwind from the truck as far as practicable and ensuring that the gases do not accumulate in a confined space or in any area that has the potential for auto-ignition. It is also recommended that the exhaust stack be elevated to enhance the dispersion of emissions.

- Each AFVR event shall be conducted for an 8- to 12-hour period or until the vacuum truck tank is full of product and groundwater. The vacuum truck shall be equipped with a 4- or 6-inch-diameter recovery hose, which is connected to the recovery wells. The recovery wells should be a minimum of 4-inch-diameter wells specifically designed for free-product recovery. The 1- to 1.5-inch Stinger pipe with the inlet shall be placed inside each recovery well positioned approximately 12 inches below the static water level. The Stinger pipe shall then be sealed to the well head to prevent vacuum loss.

### 6.3.2 Treatment Recovered Liquids

All free product and water recovered from the location shall be stored in the tank of the vacuum truck. After completion of each event, the Subcontractor shall be responsible for disposing of the waste at an appropriate licensed location with prior approval from the Navy.

## 6.4 AFVR ACTIVITIES

The primary goal of AFVR is to rapidly remove free product from the groundwater and capillary fringe. The thickness of free product in each well will be measured before the initial recovery event. After the recovery event, the amount of free product will be measured. Recovery events shall continue if the free-product removal is determined to be effective. Based on free-product estimates, similar experience in Florida, and discussions with vendors, the number of recovery events is estimated at six or less. Free-

product thickness measurements and vapor measurements shall be obtained during AFVR activities. In general, the following apply.

- Because of high vacuum pressures, an actual increase in product thickness may occur after the first event. This is not unusual because the vacuum causes water, product, and air to the vacuum wells. Each AFVR event shall be performed as long as possible (8 or more hours per event) in order to maximize effectiveness.

- The radius of influence assumed for this RAP is 50 feet, but the water levels and vacuum pressures in nearby wells will determine this when measured during the first AFVR event. This information may also be useful for system optimization.

AFVR events require the following measurement and actions to be performed.

- When the AFVR truck arrives on-site, a safety check of all equipment shall be performed. The vacuum truck tank shall be inspected to verify that the tank is free of any residual petroleum.

- Prior to the AFVR event, free product and groundwater measurements shall be obtained from the proposed recovery wells and all other wells at the site.

- Install AFVR to recovery wells and begin operation.

- During the AFVR operation the parameters listed below shall be collected at 15-minute intervals for the first 2 hours, and at 30-minute intervals thereafter.

  - Vacuum pressures on blower or pump and on nearby wells (non-AFVR wells).
  - Water levels and free-product measurements at nearby wells (non-AFVR wells).
  - Use an Anemometer or Pitot Tube to collect air velocity rates from the center of the stack or discharge outlet.
  - Temperature from the stack or discharge outlet.
  - Use an OVA-FID to measure the TRPH concentrations (ppm) from the stack or discharge outlet and provide the inside diameter dimension of the stack. An FID that has a range of 0-10,000 ppm or an FID with a range of 0-100,000 ppm is an approved instrument for determining TRPH concentrations. Do not use a photoionization detector (PID). When

recovering high boiling point hydrocarbons (e.g., heating oil), expect low TRPH concentrations from the discharge stack of the truck.

- After the completion of the event, free product and groundwater measurements shall be collected from the AFVR wells, and the volume of free product recovered in the vacuum truck tank shall also be determined.

- Disconnect system and demobilize.

- Measure for the presence of free product in all wells 2 weeks after the AFVR event. If free product is present in wells at the site, schedule another AFVR event. If free product is not present in any well after the 2-week measurement, continue to measure for free product every 2 weeks until 2 months have passed since the day of the AFVR event. If no free product is present at this time, post-active remediation monitoring shall be implemented.

- The above measurements (velocity, temperature, TRPH concentrations, and diameter of stack) will be used to calculate a mass vapor-phase removal rate [pounds per hour (lb/hr)] by using the equations below. From the emission calculations, convert the units from pounds to gallons removed. To arrive at a total gallons removed, add the gallons (from emission calculation) to the total gallons of free product measured in the tank of the vacuum truck. All measurements and calculations for each event shall be incorporated into a "Free Product Recovery Status Letter." The equations necessary for the vapor-phase mass removal rates are:

<u>Equation to Determine Flow as Dry Standard Cubic Feet Per Minute (DSCFM):</u>

$B_{ws}$ = ($B_{wsw}$/18 lb-mole $H_2O$)/ [1/28.84 lb-mole dry air) + ($B_{wsw}$/18 lb-mole $H_2O$)]

$Q_{std}$ = (60 sec/min) (1-$B_{ws}$) (V) (A) (528 $R^o$ / $T_s$)

Where:

$Q_{std}$ = flow at DSCFM
$B_{wsw}$ = lb of water per lb of dry air (use high temperature psychrometric chart for air-water vapor mixtures in *Perry's Chemical Engineers' Handbook*, 1984)
$B_{ws}$ = water vapor % by volume
V = velocity in ft/sec [obtain with hot wire anemometer or pitot tube (use average value)]
A = cross sectional area of discharge stack in sq. ft. at sampling location
$T_s$ = stack temperature in degrees Rankin ($R^o$), $R^o$ = degrees Fahrenheit ($F^o$) + 460 (use average value)

Equations to determine Vapor Phase Mass Removal rate ($PMR_h$):

$ppm_w = ppm_{measured}$

$ppm_d = (ppm_w) / (1-B_{ws})$

$ppm_c = (ppm_d) (K)$

$C_{c:m} = ppm_c (M_c/K_3)$

$C_c = C_{c:m} (62.43x10^{-9}$ lb-$m^3$/mg-$ft^3$)

$PMR_c = C_c$ (Qstd) (60 min/hr)

$PMR_h = (PMR_c) (M_h/M_{ch})$

Where:

$ppm_w$ = "wet" concentration

$ppm_{measured}$ = obtained directly from OVA (use average value)

$ppm_d$ = "dry" concentration

K = number of carbons in calibration gas (methane K=1, propane K=3, hexane K=6)

$ppm_c = ppm_v$, volumetric concentration of VOC emissions as carbon, dry basis, at standard temperature and pressure (STP)

$C_{c:m}$ = mg/$dsm^3$, mass concentration of VOC emissions as carbon

$M_c$ = 12.01 mg/mg-mole, molecular weight of carbon

$K_3$ = 24.07 $dsm^3/10^6$ mg-mole, mass to volume conversion factor at STP

$C_c$ = lb/dscf, mass concentration of VOC emissions as carbon, dry basis, at STP

$PMR_c$ = lb/hr, pollutant mass removal rate of VOCs as carbon

$PMR_h$ = lg/hr, pollutant mass removal rate of VOCs as heating oil

$M_h$ = mg/mg-mole, molecular weight of heating oil

$M_{ch}$ = mg/mg-mole, weight of carbon in heating oil molecule

## 6.5 ABSORBENT SOCKS

Absorbent socks are simple skimming devices that are suspended in the well across the surface of the free-product layer. Attached material absorbs free product from the water surface and must be periodically removed and disposed.

The primary goal of the absorbent socks is to recover free product from those wells where product thickness is relatively low. Absorbent socks will be placed in monitoring wells that have historically contained measurable free product (MW-2, MW-8, MW-11, MW-12, MW-19, MW-30 through MW-34, and MW-36).

## 6.6 GROUNDWATER REMEDIATION

A phased approach will be used for site remediation. The first phase will consist of free-product recovery. Because groundwater will be co-extracted as a by-product during free-product recovery, some groundwater remediation will be accomplished in the first phase. In the second phase, following the termination of free-product recovery, natural attenuation as a groundwater remediation option will be re-assessed according to data collected during and following free-product recovery. If natural attenuation is still not a viable option, the free-product recovery system will be converted to a groundwater pump and treat system. The pump and treat system will be operated until the site data demonstrate that natural attenuation is a viable remedial option.

In an effort to decrease active remediation time, select wells outside the horizontal extent of the free-product layer will be included to extract groundwater from areas of high lead concentrations for treatment during the first phase of site remediation. Submersible pumps will be used to extract groundwater from these wells. Extraction rates from these wells will be low to prevent their influence on the adjacent free-product layer.

## 6.7 ROUTINE REMEDIAL SYSTEM OPERATION AND MAINTENANCE

The proposed remedial system is designed to operate continually and automatically with minimal maintenance. Site visits for system inspection and maintenance will be performed by a trained and qualified technician in conjunction with regularly scheduled sampling events. The following inspection and maintenance items are scheduled to be performed daily for the first week and biweekly thereafter.

- Inspect system area for signs of trespassing/tampering, weather damage, deterioration, unusual noises, temperature, fire extinguisher charge, and general cleanliness.
- Inspect all signs and markings for condition and legibility.
- Inspect extraction wells and measure flow.
- Inspect and replace any gauge, valve, or sensor found to be leaking or inoperable.
- Inspect oil/water separator and remove and dispose of accumulated free product. Record volume of free product recovered.
- Record run time meter readings, groundwater discharge flow rate, and total gallons of water discharged.
- Log all inspection activities and repairs performed.

## 6.8 REMEDIAL SYSTEM TERMINATION CRITERIA

Groundwater pump and treat will terminate when site contaminant concentrations meet the natural attenuation criteria in Chapter 62-770.690 F.A.C. Natural attenuation monitoring will then be performed according to Chapter 62-770-690(7) F.A.C.

## 6.9 SITE RESTORATION

Following completion of remediation, the extraction wells will be abandoned, the collection piping removed, the oil/water separator salvaged, and site utilities capped or removed.

# 7.0 MONITORING PLAN AND PROJECT CLOSEOUT

The Monitoring Plan contains procedures for system implementation, routine O&M between AFVR events, and final reporting and monitoring after the completion.

## 7.1 MONITORING FREE-PRODUCT REMEDIATION PROGRESS

The performance monitoring program will be evaluated after each AFVR event and will be modified as necessary to maximize the effectiveness of the remediation. During AFVR events, three phases of petroleum will be removed: the free product, the dissolved phase contained in the groundwater, and the vapor phase, which is discharged in the exhaust. The following monitoring requirements will be performed during each AFVR event.

- Hydrocarbon mass. The mass rate of hydrocarbons removed by the AFVR system in comparison with the estimated mass present.

- Free product in recovery wells. The free-product thickness will be measured immediately after the AFVR event and again 2 weeks later. If free product is present at that time, the next AFVR event shall be scheduled. The AFVR events shall be scheduled at an interval to allow for free-product monitoring after 2 weeks and to allow submission of status reports, to determine if an additional AFVR event is necessary.

- Free product and groundwater elevations. The thickness of free product and water and product elevations will be measured in all monitoring wells. The absorbent socks will be removed, inspected, and replaced as necessary. Water and free-product measurements will be taken every 2 weeks during active remediation.

- Free-product skimming. Free-product skimming using absorbent socks should be continued until it is no longer recovering significant amounts of hydrocarbons (e.g., less than 2 gallons per month).

- Free-product thickness trend. If the trend in free-product thickness indicates the technology is effective in remediating the area, the additional events shall be performed. If after the second AFVR event the AFVR events are determined to be unsuccessful, then the AFVR events shall be discontinued and modification or an alternate approach shall be considered.

Monitoring data will be used to determine if the objectives of the RAP and standards of the design criteria are being met (i.e., free-product thickness is less than 0.01 foot). After each AFVR event a brief status letter shall be submitted providing the information stated in Section 6.0 and recommendations. The status letters are discussed in further detail in subsection 7.5. The remediation will be modified if the monitoring data indicate that the cleanup goals can be met earlier or cannot be met in the time frame as specified in the RAP. Modifications of the remedial action will be based on the site-specific monitoring data.

## 7.2 FREE-PRODUCT REMEDIATION COMPLETION

If the AFVR events are successful in removing the free product from the site to less than 0.01 foot, and absorbent socks are no longer skimming a significant amount of product, then the socks will be removed from the wells and the post-active remediation monitoring in Chapter 62-770.750, F.A.C. shall be implemented. Water level and free-product thickness will continue to be measured quarterly for 12 months following the suspension of active remediation. A threshold level of hydrocarbon thickness of 0.1 foot will be used as an action level to restart free-product recovery.

## 7.3 MONITORING GROUNDWATER REMEDIATION PROGRESS

A system- and site-monitoring program will be initiated upon approval of this RAP and subsequent to the completion of remedial activities. The monitoring plan has the following three main objectives:

- Monitor the overall effectiveness of remedial activities in reducing free-product volume and groundwater contaminant concentrations.
- Verify that the contaminant plumes have not migrated beyond current boundaries.
- Comply with Chapter 62-770, F.A.C.

