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NAS WHITING FIELD  
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CONTAMINATION ASSESSMENT REPORT FOR SITE 2866 NAVY EXCHANGE SERVICE  
STATION NAS WHITING FIELD FL  
2/1/1993  
ABB ENVIRONMENTAL

**CONTAMINATION ASSESSMENT REPORT**

**SITE 2866  
NAVAL AIR STATION WHITING FIELD  
MILTON, FLORIDA**

**UIC: N60508**

**Contract No. N62467-89-D-0317**

**Prepared by:**

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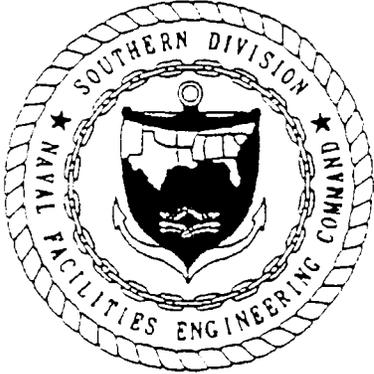
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**February 1993**



## FOREWORD

Subtitle I of the Hazardous and Solid Waste Amendments (HSWA) of 1984 to the Solid Waste Disposal Act (SWDA) of 1965 established a national regulatory program for managing underground storage tanks (USTs) containing hazardous materials, especially petroleum products. Hazardous wastes stored in USTs were already regulated under the Resource Conservation and Recovery Act (RCRA) of 1976, which was also an amendment to SWDA. Subtitle I requires that the U.S. Environmental Protection Agency (USEPA) promulgate UST regulations. The program was designed to be administered by the individual States, who were allowed to develop more stringent standards, but not less stringent standards. Local governments were permitted to establish regulatory programs and standards that are more stringent, but not less stringent than either State or Federal regulations. The USEPA UST regulations are found in the Code of Federal Regulations, Title 40, Part 280 (Title 40 CFR 280) (*Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*) and Title 40 CFR 281 (*Approval of State Underground Storage Tank Programs*). Title 40 CFR 280 was revised and published on September 23, 1988, and became effective December 22, 1988.

The Navy's UST program policy is to comply with all Federal, State, and local regulations pertaining to USTs. This report was prepared to satisfy the requirements of the Florida Department of Environmental Regulation (FDER) Chapter 17-770, Florida Administrative Code (FAC) (*State Underground Petroleum Environmental Response*) regulations on petroleum contamination in Florida's environment as a result of petroleum spills or leaking tanks or piping.

Questions regarding this report should be addressed to the Environmental Coordinator, Naval Air Station (NAS) Whiting Field, Milton, Florida, at 904-623-7181, or to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Code 1843, at DSN 563-0613 or 803-743-0613.

## EXECUTIVE SUMMARY

ABB Environmental Services, Inc. (ABB-ES), was contracted by Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) to perform a contamination assessment (CA) for six sites at Naval Air Station Whiting Field, Milton, Florida, identified as possibly having soil contamination exceeding State regulatory standards. The Navy Exchange Service Station is one of the six sites.

The Navy Exchange Service Station is a full service auto station. The station consists of three underground storage tanks (USTs) containing unleaded gasoline, one aboveground storage tank (AST) containing waste oil, two pump islands, and two maintenance bays for mechanical repairs.

In October 1989, all three USTs at the Navy Exchange Service Station were precision tested. Two tanks, 2866-B and 2866-C, failed the tank tightness tests. The tanks have since been repaired and tested tight.

Soil borings and monitoring wells were placed at the site during the CA to assess the degree and extent of soil and groundwater contamination resulting from reported release associated with the USTs. Soil and groundwater samples were collected and analyzed for appropriate parameters. The Executive Summary Figure shows the locations of soil borings and monitoring wells. The findings, conclusions, and recommendations of the Contamination Assessment Report (CAR) are summarized below.