## 7.4 SYSTEM AND SITE MONITORING

The final selection of monitoring wells will be based on pre-design and construction data. Initial system start-up and testing will incorporate the requirements below, but will be performed daily for the first 3 days with a 24-hour analysis turnaround, then monthly for 2 months, quarterly for the first year, and semiannually thereafter.

- The groundwater collection system's 10 extraction wells will be monitored on a quarterly basis for groundwater elevation and extraction rates.

- Measurements of groundwater levels in the groundwater extraction wells and selected monitoring wells will determine groundwater flow on a quarterly basis.

- Sampling and laboratory testing of groundwater from groundwater extraction wells and selected monitoring wells (to document remediation progress) will be performed quarterly for the first 2 years and semiannually thereafter. Groundwater analysis will be determined based on the results of the initial comprehensive groundwater sampling events. However, unless site contaminant concentrations change significantly from available data, the following is expected to be required. Groundwater samples will be analyzed for gasoline and kerosene range hydrocarbons, TRPH, and total lead. Dissolved oxygen (DO), oxygen reduction potential (ORP), pH, temperature, conductivity, and turbidity will also be measured. Preliminary analyses will include total suspended solids, total dissolved solids, iron, and hardness. It is recommended that the initial comprehensive groundwater monitoring event include natural attenuation parameters to determine a baseline for future comparison once monitored natural attenuation is implemented.

- Samples will be collected from selected groundwater monitoring wells for natural attenuation parameters. These samples will be analyzed for DO, ORP, nitrate, sulfate, methane, and ferrous iron, and any other constituents required for the natural attenuation evaluation.

- Additional monitoring and analyses will be performed as needed for system optimization.

If COCs do not exceed the background concentrations or the applicable GCTLs in samples from the groundwater extraction wells or monitoring wells for three consecutive quarters, these wells may be excluded from subsequent monitoring events, per Chapter 62-770.700(3)4(h), F.A.C. The requirements of the proposed monitoring plan are summarized in Table 7-1.

**TABLE 7-1**

**GROUNDWATER REMEDIAL ACTION MONITORING SUMMARY**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| Monitoring/Sample Location | Parameters | Frequency/Reporting |
|---|---|---|
| Groundwater monitoring for natural attenuation | $NO_3$, $SO_4$, $CH_4$, and $Fe^{2+}$ | Pre-design and following active remediation |
| Direct push saturated soil testing | D, $K_{OC}$, and foc | Pre-design |
| Oil/water Separator | Production quantities | Monthly[1] |
| Monitoring wells (active remediation field measurements) | Water levels, pH, conductivity, turbidity, DO, ORP, and temperature | Quarterly |
| Monitoring wells and groundwater extraction wells | Gasoline and kerosene range hydrocarbons, TRPH, and total lead<br>Water level and flow rate | Quarterly |
| Monitoring wells (post-active remediation) | Gasoline and kerosene range hydrocarbons, TRPH, and total Lead | Quarterly for one year, then semiannually |

$CH_4$ - Methane
D - Density
$Fe^2$+ - Ferrous iron
foc - Fraction organic compound
$K_{OC}$ - Partition coefficient
$NO_3$ - Nitrate
$SO_4$ - Sulfate
TDS - Total dissolved solids
TSS - Total suspended solids

Notes:
[1] – Monthly for 2 months and then quarterly

## 7.5 STATUS LETTERS

A summary of remedial activities and groundwater monitoring activities will be submitted quarterly, as is required in Chapter 62-770.700 (12) F.A.C. The first status report will also include system "As Built" drawings and start-up and testing results. Status reports will include requests and/or documentation for revisions to the remedial goals, system modifications, operation variances, or problems encountered with implemented solutions, per Chapter 62-770.700 (13), (14), and (15), F.A.C. Status/monitoring reports will summarize all remedial and monitoring activities and contain at least the following information:

For AFVR events:

- AFVR application date.
- Estimated volume of free product recovered.
- Hydrocarbon constituent concentrations in recovered vapors.
- Cumulative mass of hydrocarbon removed by the AFVR system.

- Free-product measurements in recovery and monitoring wells before and after AFVR event.
- Summary of system operational data.
- Summary of condition, replacement, and/or disposal of absorbent socks.
- Conclusions as to the effectiveness of the AFVR event, and recommendations for further monitoring and operation.

For groundwater remediation system:

- Start-up date,
- Total volume of groundwater extracted and disposed,
- Discharge and disposal analytical results,
- Copies of all waste manifests,
- System downtimes percentage and evaluation of efficiency for all operating components,
- All other sampling, testing, and analytical results,
- A figure showing free-product extent,
- A figure indicating the locations of all existing monitoring wells,
- A figure showing groundwater contour and contaminant maps,
- Conclusions as to the effectiveness of the remedial activities, prediction of time required for complete remediation, and recommendations on future monitoring and operations of the system.

### 7.5.1 Request to Discontinue Active Remediation

A request to discontinue active remediation will be prepared and submitted once site conditions warrant at any time during the remedial activities at Site 20. Submittals will be made for termination of free-product recovery, groundwater pump and treat, and natural attenuation monitoring, according to Chapter 62-770.700(15) and (16), F.A.C.

### 7.5.2 Post-Remedial Action Monitoring Plan

Following approval for discontinuation of active remediation, a Post-Remedial Action Monitoring Plan will be prepared and submitted. Groundwater monitoring will continue on a quarterly basis until COCs fall to predicted natural attenuation concentrations. Monitoring for natural attenuation will then proceed in selected wells on an annual basis. Status reports will be submitted, as applicable.

# REFERENCES

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# APPENDIX A

# FREE-PRODUCT VOLUME CALCULATIONS

**TABLE A-1**

**ESTIMATING THICKNESS AND VOLUME OF FREE PRODUCT**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

Method of de Pastrovich (1979)

$$H_f = \frac{H_o(\rho_w - \rho_o)}{\rho_o}$$

Where:
$H_f$ = thickness of mobile hydrocarbon in the adjacent formation
$H_o$ = hydrocarbon thickness measured in well
$\rho_\omega$ = the density of water
$\rho_o$ = the density of the liquid hydrocarbon

| | | | | | |
|---|---|---|---|---|---|
| $H_o$ = | 18.26 | cm | ( 0.60 ) | ft | (TtNUS 2001) |
| $\rho_\omega$ = | 1 | gm/cm$^3$ | | | |
| $\rho_o$ = | 0.923 | gm/cm$^3$ | | | |
| $H_f$ = | 1.52 | cm | ( 0.05 ) | ft | |

Assumptions:
1. Density of Bunker C = 0.923 gm/cm$^3$ (USEPA 1996)
2. Product measured = average of 11 wells (TtNUS 2001)

This method depends only upon the density of the liquid hydrocarbon relative to the density of water. For a hydrocarbon liquid with a density of 0.8, and assuming that the density of water is equal to 1, the hydrocarbon thickness in the formation (the actual thickness) is only one-fourth the thickness measured in the well (the apparent thickness). The principal weakness of this method is that it does not account for the effects of different soil types. In general, the ratio of apparent to true free product thickness increases as soil grain size decreases. Thus, this method may be more accurate in finer grained soil (e.g., silt, clay) than coarser-grained soil (e.g., sand, loam).

**Estimated Volume of Total Free Product in Subsurface**

Assumptions:

| | | | | |
|---|---|---|---|---|
| Estimated area of free product | = | 102,000 | ft$^2$ | (TtNUS 2001) |
| Actual thickness of product | = | 0.05 | ft | |
| Effective porosity | = | 0.15 | | (TtNUS 2001) |

Volume of product area = area x thickness

102,000 ft$^2$ x 0.05 ft = 5,098 ft$^3$

Note: In the absence of site specific data, effective porosity is more appropriate for use than total porosity.

Free product volume = volume of product area x effective porosity
5,098 ft$^3$ x 0.15 = 765 ft$^3$

Gallons of free product = free product volume x 7.4794 gallons/ft$^3$
765 ft$^3$ x 7.4794 gallons/ft$^3$ = **5,719** gallons

**Total volume of free product in subsurface = 5,719 gallons**

Prepared By: Cliff Blanchard
Date: 11/07/01

Checked By: PKJ
Date: 9/27/02

Approved By: MFA
Date: 9/27/02

# APPENDIX B

# GROUNDWATER CALCULATIONS

**TABLE B-1**

**ESTIMATED MASS OF DISSOLVED CONTAMINANTS IN SATURATED ZONE**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

| | Mass of Soluble Contaminants | | | | | |
|---|---|---|---|---|---|---|
| **Well Number** | **Acenaphthene (ug/L)** | **1-Methylnaphthalene (ug/L)** | **2-Methylnaphthalene (ug/L)** | **Naphthalene (ug/L)** | **Lead (ug/L)** | **TRPH (ug/L)** |
| **SAR** | | | | | | |
| MW-3 | 23 | -- | -- | -- | 4 | -- |
| MW-4 | -- | 540 | 580 | 330 | 31 | 54000 |
| MW-5 | -- | -- | -- | -- | 41 | -- |
| MW-13 | -- | -- | -- | -- | 22 | -- |
| MW-16 | 6 | 4 | 3 | -- | -- | 660 |
| MW-17 | 4 | 54 | 42 | -- | -- | 42000 |
| MW-21 | 67 | 11 | 7 | -- | -- | 330 |
| MW-39 | -- | -- | -- | -- | 144 | -- |
| MW-42 | 27 | 6 | -- | -- | -- | 970 |
| MW-43 | 49 | 6 | -- | -- | -- | -- |
| MW-44 | 22 | -- | -- | -- | -- | -- |
| MW-45 | -- | -- | -- | -- | 62 | -- |
| MW-49 | 69 | 17 | -- | -- | -- | 360 |
| MW-52 | -- | -- | -- | -- | -- | 14000 |
| MW-56 | 15 | 3 | -- | 2 | 20 | -- |
| **SARA** | | | | | | |
| MW-18 | 10.5 | 6.6 | 4.3 | -- | -- | 10900 |
| MW-37 | 44.1 | -- | -- | -- | -- | 1450 |
| MW-46 | -- | -- | -- | -- | 115 | 250 |
| MW-48 | 67.7 | 13 | 3.8 | -- | -- | -- |
| **Average Dissolved Contaminant Concentration (ug/L)** | 21.28 | 34.77 | 33.69 | 17.47 | 23.11 | 6574.74 |
| **Estimated Mass of Dissolved Contaminants (lbs)** | 0.70 | 1.15 | 1.11 | 0.58 | 0.76 | 216.66 |
| **Estimated Mass of Dissolved Contaminants (kg)** | **0.32** | **0.52** | **0.50** | **0.26** | **0.35** | **98.48** |

**Estimated GW Volume:**

pacted Area x Thickness x Total Porosity (n) = (153,000 $ft^2$)*(11.5 ft)*(0.30)*(7.48 $gal/ft^3$) = 3,948,318 gallons

**Estimated Mass of Soluble Contaminants:**

$M_{dissolved}$ (lbs) = $C_{dissolved}$ (ug/L) * $V_{gw}$ (gal) * 3.7854 (L/gal) * 2.205E-9 (lb/ug)

where: $M_{dissolved}$ = mass of dissolved contaminants (lbs)

$C_{dissolved}$ = average dissolved contaminant concentration (ug/L)

$V_{gw}$ = volume of impacted groundwater (gal)

Prepared By: Clifton Blanchard CB Date: 11/07/01

Checked By: PKJ Date: 9/27/02

Approved By: MEA Date: 9/27/02

# TABLE B-2

## MASS OF ADSORBED CONTAMINANTS CALCULATIONS

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

1. Concentration of Contaminants Adsorbed to Soil: C(soil) = C(dissolved) x Kd

where: C(soil) = contaminant concentration in soil (mg/kg)
C(dissolved) = average dissolved contaminant concentration (mg/L)
Kd = solid/liquid distribution coefficient (l/kg)

2. For organics: Kd = Koc x foc

where: Koc = organic carbon/water partition coefficient (l/kg) (from Mullens & Rogers, AICE 1993)
foc = fractional organic carbon content (0.5 % by weight for typical sand) (from EPA 440/5-89-002)

| | Acenaphthene | Naphthalene | 1-Methlynaphthalene | 2-Methlynaphthalene | Lead | TPH |
|---|---|---|---|---|---|---|
| Koc (l/kg): | 2580 | 2000 | 2660 | 7500 | 900 | 1580 |
| foc (kg/kg): | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| **Kd (l/kg) =** | **12.90** | **10.00** | **13.30** | **37.50** | **4.50** | **7.90** |

| | | | | | | |
|---|---|---|---|---|---|---|
| C(dissolved) (mg/L): | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 6.57 |
| Kd (l/kg): | 12.90 | 10.00 | 13.30 | 37.50 | 4.50 | 7.90 |
| **C(adsorbed) (mg/kg) =** | **0.27** | **0.35** | **0.45** | **0.66** | **0.10** | **51.94** |

3. Estimate of Contaminated Mass in Saturated Zone: M(soil) = Impacted Area x Impacted Thickness = (153,000 ft)(11.5 ft)(1.0 $yd^3/27\ ft^3$)(1.55 tons/$yd^3$)(907.2 kg/ton) = **9.18E+07 kg**

4. Estimated Mass of Contaminants Adsorbed to Soil in the Saturated Zone: M(adsorbed)(lbs) = C(soil)(mg/kg) x M(soil)(kg) x 2.205E-6 (lb/mg)

| | | | | | | |
|---|---|---|---|---|---|---|
| C(soil) (mg/kg): | 0.27450 | 0.347684 | 0.448 | 0.655 | 0.104 | 52 |
| M(soil): | 9.18E+07 | 9.18E+07 | 9.18E+07 | 9.18E+07 | 9.18E+07 | 9.18E+07 |
| **M(adsorbed) (lbs) =** | **55.55** | **70.36** | **90.68** | **132.61** | **21.04** | **10,512** |
| **M(adsorbed) (kg) =** | **25.25** | **31.98** | **41.22** | **60.28** | **9.56** | **4,778** |

**Estimated Total Mass of Adsorbed Contaminants Based on TRPH Concentration = 10,512 lbs**

**TOTAL ESTIMATED MASS OF HYDROCARBONS IN SATURATED ZONE (LBS) = ADSORBED MASS + DISSOLVED MASS = 10,728 lbs**

**Prepared by:** Clifton Blanchard CFB 11/07/01
Date

**Checked by:** PKJ 9/27/02
Date

**Approved by:** MFA 9/27/02
Date

# TABLE B-3

## GROUNDWATER PUMP AND TREAT CAPTURE ZONE

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

**Site Information**

| | |
|---|---|
| **Site:** | Site 20 |
| **Location:** | Pensacola, Flordia |
| **Client:** | NAVY |
| **Project #** | N0401.0000.FL0160205 |

| **Well Information** | **Units** | **Value** |
|---|---|---|
| Extraction Well Numbers | | EW-1 through EW-10 |
| Static Water Level Depth | ft | 6 |
| Top of Filter Screen Depth | ft | 3 |
| Bottom of Filter Screen Depth | ft | 13 |
| Outside Diameter of Well | in | 4 |
| Open Area of Screen | in2/ft | 11.3 |
| **Modeling Data** | | |
| Pumping Rate | gpm | 0.5 |
| Drawdown in Well | ft | 1.3 |
| Additional Depth of Influence | ft | 4.5 |
| Hydraulic Conductivity (K) | cm/sec | 9.52E-03 |
| Regional Hydraulic Gradient (i) | ft/ft | 5.20E-04 |
| **Aquifer Transmissivity** | | |
| Screen Depth below Water Table | ft | 7 |
| Total Aquifer Thickness Contributing to | ft | 11.5 |
| Well Flow (b) | m | 3.5 |
| Hydraulic Conductivity (K) | gpd/ft2 | 202 |
| Aquifer Transmissivity (T = Kb) | m2/sec | 3.32E-04 |
| | gpd/ft | 2,321 |
| **Flow Velocity** | | |
| Submerged Screen Length while Pumping | ft | 5.7 |
| Flow Velocity through Screen (must be < 0.1 ft/second) | ft/sec | 0.002 |
| **Capture Zone** | | |
| Distance from Well to Dividing Streamline Downgradient (A = Q/(2*3.141*T*i)) | ft | 95 |
| Distance from Well to Dividing Streamline Perpendicular to Regional Groundwater Flow (B = Q/(4*T*i)) | ft | 149 |
| Distance from Capture Zone Axis to Dividing Streamline Far Upgradient (C = Q/(2*T*i)) | ft | 298 |

Prepared By: Clifton Blanchard CFB 11/07/01
Date

Checked By: PKJ 9/27/02
Date

Approved By: FFA 9/27/02
Date

**TABLE B-4**

**ESTIMATED REMEDIAL TIME**
**GROUNDWATER PUMP AND TREAT**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**



| **Plume Description** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Plume Location | | Shallow | | | | | |
| | Surface Area of Plume (sq ft) | | 153,000 | | | | | |
| | Average Plume Thickness (ft) | | 11.5 | | | | | |
| | Total Porosity | | 0.30 | | | | | |
| | Plume Volume (gal. of water) | | 3,948,318 | | | | | |
| **Groundwater Effective Flow Rates** | | | | | | | | |
| Compound | Pumping Rate (Q) | Retardation Coefficient | Initial Ave.GW Concentration ($C_o$) | Effective Flow Rate ($Q_e$) | Residence Time ($T_r$) | | | |
| | gpm | | ug/L | gpd | day | | | |
| Acenaphthene | 5 | 13.90 | 21 | 518 | 7,622 | | | |
| Naphthalene | 5 | 11.00 | 35 | 655 | 6,032 | | | |
| 1-Metlynaphthalene | 5 | 14.30 | 34 | 503 | 7,842 | | | |
| 2-Metlynaphthalene | 5 | 38.50 | 17 | 187 | 21,113 | | | |
| Lead | 5 | 5.50 | 23 | 1309 | 3,016 | | | |
| TRPH | 5 | 8.90 | 6575 | 809 | 4,881 | | | |

Notes:
The retardation coefficient is calculated using the concentration distributions calculated on **Tables B-1 and B-2**.
The retardation coefficient is determined by the following equation: R = [1 + adsorbed concentration / dissolved concentration] (Remediation Engineering, Sutherson, 1997)
The concentrations shown below are based on the continuous flow mixed tank equation [C=Co*e^(-t/Tr)]. Concentrations shown below are ug/L.
$Q_e = Q/R$
$T_r$ = Plume Volume/$Q_e$
gpm = gallons per minute
gpd = gallons per day
ppb = parts per billion
MG = million gallons

**Contaminant Concentration Decline During Remediation**

| **Time After Start of Remediation** | **Contaminant Concentration at End of Period** | | | | | | **Total Extracted Volume** | **Treatment Completed** |
|---|---|---|---|---|---|---|---|---|
| t (months) | Acenaphthene | Naphthalene | 1-Metlynaphthalene | 2-Metlynaphthalene | Lead | TRPH | MG | |
| 0 | 21 | 35 | 34 | 17 | 23 | 6575 | 0.22 | |
| 1 | 21 | 35 | 34 | 17 | 23 | 6534 | 0.44 | |
| 2 | 21 | 34 | 33 | 17 | 23 | 6493 | 0.66 | |
| 3 | 21 | 34 | 33 | 17 | 22 | 6453 | 0.88 | |
| 4 | 21 | 34 | 33 | 17 | 22 | 6413 | 1.10 | |
| 5 | 21 | 34 | 33 | 17 | 22 | 6373 | 1.31 | |
| 6 | 21 | 34 | 33 | 17 | 22 | 6333 | 1.53 | |
| 7 | 21 | 34 | 33 | 17 | 22 | 6294 | 1.75 | |
| 8 | 21 | 33 | 33 | 17 | 21 | 6255 | 1.97 | |
| 9 | 21 | 33 | 33 | 17 | 21 | 6216 | 2.19 | |
| 10 | 20 | 33 | 32 | 17 | 21 | 6177 | 2.41 | |
| 11 | 20 | 33 | 32 | 17 | 21 | 6139 | 2.63 | |
| 12 | 20 | 33 | 32 | 17 | 20 | 6101 | 2.85 | |
| 13 | 20 | 33 | 32 | 17 | 20 | 6063 | 3.07 | |
| 14 | 20 | 32 | 32 | 17 | 20 | 6025 | 3.29 | |
| 15 | 20 | 32 | 32 | 17 | 20 | 5988 | 3.50 | |
| 16 | 20 | 32 | 32 | 17 | 20 | 5951 | 3.72 | |
| 17 | 20 | 32 | 32 | 17 | 19 | 5914 | 3.94 | |
| 18 | 20 | 32 | 31 | 17 | 19 | 5877 | 4.16 | |
| 19 | 20 | 32 | 31 | 17 | 19 | 5841 | 4.38 | |
| 20 | 20 | 31 | 31 | 17 | 19 | 5804 | 4.60 | |
| 21 | 20 | 31 | 31 | 17 | 19 | 5768 | 4.82 | |
| 22 | 19 | 31 | 31 | 17 | 19 | 5732 | 5.04 | |
| 23 | 19 | 31 | 31 | 17 | 18 | 5697 | 5.26 | |
| 24 | 19 | 31 | 31 | 17 | 18 | 5661 | 5.48 | |
| 25 | 19 | 31 | 31 | 17 | 18 | 5626 | 5.69 | |
| 26 | 19 | 30 | 30 | 17 | 18 | 5591 | 5.91 | |
| 27 | 19 | 30 | 30 | 17 | 18 | 5556 | 6.13 | |
| 28 | 19 | 30 | 30 | 17 | 17 | 5522 | 6.35 | |
| 29 | 19 | 30 | 30 | 17 | 17 | 5488 | 6.57 | |
| 30 | 19 | 30 | 30 | 17 | 17 | 5454 | 6.79 | |
| 31 | 19 | 30 | 30 | 17 | 17 | 5420 | 7.01 | |
| 32 | 19 | 30 | 30 | 17 | 17 | 5386 | 7.23 | |
| 33 | 19 | 29 | 30 | 17 | 17 | 5353 | 7.45 | |
| 34 | 19 | 29 | 30 | 17 | 16 | 5319 | 7.67 | |
| 35 | 19 | 29 | 29 | 17 | 16 | 5286 | 7.88 | |
| 36 | 18 | 29 | 29 | 17 | 16 | 5253 | 8.10 | |
| 37 | 19 | 29 | 29 | 17 | 16 | 5221 | 8.32 | |
| 38 | 18 | 29 | 29 | 17 | 16 | 5188 | 8.54 | |
| 39 | 18 | 29 | 29 | 17 | 16 | 5156 | 8.76 | |
| 40 | 18 | 28 | 29 | 16 | 15 | 5124 | 8.98 | |
| 41 | 18 | 28 | 29 | 16 | 15 | 5092 | 9.20 | |
| 42 | 18 | 28 | 29 | 16 | 15 | 5061 | 9.42 | |
| 43 | 18 | 28 | 29 | 16 | 15 | 5029 | 9.64 | |
| 44 | 18 | 28 | 28 | 16 | 15 | 4998 | 9.86 | |
| 45 | 18 | 28 | 28 | 16 | 15 | 4967 | 10.07 | |