### Findings

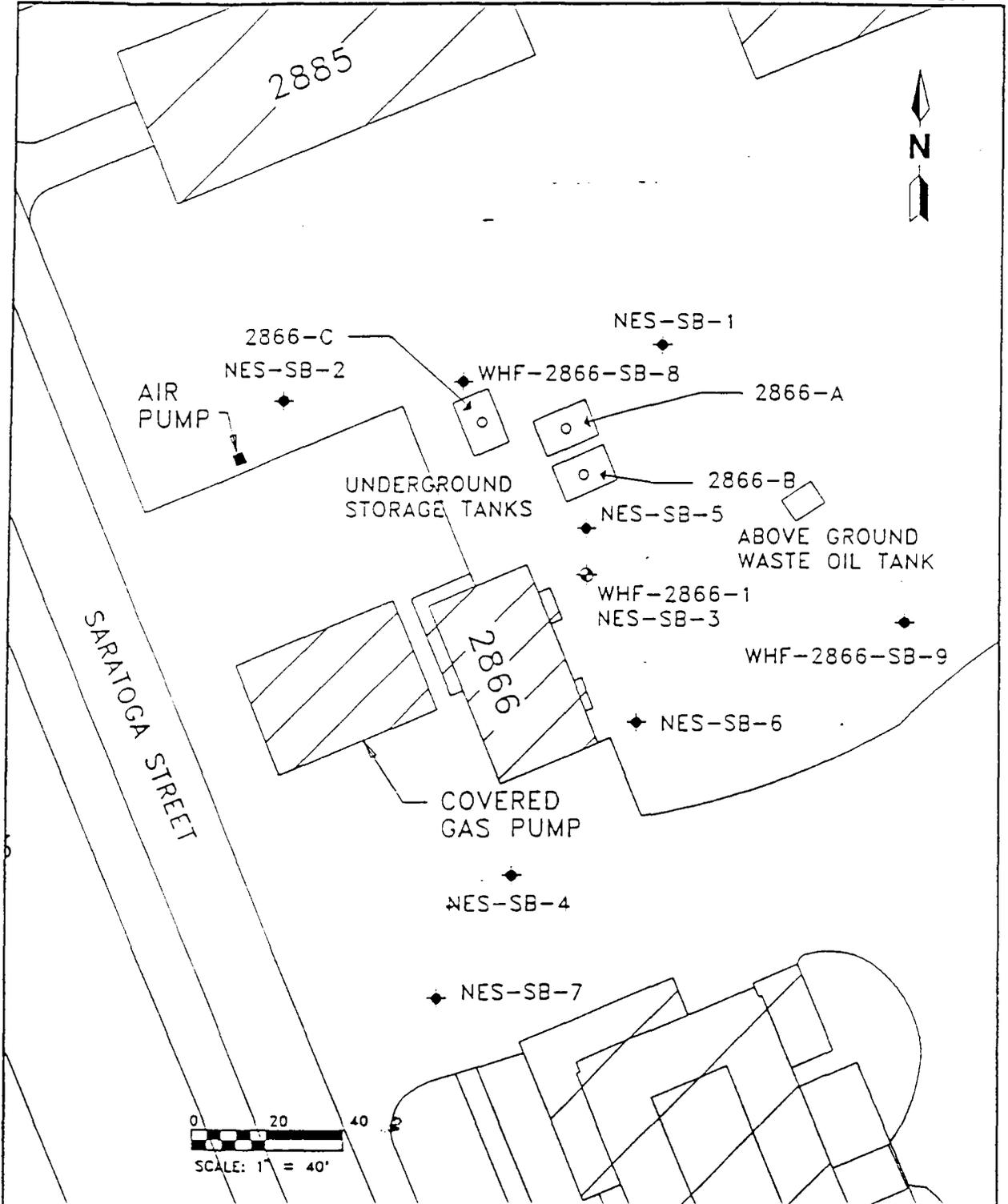
- Minimal concentrations of petroleum hydrocarbons were detected in soils at the site by organic vapor analyzer (OVA) headspace analysis.
- Methyl tert-butyl ether (MTBE) was detected in one groundwater sample at a concentration of 11 parts per billion (ppb). The State regulatory standard for MTBE is 50 ppb.
- 1,1-Dichloroethene and 1,1,1-trichloroethane were detected in one sample at concentrations of 4 ppb and 5 ppb, respectively. There are no State guidance standards for dichloroethene and trichloroethane.

### Conclusions

The levels of groundwater or soil contamination at Site 2866 did not exceed State regulatory standards.

### Recommendations

Field screening of soil samples and laboratory analytical results of groundwater samples indicate concentrations of petroleum constituents well below State target levels. Therefore, a No Further Action Proposal (NFAP) is requested for Site 2866. However, due to the proximity of this site to the North Fuel Farm (Site 1467), a known highly contaminated site upgradient to Site 2866, a Monitoring Only Proposal (MOP) is recommended for WHF-2866-1.