**TABLE B-4**

**ESTIMATED REMEDIAL TIME**
**GROUNDWATER PUMP AND TREAT**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**



| Time After Start of Remediation | Contaminant Concentration at End of Period | | | | | | Total Extracted Volume | Treatment Completed |
|---|---|---|---|---|---|---|---|---|
| t (months) | Acenaphthene | Naphthalene | 1-Metlynaphthalene | 2-Metlynaphthalene | Lead | TRPH | MG[1] | |
| 46 | 18 | 28 | 28 | 16 | 15 | 4936 | 10.29 | |
| 47 | 18 | 27 | 28 | 16 | 14 | 4905 | 10.51 | |
| 48 | 18 | 27 | 28 | 16 | 14 | 4875 | 10.73 | |
| 49 | 17 | 27 | 28 | 16 | 14 | 4845 | 10.95 | |
| 50 | 17 | 27 | 28 | 16 | 14 | 4814 | 11.17 | |
| 51 | 17 | 27 | 28 | 16 | 14 | 4785 | 11.39 | |
| 52 | 17 | 27 | 28 | 16 | 14 | 4755 | 11.61 | |
| 53 | 17 | 27 | 27 | 16 | 14 | 4725 | 11.83 | |
| 54 | 17 | 26 | 27 | 16 | 13 | 4696 | 12.05 | |
| 55 | 17 | 26 | 27 | 16 | 13 | 4667 | 12.26 | |
| 56 | 17 | 26 | 27 | 16 | 13 | 4638 | 12.48 | |
| 57 | 17 | 26 | 27 | 16 | 13 | 4609 | 12.70 | |
| 58 | 17 | 26 | 27 | 16 | 13 | 4580 | 12.92 | |
| 59 | 17 | 26 | 27 | 16 | 13 | 4552 | 13.14 | |
| 60 | 17 | 26 | 27 | 16 | 13 | 4524 | 13.36 | |
| 61 | 17 | 26 | 27 | 16 | 12 | 4495 | 13.58 | |
| 62 | 17 | 25 | 26 | 16 | 12 | 4468 | 13.80 | |
| 63 | 17 | 25 | 26 | 16 | 12 | 4440 | 14.02 | |
| 64 | 16 | 25 | 26 | 16 | 12 | 4412 | 14.24 | |
| 65 | 16 | 25 | 26 | 16 | 12 | 4385 | 14.45 | |
| 66 | 16 | 25 | 26 | 16 | 12 | 4358 | 14.67 | |
| 67 | 16 | 25 | 26 | 16 | 12 | 4330 | 14.89 | |
| 68 | 16 | 25 | 26 | 16 | 12 | 4304 | 15.11 | |
| 69 | 16 | 25 | 26 | 16 | 12 | 4277 | 15.33 | |
| 70 | 16 | 24 | 26 | 16 | 11 | 4250 | 15.55 | |
| 71 | 16 | 24 | 26 | 16 | 11 | 4224 | 15.77 | |
| 72 | 16 | 24 | 25 | 16 | 11 | 4198 | 15.99 | |
| 73 | 16 | 24 | 25 | 16 | 11 | 4172 | 16.21 | |
| 74 | 16 | 24 | 25 | 16 | 11 | 4146 | 16.43 | |
| 75 | 16 | 24 | 25 | 16 | 11 | 4120 | 16.64 | |
| 76 | 16 | 24 | 25 | 16 | 11 | 4094 | 16.86 | |
| 77 | 16 | 24 | 25 | 16 | 11 | 4069 | 17.08 | |
| 78 | 16 | 23 | 25 | 16 | 11 | 4044 | 17.30 | |
| 79 | 16 | 23 | 25 | 16 | 10 | 4018 | 17.52 | |
| 80 | 15 | 23 | 25 | 16 | 10 | 3993 | 17.74 | |
| 81 | 15 | 23 | 25 | 16 | 10 | 3969 | 17.96 | |
| 82 | 15 | 23 | 25 | 16 | 10 | 3944 | 18.18 | |
| 83 | 15 | 23 | 24 | 16 | 10 | 3919 | 18.40 | |
| 84 | 15 | 23 | 24 | 15 | 10 | 3895 | 18.62 | |
| 85 | 15 | 23 | 24 | 15 | 10 | 3871 | 18.83 | |
| 86 | 15 | 23 | 24 | 15 | 10 | 3847 | 19.05 | |
| 87 | 15 | 22 | 24 | 15 | 10 | 3823 | 19.27 | |
| 88 | 15 | 22 | 24 | 15 | 10 | 3799 | 19.49 | |
| 89 | 15 | 22 | 24 | 15 | 9 | 3776 | 19.71 | |
| 90 | 15 | 22 | 24 | 15 | 9 | 3752 | 19.93 | |
| 91 | 15 | 22 | 24 | 15 | 9 | 3729 | 20.15 | |
| 92 | 15 | 22 | 24 | 15 | 9 | 3706 | 20.37 | |
| 93 | 15 | 22 | 23 | 15 | 9 | 3683 | 20.59 | |
| 94 | 15 | 22 | 23 | 15 | 9 | 3660 | 20.81 | |
| 95 | 15 | 22 | 23 | 15 | 9 | 3637 | 21.02 | |
| 96 | 15 | 21 | 23 | 15 | 9 | 3614 | 21.24 | |
| 97 | 14 | 21 | 23 | 15 | 9 | 3592 | 21.46 | |
| 98 | 14 | 21 | 23 | 15 | 9 | 3570 | 21.68 | |
| 99 | 14 | 21 | 23 | 15 | 9 | 3547 | 21.90 | |
| 100 | 14 | 21 | 23 | 15 | 8 | 3525 | 22.12 | |
| 101 | 14 | 21 | 23 | 15 | 8 | 3504 | 22.34 | |
| 102 | 14 | 21 | 23 | 15 | 8 | 3482 | 22.56 | |
| 103 | 14 | 21 | 23 | 15 | 8 | 3460 | 22.78 | |
| 104 | 14 | 21 | 23 | 15 | 8 | 3439 | 23.00 | |
| 105 | 14 | 20 | 22 | 15 | 8 | 3417 | 23.21 | |
| 106 | 14 | 20 | 22 | 15 | 8 | 3396 | 23.43 | |
| 107 | 14 | 20 | 22 | 15 | 8 | 3375 | 23.65 | |
| 108 | 14 | 20 | 22 | 15 | 8 | 3354 | 23.87 | |
| 109 | 14 | 20 | 22 | 15 | 8 | 3333 | 24.09 | |
| 110 | 14 | 20 | 22 | 15 | 8 | 3312 | 24.31 | |
| 111 | 14 | 20 | 22 | 15 | 8 | 3292 | 24.53 | |
| 112 | 14 | 20 | 22 | 15 | 7 | 3271 | 24.75 | |
| 113 | 14 | 20 | 22 | 15 | 7 | 3251 | 24.97 | |
| 114 | 14 | 20 | 22 | 15 | 7 | 3231 | 25.19 | |
| 115 | 13 | 19 | 22 | 15 | 7 | 3211 | 25.40 | |
| 116 | 13 | 19 | 21 | 15 | 7 | 3191 | 25.62 | |
| 117 | 13 | 19 | 21 | 15 | 7 | 3171 | 25.84 | |
| 118 | 13 | 19 | 21 | 15 | 7 | 3151 | 26.06 | |
| 119 | 13 | 19 | 21 | 15 | 7 | 3132 | 26.28 | |
| 120 | 13 | 19 | 21 | 15 | 7 | 3112 | 26.50 | |
| 121 | 13 | 19 | 21 | 15 | 7 | 3093 | 26.72 | |
| 122 | 13 | 19 | 21 | 15 | 7 | 3074 | 26.94 | |
| 123 | 13 | 19 | 21 | 15 | 7 | 3055 | 27.16 | |
| 124 | 13 | 19 | 21 | 15 | 7 | 3036 | 27.38 | |

**TABLE B-4**

**ESTIMATED REMEDIAL TIME**
**GROUNDWATER PUMP AND TREAT**

**SITE 20, ALLEGHENY PIER (PIER 303)**
**NAS PENSACOLA, PENSACOLA, FLORIDA**

**PAGE 3 OF 3**

| Time After Start of Remediation | Contaminant Concentration at End of Period | | | | | | Total Extracted Volume | Treatment Completed |
|---|---|---|---|---|---|---|---|---|
| 125 | 13 | 19 | 21 | 15 | 7 | 3017 | 27.59 | |
| 126 | 13 | 18 | 21 | 15 | 6 | 2998 | 27.81 | |
| 127 | 13 | 18 | 21 | 15 | 6 | 2979 | 28.03 | |
| 128 | 13 | 18 | 21 | 15 | 6 | 2961 | 28.25 | |
| 129 | 13 | 18 | 20 | 15 | 6 | 2943 | 28.47 | |
| 130 | 13 | 18 | 20 | 14 | 6 | 2924 | 28.69 | |
| 131 | 13 | 18 | 20 | 14 | 6 | 2906 | 28.91 | |
| 132 | 13 | 18 | 20 | 14 | 6 | 2888 | 29.13 | |
| 133 | 13 | 18 | 20 | 14 | 6 | 2870 | 29.35 | |
| 134 | 12 | 18 | 20 | 14 | 6 | 2852 | 29.57 | |
| 135 | 12 | 18 | 20 | 14 | 6 | 2835 | 29.78 | |
| 136 | 12 | 18 | 20 | 14 | 6 | 2817 | 30.00 | |
| 137 | 12 | 17 | 20 | 14 | 6 | 2799 | 30.22 | |
| 138 | 12 | 17 | 20 | 14 | 6 | 2782 | 30.44 | |
| 139 | 12 | 17 | 20 | 14 | 6 | 2765 | 30.66 | |
| 140 | 12 | 17 | 20 | 14 | 6 | 2748 | 30.88 | |
| 141 | 12 | 17 | 19 | 14 | 6 | 2731 | 31.10 | |
| 142 | 12 | 17 | 19 | 14 | 6 | 2714 | 31.32 | |
| 143 | 12 | 17 | 19 | 14 | 5 | 2697 | 31.54 | |
| 144 | 12 | 17 | 19 | 14 | 5 | 2680 | 31.76 | |
| 145 | 12 | 17 | 19 | 14 | 5 | 2663 | 31.97 | |
| 146 | 12 | 17 | 19 | 14 | 5 | 2647 | 32.19 | |
| 147 | 12 | 17 | 19 | 14 | 5 | 2630 | 32.41 | |
| 148 | 12 | 16 | 19 | 14 | 5 | 2614 | 32.63 | |
| 149 | 12 | 16 | 19 | 14 | 5 | 2598 | 32.85 | |
| 150 | 12 | 16 | 19 | 14 | 5 | 2582 | 33.07 | |
| 151 | 12 | 16 | 19 | 14 | 5 | 2566 | 33.29 | |
| 152 | 12 | 16 | 19 | 14 | 5 | 2550 | 33.51 | |
| 153 | 12 | 16 | 19 | 14 | 5 | 2534 | 33.73 | |
| 154 | 12 | 16 | 19 | 14 | 5 | 2518 | 33.95 | |
| 155 | 11 | 16 | 18 | 14 | 5 | 2502 | 34.16 | |
| 156 | 11 | 16 | 18 | 14 | 5 | 2487 | 34.38 | |
| 157 | 11 | 16 | 18 | 14 | 5 | 2471 | 34.60 | |
| 158 | 11 | 16 | 18 | 14 | 5 | 2456 | 34.82 | |
| 159 | 11 | 16 | 18 | 14 | 5 | 2441 | 35.04 | |
| 160 | 11 | 16 | 18 | 14 | 5 | 2426 | 35.26 | |
| 161 | 11 | 15 | 18 | 14 | 5 | 2411 | 35.48 | |
| 162 | 11 | 15 | 18 | 14 | 5 | 2396 | 35.70 | |
| 163 | 11 | 15 | 18 | 14 | 4 | 2381 | 35.92 | |
| 164 | 11 | 15 | 18 | 14 | 4 | 2366 | 36.14 | |
| 165 | 11 | 15 | 18 | 14 | 4 | 2351 | 36.35 | |
| 166 | 11 | 15 | 18 | 14 | 4 | 2337 | 36.57 | |

Prepared By: Clifton Blanchard CFB 11/12/2001 Date

Checked By: PKJ 9/27/02 Date

Approved By: MFA 9/27/02 Date

# APPENDIX B-5
# AQUIFER CALCULATIONS

Based On: Darcy Flow Equation

References:

1. *Groundwater,* by Freeze and Cherry, pages 17, 71, and 72
2. Site Assessment Report Addendum, TtNUS, 2000.

## B.5.1 - CALCULATION OF HORIZONTAL HYDRAULIC GRADIENT

**EQUATION:** $i = \Delta H/\Delta L = dh/dl$

WHERE:

i = hydraulic gradient
dh = difference in hydraulic head
dl = linear distance over which the change in head is observed

## CALCULATIONS - JULY 2000 DATA (TtNUS, 2000)

$i_{MW-9/MW-14}$ = (19.31 ft -19.13 ft) / 340 ft = 0.18 ft / 340 ft = **0.00053 ft/ft**

$i_{MW-34/MW-37}$ = (19.35 ft -19.10 ft) / 379 ft = 0.25 ft / 379 ft = **0.00066 ft/ft**

$i_{MW-9/MW-23}$ = (19.31 ft -19.16 ft) / 399 ft = 0.15 ft / 399 ft = **0.00038 ft/ft**

## CALCULATION OF THE AVERAGE (ARITHMETIC MEAN) GRADIENT:

$i_{AVE}$ = (0.00053 ft/ft + 0.00066 ft/ft + 0.00038 ft/ft) / 3 = **0.00052 ft/ft**

## B.5.2 - CALCULATION OF GROUNDWATER SEEPAGE VELOCITY

**EQUATION:** $V = K_{av}\, i/\eta_e$

WHERE

$K_{av}$ = $3.12 \times 10^{-4}$ ft/sec
i = 0.00052
$\eta_e$ = 0.15 – for sand (from Fetter, page 69)

**Groundwater Seepage (Average Linear) Velocity**

$$V = \frac{(3.12 \times 10^{-4}\ \text{ft/sec})(0.00052)}{0.15} = \mathbf{1.08 \times 10^{-6}\ ft/sec}$$

**Converting to feet per year (ft/yr):**

$1.08 \times 10^{-6}$ ft/sec X 31,536,000 sec/yr = **34.1 ft/yr**

PREPARED BY Cliff Blanchard CFB 11/07/01
DATE

CHECKED BY: PKJ 9/27/02
DATE

APPROVED BY: MFA 9/27/02
DATE

# APPENDIX C

# REMEDIAL ALTERNATIVE COST ESTIMATES

# TABLE C-1

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 1

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



### Free-Product Recovery Alternative No. 1-LUCs, Passive Skimming, and Monitoring

| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **Project Planning** | | | | |
| Prepare Work Plan | 40 | hr | $33.79 | $1,352 |
| Project Scheduling and Procurement | 8 | hr | $33.79 | $270 |
| **Mobilization (for new monitoring wells)** | | | | |
| Equipment Mob/Demob | 1 | ea | $450.00 | $450 |
| Mobilize/Demobilize Personnel (2 persons) | 1 | ea | $675.00 | $675 |
| **Decontamination** | | | | |
| Temporary Decon Pad | 1 | ea | $1,000.00 | $1,000 |
| Decon Water Disposal | 10 | ea | $125.00 | $1,250 |
| Decon Water Storage Drums | 10 | ea | $45.00 | $450 |
| PPE (2 persons for 15 days) | 30 | day | $30.00 | $900 |
| Decon Equipment (pressure washer) | 10 | day | $50.00 | $500 |
| **New Monitoring Wells (10)** | | | | |
| Hollow Stem Auger (10 wells to 15 ft) | 150 | ft | $25.00 | $3,750 |
| 4-inch PVC well casing | 50 | ft | $10.00 | $500 |
| Construction (2-man crew) | 15 | day | $450.00 | $6,750 |
| 4-inch well screen | 100 | ft | $8.00 | $800 |
| **Professional Services** | | | | |
| Drawings Preparation and Eng. Oversight | 40 | hr | $33.79 | $1,352 |
| **Land Use Controls** | | | | |
| Construction (2-man crew) | 1 | day | $450.00 | $450 |
| Prepare Land Use Plan | 80 | hr | $33.79 | $2,703 |
| Modify Master Plan and Prepare Deed Restrictions | 50 | hr | $33.79 | $1,690 |
| **Free Product Removal/Skimming System Installation** | | | | |
| assume qtrly change out required | | | | |
| 2-inch absorbent socks (for 11 wells) | 44 | ea | $368 | $16,191 |
| 4-inch absorbent socks (for 10 wells) | 40 | ea | 450 | $18,000 |
| 1 Technician, 1 day @ 8 hrs | 8 | hrs | $35 | $280 |
| 1 Jr. Level Engineer, 1 day @ 8 hrs | 8 | hrs | $45 | $360 |
| **Total Direct Costs** | | | | **$59,672** |

# TABLE C-1

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 1

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **TREATMENT SYSTEM O&M (annual)** | | | | |
| System Maintenance | | | | |
| Labor: | | | | |
| Technician, 24 hrs per month | 288 | hr | $30 | $8,640 |
| Sr. Engineer, 2 hours per month | 24 | hr | $90 | $2,160 |
| Project Mgr, 2 hrs per month | 24 | hr | $100 | $2,400 |
| Recovered Product Drum Disposal, 6 per year | 6 | ea | $150 | $900 |
| Absorbent Socks Drum Disposal, 4 per year | 4 | ea | $150 | $600 |
| **Total** | | | | **$14,700** |
| EXPENDABLES AND EQUIPMENT RENTAL: | | | | |
| Gloves (1 box) | 1 | box | $10 | $10 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water/hydrocarbon interface probe | 30 | days | $25 | $750 |
| Total Expendables and Equipment Rental: | | | | $810 |
| **Total cost for treatment system O&M** | | | | **$15,510** |
| **Quarterly Status Reports** | | | | |
| (assume four status reports) | | | | |
| 1 Jr. Level Geologist 16 hrs | 64 | | $45 | $2,880 |
| 1 Senior Geologist 4 hrs | 16 | | $80 | $1,280 |
| Technical Expert 2 hrs | 8 | | $75 | $600 |
| Production: | | | | $0 |
| Word Processing 8 hrs | 32 | | $35 | $1,120 |
| Editor 2 hrs | 8 | | $60 | $480 |
| **Total** | | | | **$6,360** |
| **Total** | | | | **$81,542** |

# TABLE C-2

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 2

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



### Free-Product Recovery Alternative No. 2-LUCs, Water Table Depression, and Monitoring

| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **Project Planning** | | | | |
| Prepare Work Plan | 40 | hr | $33.79 | $1,352 |
| Project Scheduling and Procurement | 8 | hr | $33.79 | $270 |
| **Mobilization (for new monitoring wells)** | | | | |
| Equipment Mob/Demob | 1 | ea | $450.00 | $450 |
| Mobilize/Demobilize Personnel (2 persons) | 1 | ea | $675.00 | $675 |
| **Decontamination** | | | | |
| Temporary Decon Pad | 1 | ea | $1,000.00 | $1,000 |
| Decon Water Disposal | 10 | ea | $125.00 | $1,250 |
| Decon Water Storage Drums | 10 | ea | $45.00 | $450 |
| PPE (2 persons for 15 days) | 30 | day | $30.00 | $900 |
| Decon Equipment (pressure washer) | 10 | day | $50.00 | $500 |
| **New Monitoring Wells (10)** | | | | |
| Hollow Stem Auger (10 wells to 15 ft) | 150 | ft | $25.00 | $3,750 |
| 4-inch PVC well casing | 50 | ft | $10.00 | $500 |
| Construction (2-man crew) | 15 | day | $450.00 | $6,750 |
| 4-inch well screen | 100 | ft | $8.00 | $800 |
| **Professional Services** | | | | |
| Drawings Preparation and Eng. Oversight | 40 | hr | $33.79 | $1,352 |
| **Land Use Controls** | | | | |
| Construction (2-man crew) | 1 | day | $450.00 | $450 |
| Prepare Land Use Plan | 80 | hr | $33.79 | $2,703 |
| Modify Master Plan and Prepare Deed Restrictions | 50 | hr | $33.79 | $1,690 |
| **Free Product Recovery with Water Table Depression** | | | | |
| Pneumatic Product Recovery Pump | 4 | ea | $602 | $2,408 |
| 80 Gallon Air Compressor | 1 | ea | $4,942 | $4,942 |
| 20 gpm Oil/Water Separator | 1 | ea | $9,199 | $9,199 |
| Air Supply and Exhaust Hose | 400 | ft | $2 | $800 |
| Hydrocarbon Discharge Line | 400 | ft | $2 | $800 |
| Electrical site usage | 12 | mo | $240 | $2,880 |
| 15 gpm, 1/2 HP, Transfer Pump with motor valves and piping | 4 | ea | $1,128 | $4,512 |
| 4,000 Polyethylene Aboveground Holding Tank | 12 | mo | $540 | $6,480 |
| Totalizing flow meter | 4 | ea | $300 | $1,200 |
| Flow indicator | 4 | ea | $100 | $400 |
| Pressure guage | 4 | ea | $100 | $400 |
| Sewer connection fee | 1 | ea | $2,150 | $2,150 |
| Labor | | | | |
| 1 Technician, 1 week @ 50 hrs/wk | 50 | hrs | $35 | $1,750 |
| 1 Jr. Level Engineer, 1 week @ 50 hrs/wk | 50 | hrs | $45 | $2,250 |
| 1 Sr. Engineer, 16 hours | 16 | hrs | $90 | $1,440 |
| **TOTAL Direct Costs** | | | | **$66,452** |

# TABLE C-2

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 2

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **TREATMENT SYSTEM O&M (annual)** | | | | |
| System Maintenance | | | | |
| Labor: | | | | |
| Jr. Engineer, 25 hrs per month, system operating data, control | 300 | hr | $45 | $13,500 |
| Sr. Engineer, 5 hours per month | 60 | hr | $90 | $5,400 |
| Technician, 25 hrs per month | 300 | hr | $30 | $9,000 |
| Project Mgr, 2 hrs per month | 24 | hr | $100 | $2,400 |
| Electrician, 15 hours per year | 15 | hr | $60 | $900 |
| TOTAL | | | | $31,200 |
| **Quarterly Status Reports** | | | | |
| (assume four status reports with groundwater analytical results reported in last quarter) | | | | |
| 1 Jr. Level Geologist 30 hrs | 64 | | $45 | $2,880 |
| 1 Senior Geologist 10 hrs | 16 | | $80 | $1,280 |
| Technical Expert 5 hrs | 8 | | $75 | $600 |
| Production: | | | | $0 |
| Word Processing 8 hrs | 32 | | $35 | $1,120 |
| Editor 2 hrs | 8 | | $60 | $480 |
| **Total** | | | | $6,360 |
| **Total** | | | | $104,012 |

# TABLE C-3

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 3

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



**Free-Product Recovery Alternative No. 3-LUCs, AFVR, Passive Skimming, and Monitoring**

| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **Project Planning** | | | | |
| Prepare Work Plan | 40 | hr | $33.79 | $1,352 |
| Project Scheduling and Procurement | 8 | hr | $33.79 | $270 |
| **Land Use Controls** | | | | |
| Construction (2-man crew) | 1 | day | $450.00 | $450 |
| Prepare Land Use Plan | 80 | hr | $33.79 | $2,703 |
| Modify Master Plan and Prepare Deed Restrictions | 50 | hr | $33.79 | $1,690 |
| **Free Product Recovery Via Mobile Enhanced Multi-Phase Extraction** | | | | |
| 8 hour AFVR event (2 trucks) | 6 | ea | $6,200 | $37,200.00 |
| Oily Water Removal, 6 events @ 2000 gal/event | 12000 | gal | $0.25 | $3,000 |
| **Free Product Removal/Skimming System Installation** | | | | |
| assume qtrly change out required | | | | |
| 2-inch absorbent socks (for 11 wells) | 44 | ea | $368 | 16,191 |
| 1 Technician, 1 day @ 8 hrs | 8 | hrs | $35 | 280 |
| 1 Jr. Level Engineer, 1 day @ 8 hrs | 8 | hrs | $45 | 360 |
| **Total Direct Costs** | | | | **63,496** |
| **TREATMENT SYSTEM O&M (annual)** | | | | |
| System Maintenance | | | | |
| Labor: | | | | |
| Technician, 12 hrs per month | 144 | hr | $30 | 4,320 |
| Sr. Engineer, 2 hours per month | 24 | hr | $90 | 2,160 |
| Project Mgr, 2 hrs per month | 24 | hr | $100 | 2,400 |
| Absorbent socks drum disposal, 4 per year | 4 | ea | $150 | 600 |
| **Total** | | | | **9,480** |
| **AFVR Costs for Oversight and free product monitoring** | | | | |
| Oversight by Staff Engineer during AFVR event (10 hrs per event) | 60 | hr | $45 | $2,700 |
| Free Product Monitoring by Technician | 144 | hr | $30 | $4,320 |
| (Assume 8 hrs once every two weeks for 9 month project duration) | | | | |
| Rental of water/hydrocarbon interface probe | 30 | day | $25 | $750 |
| **Total** | | | | **$7,770** |
| **Status letter Reports** | | | | |
| (assume six reports, one after each event) | | | | |
| 1 Jr. Level Geologist | 60 | hr | $45 | $2,700 |
| 1 Senior Geologist | 24 | hr | $80 | $1,920 |
| Technical Expert | 18 | hr | $75 | $1,350 |
| Production: | | | | $0 |
| Word Processing | 30 | hr | $35 | $1,050 |
| Editor | 12 | hr | $60 | $720 |
| **Total** | | | | **$7,740** |

# TABLE C-3

## FREE-PRODUCT RECOVERY ALTERNATIVE NO. 3

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| DIRECT COSTS | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **REPORTING, Site Activities Report/System Operation Report:** | | | | |
| 1 Jr. Level Geologist | 100 | hr | $45 | $4,500 |
| 1 Senior Geologist | 16 | hr | $80 | $1,280 |
| Technical Expert | 6 | hr | $75 | $450 |
| Word Processing | 15 | hr | $35 | $525 |
| Editor | 8 | hr | $60 | $480 |
| CADD Operator | 15 | hr | $40 | $600 |
| Reproduction: 100 pgs @ 20 copies | 2000 | pg | $0.10 | $200 |
| Shipping/binding: 20 reports | 20 | ea | $20 | $400 |
| **Total Report/Modeling Cost:** | | | | **$8,435** |
| **TOTAL PROJECT COST** | | | | **$96,921** |