EXECUTIVE SUMMARY FIGURE



CONTAMINATION ASSESSMENT REPORT, SITE 2866

NAS WHITING FIELD MILTON, FLORIDA

## ACKNOWLEDGMENTS

In preparing this report, the Underground Storage Tank Section of the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Group at ABB Environmental Services, Inc. (ABB-ES), commends the support, assistance, and cooperation provided by the personnel of the Naval Air Station (NAS) Whiting Field, Milton, Florida, and Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). In particular, ABB-ES acknowledges the efforts provided by the following people during the investigation and preparation of this report.

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## GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
AST	aboveground storage tank
bls	below land surface
BTEX	benzene, toluene, ethyl benzene, and xylenes
CA	contamination assessment
CAP	Contamination Assessment Plan
CAR	Contamination Assessment Report
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CompQAP	Comprehensive Quality Assurance Plan
CTO	Contract Task Order
EDB	ethylene dibromide
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulation
FID	flame ionization detector
ft/day	feet per day
ft/ft	feet per foot
GC	gas chromatograph
gpm	gallons per minute
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments
IR	Installation Restoration
K	hydraulic conductivity
msl	mean sea level
MOP	Monitoring Only Proposal
MTBE	methyl tert-butyl ether
µg/l	micrograms per liter
NAS	Naval Air Station
NEESA	Naval Energy and Environmental Support Activity
NFAP	No Further Action Proposal
NGVD	National Geodetic Vertical Datum
OVA	organic vapor analyzer
PCE	tetrachloroethene
POA	Plan of Action
ppb	parts per billion
ppm	parts per million
PVC	polyvinyl chloride

GLOSSARY (Continued)

RCRA	Resource Conservation and Recovery Act
SOUTHNAV- FACENCOM	Southern Division, Naval Facilities Engineering Command
SPT	standard penetration test
SWDA	Solid Waste Disposal Act
TCE	trichloroethene
TRAWING FIVE	Training Air Wing Five
TRPH	total recoverable petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
USTs	underground storage tanks
V	velocity
VOCs	volatile organic compounds

## 1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), was contracted by Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) to perform a contamination assessment (CA) and submit a Contamination Assessment Report (CAR) for each of six petroleum contaminated sites at Naval Air Station (NAS) Whiting Field. This CAR is submitted for one of the six sites, Site 2866.

The scope of services for the work at Site 2866 is described in Contract Task Order (CTO) No. 009, the Plan of Action (POA), and the Contamination Assessment Plan (CAP) and included the following:

- drilling of soil borings and analyzing site soil samples to assess the degree and the extent of soil contamination,
- installing and sampling a groundwater monitoring well to assess the degree and the extent of groundwater contamination,
- collecting water level data to estimate the groundwater flow direction and hydraulic gradient at the site to be used if remediation is recommended,
- conducting a potable well inventory within a 0.25-mile radius of the site,
- conducting slug tests on selected wells to estimate aquifer characteristics, and
- reducing and analyzing pertinent data gathered during the CA to complete this CAR.

The CA at Site 2866 was conducted from November 13 to 23, 1991, and completed December 9, 1992. The following sections of the report present the background information, data compilation, results, conclusions, and recommendations of the CAR.

NAS Whiting Field is also undergoing investigation as a component of the Navy Installation Restoration (IR) program. The IR program has been designed to identify, prioritize, and abate or control contaminant migration resulting from past operations at Naval Installations. There are currently 23 sites being investigated under this program at NAS Whiting Field.