# TABLE C-4

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **A. PRE-DESIGN DATA** | | | | |
| (1) Groundwater and product sampling and analysis | | | | |
| (a) Groundwater and Product Sampling and Analysis Work Plan | | | | |
| 1 Jr. Level Engineer | 40 | hrs | $45 | $1,800 |
| 1 Senior Engineer | 8 | hrs | $90 | $720 |
| Word processing | 4 | hrs | $35 | $140 |
| Technical Expert | 6 | hrs | $75 | $450 |
| Editor | 2 | hrs | $60 | $120 |
| CADD operator, 2 dwgs per report @ 8 hours per dwg | 16 | hrs | $60 | $960 |
| Reproduction & Shipping/binding | 1 | ls | $400 | $400 |
| (b) Groundwater Analysis for Contaminant Monitoring (assume 30 wells, 3 QC) | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 33 | ea | $150 | $4,950 |
| Total Lead, SW-846 Method 7421 | 33 | ea | $15 | $495 |
| TRPH (FLPRO) | 33 | ea | $90 | $2,970 |
| (c) Groundwater Analysis for Natural Attenuation Parameters (assume 10 wells - no QA) | | | | |
| Methane | 10 | ea | $85 | $850 |
| Ferrous Iron ($Fe^{2+}$) | 10 | ea | $15 | $150 |
| Sulfate ($SO_4$) | 10 | ea | $15 | $150 |
| Nitrate ($NO_3$) | 10 | ea | $15 | $150 |
| (d) Expendables and Equipment Rental | | | | |
| Gloves (2 box per event) | 2 | box | $10 | $20 |
| Teflon tubing (600 feet per event) | 600 | ft | $2.00 | $1,200 |
| Silicon tubing (200 feet per event) | 200 | ft | $2.00 | $400 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $400 | $400 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 10 | days | $60 | $600 |
| Pumps for purging wells (assume 2 for 10 days) | 20 | days | $35 | $700 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water/Hydrocarbon Interface Probe | 10 | days | $25 | $250 |
| Disposal of purge water, assume nonhaz., drums | 8 | ls | $150 | $1,200 |
| Car Rental w/fuel | 10 | ls | $65 | $650 |
| (e) Labor | | | | |
| 1 Technician, 10 days per sampling event @10 hour days | 100 | hrs | $30 | $3,000 |
| 1 Geologist, 10 days per sampling event @10 hour days | 100 | hrs | $45 | $4,500 |
| Subtotal Pre-Design Data Collection Cost: | | | | **$22,685** |
| **B. GROUNDWATER TREATEMENT SYSTEM ENGINEERING DESIGN** | | | | |
| Engineering includes preparation of all submittals, such as HASP, Erosion and Sediment Control Plan, Waste Management Plan, Construction Documentation Report, System Operations Manual, "As Builts" and Start and Testing Report (20% of construction cost) | 1 | ls | $47,000 | $47,000 |
| Subtotal System Engineering Design Cost: | | | | **$47,000** |

# TABLE C-4

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **C. SITE PREPARATION** | | | | |
| (1) Mobilization | 1 | ls | $5,000 | $5,000 |
| (2) Construction office trailer | 3 | mo | $600 | $1,800 |
| (3) Trailer delivery, setup, removal | 2 | ea | $1,000 | $2,000 |
| (4) Storage bin | 3 | mo | $120 | $360 |
| (5) Construction office and storage area fencing, 20'x30' | 100 | ft | $18 | $1,800 |
| (6) Signs, temp fencing, barricades to seclude construction area | 1 | ls | $1,500 | $1,500 |
| (7) Pressure washer and water tank | 1 | mo | $504 | $504 |
| (8) Plastic sheeting, drums, pumps, hoses, supplies | 1 | ls | $2,000 | $2,000 |
| (9) Oversight Labor | | | | |
| 1 Jr. Level Engineer, 5 days @ 8 hrs/Day | 40 | hrs | $45 | $1,800 |
| 1 Sr. Engineer, 16 hours | 16 | hrs | $90 | $1,440 |
| Subtotal Site Preparation | | | | $18,204 |
| **D. GROUNDWATER TREATMENT SYSTEM CONSTRUCTION** | | | | |
| (1) Well Installation | | | | |
| (a) Extraction wells, 10 wells @ 4'ID, PVC, 20' average bls | 200 | ft | $100 | $20,000 |
| (b) Electrical to pumps | 1 | ls | $3,000 | $3,000 |
| (c) Groundwater extraction pump, 2" submersible pump, 0.25-3 GPM, installed | 10 | ea | $1,200 | $12,000 |
| (d) Testing for Lead $K_d$ ($K_{oc}$ & foc) | 1 | ls | $3,500 | $3,500 |
| (e) Oversight and Sampling Labor | | | | |
| 1 Jr. Level Engineer, 4 weeks @ 40 hrs/wk | 160 | hrs | $45 | $7,200 |
| 1 Sr. Engineer | 32 | hrs | $90 | $2,880 |
| Subtotal Well Installation Cost | | | | $48,580 |
| (2) Collection System | | | | |
| (a) Piping for groundwater extraction wells to treatment sytem, 2" ID PVC (double walled), w/handholes, includes excavation and backfilling | 1800 | ft | $18 | $32,400 |
| (b) Electrician w/helper, 1 week @ 50 hrs/wk | 50 | hrs | $90 | $4,500 |
| (c) Oversight Labor | | | | |
| 1 Jr. Level Engineer, 1 week @ 50 hrs/wk | 50 | hrs | $45 | $2,250 |
| 1 Sr. Engineer, 24 hours | 24 | hrs | $90 | $2,160 |
| Subtotal Piping and Equipment | | | | $41,310 |

# TABLE C-4

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (3) Treatment System | | | | |
| (a) Electrical connection for treatment system (including electric poles, cable, transformer, phone line for telemetry) | 1 | ls | $2,500 | $2,500 |
| (b) Waterline Connection for Treatment System (includes underground piping and appurtenences) | 1 | ls | $1,000 | $1,000 |
| (c) Fencing, 20'x30', with manway and 14' gate | 100 | ft | $18 | $1,800 |
| (d) Gravity oil/water separator, 1000-gallon fiberglass | 1 | ls | $3,800 | $3,800 |
| (e) Discharge pump (Duplex system) | 1 | ls | $2,000 | $2,000 |
| (f) Force main to POTW collection pipeline | 200 | ft | $10 | $2,000 |
| (g) Associated piping and valves @ 12% total treatment system cost | 1 | ls | $14,551 | $14,551 |
| (h) Flow meters | 2 | ls | $300 | $600 |
| (i) Flow indicators | 2 | ls | $150 | $300 |
| (j) Instrument panel, controls | 1 | ls | $3,000 | $3,000 |
| (k) Transfer pump | 1 | ls | $1,000 | $1,000 |
| (l) Telemetry | 1 | ls | $10,000 | $10,000 |
| (m) Oversite Labor | | | | |
| 1 Jr. Engineer (8 weeks @ 50 hrs/week) | 400 | hrs | $45 | $18,000 |
| 1 Sr. Engineer (8 weeks @ 16 hrs/week) | 124 | hrs | $90 | $11,160 |
| Subtotal Treatment System Cost | | | | $71,711 |
| Subtotal Capital Cost | | | | $249,490 |
| **E. GROUNDWATER TREATMENT SYSTEM O&M (annual)** | | | | |
| (1) Labor | | | | |
| (a) Jr. Engineer, 12 hrs per month, system operating data, control | 144 | hr | $45 | $6,480 |
| (b) Sr. Engineer, 4 hours per month | 48 | hr | $90 | $4,320 |
| (c) Technician, 20 hrs per month | 240 | hr | $30 | $7,200 |
| (d) Project Mgr, 2 hrs per month | 12 | hr | $100 | $1,200 |
| (e) Electrician, 4 hours per year | 4 | hr | $75 | $300 |
| (2) POTW discharge fee | 2,628 | Kgal | $6 | $15,768 |
| (3) Misc. equip/supplies | 12 | mo | $800 | $9,600 |
| (4) Electricity (40 kW*24 hr/day*365 day/yr = 350,400 kWh/yr) | 350,400 | kWh | $0.08 | $28,032 |
| (5) Water (assume $500/year) | 1 | ls | $500 | $500 |
| Subtotal Groundwater System O&M | | | | $73,400 |

# TABLE C-4

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **H. REMEDIAL ACTION MONITORING** | | | | |
| (1) Quarterly Groundwater Monitoring (Includes 4 monitoring wells, 3 GW extraction wells, and 1 QA) | | | | |
| (a) Labor | | | | |
| 1 Technician, 5 days per sampling event @ 10 hour days | 50 | hrs | $30 | $1,500 |
| 1 Geologist, 5 days per sampling event @ 10 hour days | 50 | hrs | $45 | $2,250 |
| Car Renta w/fuel (5 days per event) | 5 | ls | $65 | $325 |
| (b) Analysis | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 8 | ea | $150 | $1,200 |
| Total Lead, SW-846 Method 7421 | 8 | ea | $15 | $120 |
| TRPH (FLPRO) | 8 | ea | $90 | $720 |
| (c) Expendables and Equipment Rental | | | | |
| Gloves (2 boxes per event) | 4 | box | $10 | $40 |
| Teflon tubing (400 feet per event) | 400 | ft | $2.00 | $800 |
| Silicon tubing (50 feet per event) | 50 | ft | $2.00 | $100 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $250 | $250 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 4 | days | $60 | $240 |
| Pumps for purging wells (2 pumps, 3 days rental per event) | 6 | days | $35 | $210 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water/Hydrocarbon Interface Probe | 5 | days | $25 | $125 |
| Disposal of purge water, assume nonhaz., drums | 8 | ea | $150 | $1,200 |
| Subtotal Quarterly Groundwater Monitoring Costs | | | | $9,130 |
| (2) Treatment System Monitoring (qtrly) | | | | |
| (a) Labor: | | | | |
| performed in conjunction with other site activiites | | | | |
| (b) Effluent Analysis (1 QA) | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 2 | ea | $150 | $300 |
| Total Lead, SW-846 Method 7421 | 2 | ea | $15 | $30 |
| TRPH (FLPRO) | 2 | ea | $80 | $160 |
| Total Suspended Solids | 2 | ea | $15 | $30 |
| Total Dissolved Solids | 2 | ea | $15 | $30 |
| Total Iron | 2 | ea | $15 | $30 |
| Subtotal Treatment System Monitoring Costs | | | | $580 |

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (3) Post-Active Remdial Action Monitoring (4 wells, 1 QA, for Natural Attenuation annually) | | | | |
| (a) Labor: | | | | |
| 1 Technician, 3 days per sampling event @10 hour days | 30 | hrs | $30 | $900 |
| 1 Geologist, 3 days per sampling event @10 hour days | 30 | hrs | $45 | $1,350 |
| Car Renta w/fuel | 3 | days | $65 | $195 |
| (b) Analysis | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 5 | ea | $150 | $750 |
| Total Lead, SW-846 Method 7421 | 5 | ea | $15 | $75 |
| TRPH (FLPRO) | 5 | ea | $90 | $450 |
| (c) Expendables and Equipment Rental | | | | |
| Gloves | 2 | box | $10 | $20 |
| Teflon tubing | 200 | ft | $2.00 | $400 |
| Silicon tubing | 50 | ft | $2.00 | $100 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $250 | $250 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 3 | days | $60 | $180 |
| Pumps for purging wells (2 pumps, 2 days rental) | 4 | days | $35 | $140 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water level indicator | 3 | days | $25 | $75 |
| Disposal of purge water, assume nonhaz., drums | 2 | ls | $150 | $300 |
| Subtotal Quarterly Groundwater Monitoring Costs | | | | $5,235 |
| **I. SUBMITTALS** | | | | |
| (1) Status/Monitoring Report | | | | |
| (a) 1 Jr. Level Engineer | 80 | hrs | $45 | $3,600 |
| (b) 1 Senior Engineer | 16 | hrs | $90 | $1,440 |
| (c) Word processing | 6 | hrs | $35 | $210 |
| (d) Technical Expert | 6 | hrs | $75 | $450 |
| (e) Editor | 6 | hrs | $60 | $360 |
| (f) CADD operator, 4 dwgs per report @ 2 hours per dwg | 8 | hrs | $40 | $320 |
| (g) Reproduction & Shipping/binding: 20 reports, 100 pgs @ 20 copies | 1 | ls | $600 | $600 |
| Subtotal Status/Monitoring Report Cost: | | | | $6,980 |
| (2) Request for Discontinuation of Active Remediation | | | | |
| (a) 1 Jr. Level Engineer | 32 | hrs | $45 | $1,440 |
| (b) 1 Senior Engineer | 4 | hrs | $90 | $360 |
| (c) Word processing | 4 | hrs | $35 | $140 |
| (d) Technical Expert | 12 | hrs | $75 | $900 |
| (e) Editor | 4 | hrs | $60 | $240 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 100 pgs @ 20 copies | 1 | ls | $600 | $600 |
| Subtotal Request for Discontinuation of Active Remediation Report Cost: | | | | $3,840 |

# TABLE C-4

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (3) Post-Remedial Monitoring Plan | | | | |
| (a) 1 Jr. Level Engineer | 40 | hrs | $45 | $1,800 |
| (b) 1 Senior Engineer | 4 | hrs | $90 | $360 |
| (c) Word processing | 4 | hrs | $35 | $140 |
| (d) Technical Expert | 4 | hrs | $75 | $300 |
| (e) Editor | 4 | hrs | $60 | $240 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 80 pgs @ 20 copies | 1 | ls | $520 | $520 |
| Subtotal Post-Remedial Monitoring Plan Cost: | | | | $3,520 |
| (4) Post-Remedial Monitoring Report | | | | |
| (a) 1 Jr. Level Engineer | 32 | hrs | $45 | $1,440 |
| (b) 1 Senior Engineer | 2 | hrs | $90 | $180 |
| (c) Word processing | 2 | hrs | $35 | $70 |
| (d) Technical Expert | 2 | hrs | $75 | $150 |
| (e) Editor | 2 | hrs | $60 | $120 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 60 pgs @ 20 copies | 1 | ls | $450 | $450 |
| Subtotal Post-Remedial Monitoring Plan Cost: | | | | $2,570 |

$354,745

# TABLE C-4.1

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 1
## GROUNDWATER PUMP AND TREAT/DISCHARGE TO POTW DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

| Year | Capital Cost | Operation and Maintenance Cost | Annual Cost | Total Yearly Cost | Present-Worth Factor (i = 7%) | Present Worth |
|---|---|---|---|---|---|---|
| 0 | $249,490 | | | $249,490 | 1.000 | $249,490 |
| 1 | | $73,400 | $67,920 | $141,320 | 0.935 | $132,134 |
| 2 | | $73,400 | $66,760 | $140,160 | 0.873 | $122,360 |
| 3 | | $73,400 | $66,760 | $140,160 | 0.816 | $114,371 |
| 4 | | $73,400 | $66,760 | $140,160 | 0.763 | $106,942 |
| 5 | | $73,400 | $66,760 | $140,160 | 0.713 | $99,934 |
| 6 | | $73,400 | $66,760 | $140,160 | 0.666 | $93,347 |
| 7 | | $73,400 | $66,760 | $140,160 | 0.623 | $87,320 |
| 8 | | $73,400 | $66,760 | $140,160 | 0.582 | $81,573 |
| 9 | | $73,400 | $66,760 | $140,160 | 0.544 | $76,247 |
| 10 | | $73,400 | $66,760 | $140,160 | 0.508 | $71,201 |
| 11 | | $73,400 | $74,120 | $147,520 | 0.475 | $70,072 |
| 12 | | | $15,610 | $15,610 | 0.444 | $6,931 |
| 13 | | | $15,610 | $15,610 | 0.415 | $6,478 |
| 14 | | | $15,610 | $15,610 | 0.388 | $6,057 |
| 15 | | | $15,610 | $15,610 | 0.362 | $5,651 |
| 16 | | | $15,610 | $15,610 | 0.339 | $5,292 |

**TOTAL PRESENT WORTH $1,335,399**

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **A. PRE-DESIGN DATA** | | | | |
| (1) Groundwater and product sampling and analysis | | | | |
| (a) Groundwater and Product Sampling and Analysis Work Plan | | | | |
| 1 Jr. Level Engineer | 40 | hrs | $45 | $1,800 |
| 1 Senior Engineer | 8 | hrs | $90 | $720 |
| Word processing | 4 | hrs | $35 | $140 |
| Technical Expert | 6 | hrs | $75 | $450 |
| Editor | 2 | hrs | $60 | $120 |
| CADD operator, 2 dwgs per report @ 8 hours per dwg | 16 | hrs | $60 | $960 |
| Reproduction & Shipping/binding | 1 | ls | $400 | $400 |
| (b) Groundwater Analysis for Contaminant Monitoring (assume 30 wells, 3 QC) | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 33 | ea | $150 | $4,950 |
| Total Lead, SW-846 Method 7421 | 33 | ea | $15 | $495 |
| TRPH (FLPRO) | 33 | ea | $90 | $2,970 |
| (c) Groundwater Analysis for Natural Attenuation Parameters (assume 10 wells - no QA) | | | | |
| Methane | 10 | ea | $85 | $850 |
| Ferrous Iron ($Fe^{2+}$) | 10 | ea | $15 | $150 |
| Sulfate ($SO_4$) | 10 | ea | $15 | $150 |
| Nitrate ($NO_3$) | 10 | ea | $15 | $150 |
| (d) Expendables and Equipment Rental | | | | |
| Gloves (2 box per event) | 2 | box | $10 | $20 |
| Teflon tubing (600 feet per event) | 600 | ft | $2.00 | $1,200 |
| Silicon tubing (200 feet per event) | 200 | ft | $2.00 | $400 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $400 | $400 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 10 | days | $60 | $600 |
| Pumps for purging wells (assume 2 for 10 days) | 20 | days | $35 | $700 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water/Hydrocarbon Interface Probe | 10 | days | $25 | $250 |
| Disposal of purge water, assume nonhaz., drums | 8 | ls | $150 | $1,200 |
| Car Rental w/fuel | 10 | ls | $65 | $650 |
| (e) Labor | | | | |
| 1 Technician, 10 days per sampling event @10 hour days | 100 | hrs | $30 | $3,000 |
| 1 Geologist, 10 days per sampling event @10 hour days | 100 | hrs | $45 | $4,500 |
| Subtotal Pre-Design Data Collection Cost: | | | | $22,685 |
| **B. GROUNDWATER TREATEMENT SYSTEM ENGINEERING DESIGN** | | | | |
| Engineering includes preparation of all submittals, such as HASP, Erosion and Sediment Control Plan, Waste Management Plan, Construction Documentation Report, System Operations Manual, "As Builts" and Start and Testing Report (20% of construction cost) | 1 | ls | $66,168 | $66,168 |
| Subtotal System Engineering Design Cost: | | | | $66,168 |

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **C. SITE PREPARATION** | | | | |
| (1) Mobilization | 1 | ls | $5,000 | $5,000 |
| (2) Construction office trailer | 3 | mo | $600 | $1,800 |
| (3) Trailer delivery, setup, removal | 2 | ea | $1,000 | $2,000 |
| (4) Storage bin | 3 | mo | $120 | $360 |
| (5) Construction office and storage area fencing, 40'x80' | 240 | ft | $18 | $4,320 |
| (6) Signs, temp fencing, barricades to seclude construction area | 1 | ls | $1,500 | $1,500 |
| (7) Pressure washer and water tank | 1 | mo | $504 | $504 |
| (8) Plastic sheeting, drums, pumps, hoses, supplies | 1 | ls | $2,000 | $2,000 |
| (9) Oversight Labor | | | | |
| 1 Jr. Level Engineer, 6 days @ 8 hrs/Day | 48 | hrs | $45 | $2,160 |
| 1 Sr. Engineer, 16 hours | 8 | hrs | $90 | $720 |
| Subtotal Site Preparation | | | | **$20,364** |
| **D. GROUNDWATER TREATMENT SYSTEM CONSTRUCTION** | | | | |
| (1) Well Installation | | | | |
| (a) Extraction wells, 10 wells @ 4'ID, PVC, 20' average bls | 200 | ft | $100 | $20,000 |
| (b) Electrical to pumps | 1 | ls | $3,000 | $3,000 |
| (c) Groundwater extraction pump, 2" submersible pump, 0.25-3 GPM, installed | 10 | ea | $1,200 | $12,000 |
| (d) Testing for Lead $K_d$ ($K_{oc}$ & foc) | 1 | ls | $3,500 | $3,500 |
| (e) Oversight and Sampling Labor | | | | |
| 1 Jr. Level Engineer, 4 weeks @ 40 hrs/wk | 160 | hrs | $45 | $7,200 |
| 1 Sr. Engineer | 32 | hrs | $90 | $2,880 |
| Subtotal Well Installation Cost | | | | **$48,580** |
| (2) Collection System | | | | |
| (a) Piping for groundwater extraction wells to treatment sytem, 2" ID PVC (double walled), w/handholes, includes excavation and backfilling | 1800 | ft | $18 | $32,400 |
| (b) Electrician w/helper, 1 week @ 50 hrs/wk | 200 | hrs | $90 | $18,000 |
| (c) Oversight Labor | | | | |
| 1 Jr. Level Engineer, 1 week @ 50 hrs/wk | 50 | hrs | $45 | $2,250 |
| 1 Sr. Engineer, 24 hours | 24 | hrs | $90 | $2,160 |
| Subtotal Piping and Equipment | | | | **$54,810** |

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (3) Treatment System | | | | |
| (a) Electrical connection for treatment system (including electric poles, cable, transformer, phone line for telemetry) | 1 | ls | $15,000 | $15,000 |
| (b) Waterline Connection for Treatment System (includes underground piping and appurtenences) | 1 | ls | $5,000 | $5,000 |
| (d) Fencing, 50'x30', with manway and 14' gate | 160 | ft | $18 | $2,880 |
| (f) Gravity oil/water separator, 1000-gallon fiberglass | 1 | ls | $3,800 | $3,800 |
| (g) Equalization tank, 1000-gallon fiberglass | 1 | ls | $2,500 | $2,500 |
| (i) Liquid phase GAC, 5-20 gpm (Rental Unit) | 1 | ls | $1,200 | $1,200 |
| (j) Ion Exchange w/backwash, 5-20 gpm | 1 | ls | $110,000 | $110,000 |
| (l) Associated piping and valves @ 12% total treatment system cost | 1 | ls | $24,370 | $24,370 |
| (m) Flow meters | 4 | ls | $300 | $1,200 |
| (n) Flow indicators | 4 | ls | $150 | $600 |
| (p) Instrument panel, controls | 1 | ls | $10,000 | $10,000 |
| (q) Transfer and discharge pumps | 4 | ls | $1,000 | $4,000 |
| (r) Telemetry | 1 | ls | $10,000 | $10,000 |
| (s) Oversite Labor | | | | |
| 1 Jr. Engineer, 10 weeks @ 50 hrs/week | 500 | hrs | $45 | $22,500 |
| 1 Sr. Engineer | 160 | hrs | $90 | $14,400 |
| Subtotal Treatment System Cost | | | | $227,450 |
| Subtotal Capital Cost | | | | $440,057 |
| **E. GROUNDWATER TREATMENT SYSTEM O&M (annual)** | | | | |
| (1) Labor | | | | |
| (a) Jr. Engineer, 12 hrs per month, system operating data, control | 144 | hr | $45 | $6,480 |
| (b) Sr. Engineer, 4 hours per month | 48 | hr | $90 | $4,320 |
| (c) Technician, 20 hrs per month | 240 | hr | $30 | $7,200 |
| (d) Project Mgr, 2 hrs per month | 12 | hr | $100 | $1,200 |
| (e) Electrician, 4 hours per year | 4 | hr | $75 | $300 |
| (2) POTW discharge fee | 2,628 | Kgal | $6 | $15,768 |
| (3) Misc. equip/supplies | 12 | mo | $800 | $9,600 |
| (4) Electricity (40 kW*24 hr/day*365 day/yr = 350,400 kWh/yr) | 350,400 | kWh | $0.08 | $28,032 |
| (5) Water (assume $500/year) | 1 | ls | $500 | $500 |
| Subtotal Groundwater System O&M | | | | $73,400 |

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| **H. REMEDIAL ACTION MONITORING** | | | | |
| (1) Quarterly Groundwater Monitoring (Includes 4 monitoring wells, 3 GW extraction wells, and 1 QA) | | | | |
| (a) Labor | | | | |
| 1 Technician, 5 days per sampling event @10 hour days | 50 | hrs | $30 | $1,500 |
| 1 Geologist, 5 days per sampling event @10 hour days | 50 | hrs | $45 | $2,250 |
| Car Renta w/fuel (5 days per event) | 5 | ls | $65 | $325 |
| (b) Analysis | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 8 | ea | $150 | $1,200 |
| Total Lead, SW-846 Method 7421 | 8 | ea | $15 | $120 |
| TRPH (FLPRO) | 8 | ea | $90 | $720 |
| (c) Expendables and Equipment Rental | | | | |
| Gloves (2 boxes per event) | 4 | box | $10 | $40 |
| Teflon tubing (400 feet per event) | 400 | ft | $2.00 | $800 |
| Silicon tubing (50 feet per event) | 50 | ft | $2.00 | $100 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $250 | $250 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 4 | days | $60 | $240 |
| Pumps for purging wells (2 pumps, 3 days rental per event) | 6 | days | $35 | $210 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water/Hydrocarbon Interface Probe | 5 | days | $25 | $125 |
| Disposal of purge water, assume nonhaz., drums | 8 | ea | $150 | $1,200 |
| Subtotal Quarterly Groundwater Monitoring Costs | | | | **$9,130** |
| (2) Treatment System Monitoring | | | | |
| (a) Labor: | | | | |
| 1 Technician, 1 days per sampling event @10 hour days | 10 | hrs | $30 | $300 |
| Car Rental w/fuel | 1 | days | $65 | $65 |
| (b) Influent & Effluent Analysis (1 QA) | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 2 | ea | $150 | $300 |
| Total Lead, SW-846 Method 7421 | 2 | ea | $15 | $30 |
| TRPH (FLPRO) | 2 | ea | $80 | $160 |
| Total Suspended Solids | 2 | ea | $15 | $30 |
| Total Dissolved Solids | 2 | ea | $15 | $30 |
| Total Iron | 2 | ea | $15 | $30 |
| Subtotal Quarterly Groundwater Monitoring Costs | | | | **$580** |
| (3) Post-Active Remdial Action Monitoring (4 wells, 1 QA, for Natural Attenuation annually) | | | | |
| (a) Labor: | | | | |
| 1 Technician, 3 days per sampling event @10 hour days | 30 | hrs | $30 | $900 |
| 1 Geologist, 3 days per sampling event @10 hour days | 30 | hrs | $45 | $1,350 |
| Car Renta w/fuel | 3 | days | $65 | $195 |
| (b) Analysis | | | | |
| Polycyclic Aromatic Hydrocarbons, SW-846 8310 | 5 | ea | $150 | $750 |
| Total Lead, SW-846 Method 7421 | 5 | ea | $15 | $75 |
| TRPH (FLPRO) | 5 | ea | $90 | $450 |

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (c) Expendables and Equipment Rental | | | | |
| Gloves | 2 | box | $10 | $20 |
| Teflon tubing | 200 | ft | $2.00 | $400 |
| Silicon tubing | 50 | ft | $2.00 | $100 |
| Shipping and supplies (tape, bubble wrap, ice) | 1 | ls | $250 | $250 |
| Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature. | 3 | days | $60 | $180 |
| Pumps for purging wells (2 pumps, 2 days rental) | 4 | days | $35 | $140 |
| First Aid kit | 1 | ls | $50 | $50 |
| Water level indicator | 3 | days | $25 | $75 |
| Disposal of purge water, assume nonhaz., drums | 2 | ls | $150 | $300 |
| Subtotal Quarterly Groundwater Monitoring Costs | | | | $5,235 |
| **I. SUBMITTALS** | | | | |
| (1) Status/Monitoring Report | | | | |
| (a) 1 Jr. Level Engineer | 80 | hrs | $45 | $3,600 |
| (b) 1 Senior Engineer | 16 | hrs | $90 | $1,440 |
| (c) Word processing | 6 | hrs | $35 | $210 |
| (d) Technical Expert | 6 | hrs | $75 | $450 |
| (e) Editor | 6 | hrs | $60 | $360 |
| (f) CADD operator, 4 dwgs per report @ 2 hours per dwg | 8 | hrs | $40 | $320 |
| (g) Reproduction & Shipping/binding: 20 reports, 100 pgs @ 20 copies | 1 | ls | $600 | $600 |
| Subtotal Status/Monitoring Report Cost: | | | | $6,980 |
| (2) Request for Discontinuation of Active Remediation | | | | |
| (a) 1 Jr. Level Engineer | 32 | hrs | $45 | $1,440 |
| (b) 1 Senior Engineer | 4 | hrs | $90 | $360 |
| (c) Word processing | 4 | hrs | $35 | $140 |
| (d) Technical Expert | 12 | hrs | $75 | $900 |
| (e) Editor | 4 | hrs | $60 | $240 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 100 pgs @ 20 copies | 1 | ls | $600 | $600 |
| Subtotal Request for Discontinuation of Active Remediation Report Cost: | | | | $3,840 |
| (3) Post-Remedial Monitoring Plan | | | | |
| (a) 1 Jr. Level Engineer | 40 | hrs | $45 | $1,800 |
| (b) 1 Senior Engineer | 4 | hrs | $90 | $360 |
| (c) Word processing | 4 | hrs | $35 | $140 |
| (d) Technical Expert | 4 | hrs | $75 | $300 |
| (e) Editor | 4 | hrs | $60 | $240 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 80 pgs @ 20 copies | 1 | ls | $520 | $520 |
| Subtotal Post-Remedial Monitoring Plan Cost: | | | | $3,520 |

# TABLE C-5

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA



| | Quantity | Unit | Unit Cost | Total Cost |
|---|---|---|---|---|
| (4) Post-Remedial Monitoring Report | | | | |
| (a) 1 Jr. Level Engineer | 32 | hrs | $45 | $1,440 |
| (b) 1 Senior Engineer | 2 | hrs | $90 | $180 |
| (c) Word processing | 2 | hrs | $35 | $70 |
| (d) Technical Expert | 2 | hrs | $75 | $150 |
| (e) Editor | 2 | hrs | $60 | $120 |
| (f) CADD operator, 2 dwgs per report @ 2 hours per dwg | 4 | hrs | $40 | $160 |
| (g) Reproduction & Shipping/binding: 20 reports, 60 pgs @ 20 copies | 1 | ls | $450 | $450 |
| Subtotal Post-Remedial Monitoring Plan Cost: | | | | $2,570 |

**$545,312**

# TABLE C-5.1

## GROUNDWATER REMEDIATION ALTERNATIVE NO. 2
## GROUNDWATER PUMP AND TREAT DETAILED COST

## SITE 20, ALLEGHENY PIER (PIER 303)
## NAS PENSACOLA, PENSACOLA, FLORIDA

| Year | Capital Cost | Operation and Maintenance Cost | Annual Cost | Total Yearly Cost | Present-Worth Factor (i = 7%) | Present Worth |
|---|---|---|---|---|---|---|
| 0 | $440,057 | | | $440,057 | 1.000 | $440,057 |
| 1 | | $73,400 | $69,080 | $142,480 | 0.935 | $133,219 |
| 2 | | $73,400 | $66,760 | $140,160 | 0.873 | $122,360 |
| 3 | | $73,400 | $66,760 | $140,160 | 0.816 | $114,371 |
| 4 | | $73,400 | $66,760 | $140,160 | 0.763 | $106,942 |
| 5 | | $73,400 | $66,760 | $140,160 | 0.713 | $99,934 |
| 6 | | $73,400 | $66,760 | $140,160 | 0.666 | $93,347 |
| 7 | | $73,400 | $66,760 | $140,160 | 0.623 | $87,320 |
| 8 | | $73,400 | $66,760 | $140,160 | 0.582 | $81,573 |
| 9 | | $73,400 | $66,760 | $140,160 | 0.544 | $76,247 |
| 10 | | $73,400 | $66,760 | $140,160 | 0.508 | $71,201 |
| 11 | | $73,400 | $74,120 | $147,520 | 0.475 | $70,072 |
| 12 | | | $31,220 | $31,220 | 0.444 | $13,862 |
| 13 | | | $15,610 | $15,610 | 0.415 | $6,478 |
| 14 | | | $15,610 | $15,610 | 0.388 | $6,057 |
| 15 | | | $15,610 | $15,610 | 0.362 | $5,651 |
| 16 | | | $19,450 | $19,450 | 0.339 | $6,594 |

**TOTAL PRESENT WORTH $1,535,282**

# APPENDIX D

# FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION REMEDIAL ACTION PLAN SUMMARY

FLORIDA

# Remedial Action Plan Summary

DEP Form # 62-770.900(4)
Form Title: Remedial Action Plan Summary
Effective Date: September 23, 1997

**Site Name** Allegheny Pier (Pier 303)
**Location** NAS, Pensacola, Florida
**Media Contaminated:** ☑ Groundwater ☐ Soil

**FDEP Facility ID No.** 179202973
**Current Date** / /
**Date of Last GW Analysis** 7 / 24 / 00

**Type(s) of Product(s) Discharged:**
☐ Gasoline Analytical Group
☑ Kerosene Analytical Group (Diesel)
- Estimated Petroleum Mass (lbs):
  - Groundwater 217
  - Saturated Zone Soil 10,512
  - Vadose Zone Soil 75,120
- Area of Plume 153,000 ($ft^2$)
- Thickness of Plume 11.5 (ft)

**Groundwater Recovery and Specifications:**
- No. of Recovery Wells 10
  ☑ Vertical ☐ Horizontal
- Design Flow Rate/Well 0.5 (gpm)
- Total Flow Rate 5.0 (gpm)
- Hydraulic Conductivity 27 (ft/day)
- Recovery Well Screen Interval 10 (ft)
- Depth to Groundwater 6-8 (ft)

**Method of Groundwater Remediation:**
☑ Pump-and-Treat
☐ Air Stripper
☐ Low Profile ☐ Packed Tower
☐ Diffused Aerator
☑ Activated Carbon
☐ Primary Treatment ☐ Polishing
☐ In Situ Air Sparging
- No. of Sparge Points _____
  ☐ Vertical ☐ Horizontal
- Pressure _____ (psi)
- Design Air Flow Rate/Well _____ (cfm)
- Total Air Flow Rate _____ (cfm)

☐ Biosparging
- No. of Sparge Points _____
  ☐ Vertical ☐ Horizontal
- Design Air Flow Rate/Well _____ (cfm)

☐ Bioremediation
☐ In Situ ☐ Ex Situ
☐ Other _____

**Method of Groundwater Disposal:**
☐ Infiltration Gallery ☑ Sanitary Sewer
☐ Surface Discharge/NPDES ☐ Injection Well
☐ Other _____

**Free Product Present:** ☑ Yes ☐ No
- Estimated Volume 5,700 (gal)
- Maximum Thickness 17.04 (in)
- Method of Recovery (check all that apply):
  ☐ Manual Bailing ☐ Skimming Pump
  ☑ Other AFVR & Absorbent Socks

**Method of Soil Remediation:**
☐ Excavation
Volume to be Excavated _____ ($yds^3$)
☐ Thermal Treatment ☐ Land Farming On Site
☐ Landfill ☐ Bioremediation
☐ Other _____

☐ Vapor Extraction System (VES)
- No. of Venting Wells _____
  ☐ Vertical ☐ Horizontal
- VES - Applied Vacuum _____ (wg)
- Design Air Flow Rate _____ (cfm)
- Design Radius of Influence _____ (ft)
- Air Emissions Treatment
  ☐ Thermal Oxidizer ☐ Catalytic Converter
  ☐ Carbon ☐ Other _____

☐ Soil Bioventing
- No. of Venting Wells _____
  ☐ Vertical ☐ Horizontal
- Design Air Flow Rate _____ (cfm)

☐ In Situ Bioremediation
☐ Other _____

**Natural Attenuation:**
- Method of Evaluation
  ☐ Rule 62-770.690(1)(e), F.A.C.
  ☐ Rule 62-770.690(1)(f), F.A.C.

**Estimated Time of Cleanup:** 5840 (days)
- Method of Estimation
  ☐ Pore Volumes (no. of pore vols. = _____ )
  ☐ Exponential Decay (Decay Rate) ____ ($day^{-1}$)
  ☐ Groundwater Model
  ☑ Other Engineering Evaluation

**Estimated Cost:**
- Est. Capital Cost (incl. install.) $ 249,500.00
- Est. O & M Cost (per year) $ 73,400.00
- Est. Total Cleanup Cost $ 1,335,400.00 (PW)