## 2.0 SITE BACKGROUND

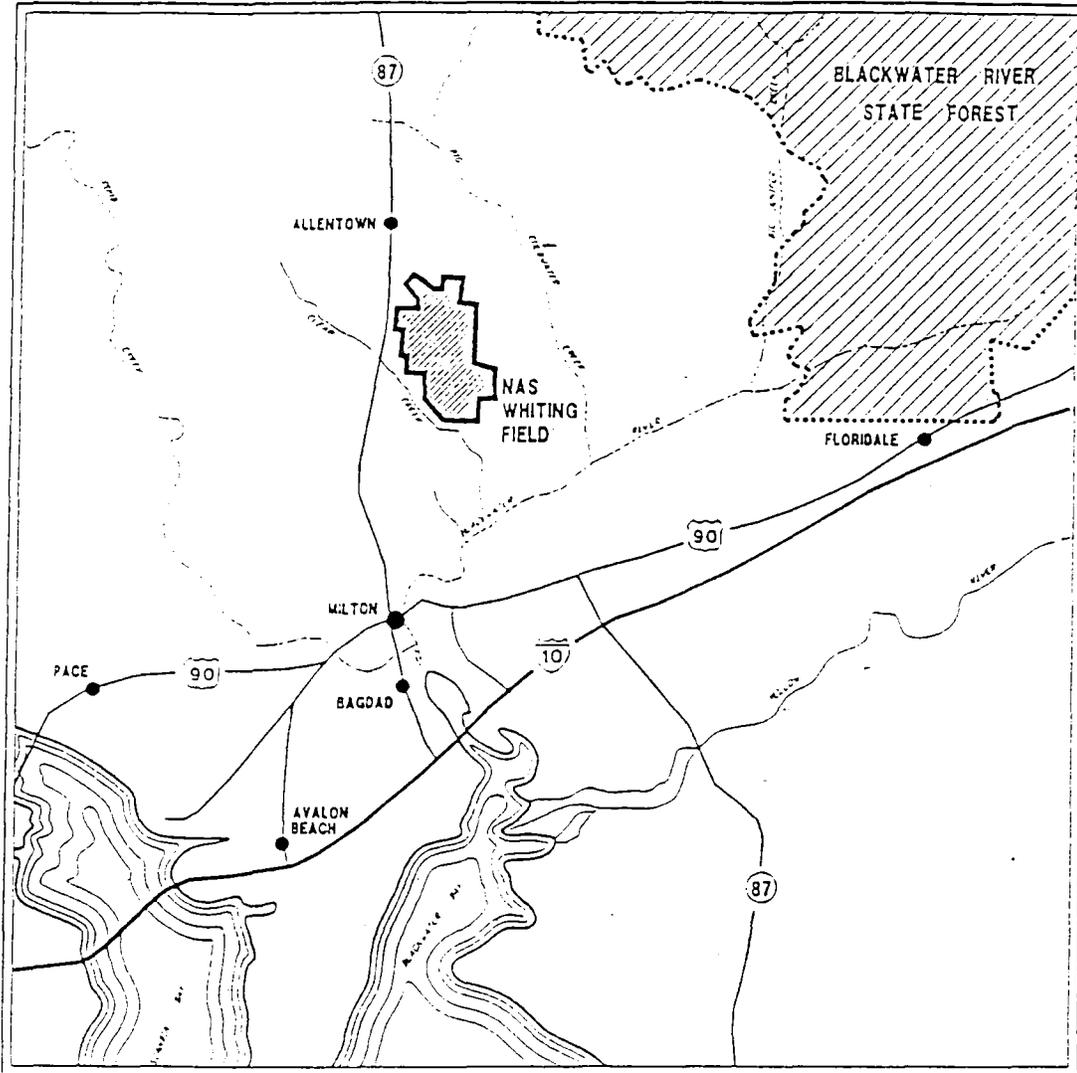
2.1 SITE DESCRIPTION. Site 2866 is the Navy Exchange Service Station located at NAS Whiting Field. Whiting Field is in Florida's northwest coastal area approximately 7 miles north of Milton and 20 miles northeast of Pensacola (Figure 2-1). NAS Whiting Field occupies 3,490 acres in north-central Santa Rosa County with easement rights to an additional 457 acres.

The station is the home base of Training Air Wing Five (TRAWING FIVE), whose mission is to administer, coordinate, and supervise flight and academic training. The station is divided into a North Field, where fixed wing training takes place, and a South Field used for helicopter training. Support facilities are located between the two fields (Figure 2-2).

The Navy Exchange Service Station is a full service automotive station. The station consists of three underground storage tanks (USTs) containing unleaded gasoline, two pump islands, and two maintenance bays for mechanical repairs (Figure 2-3).

2.2 SITE HISTORY. An attempt was made to precision test the tanks in October 1989. Tank 2866-A tested tight, but tanks 2866-B and 2866-C were not tested due to visible leaks at the seals on the manway ports. Precision tests were performed by AcuTest of Houston, Texas, using the LEAK COMPUTER™ System. The tank test results are included as Appendix A, Precision Tests. The tanks have since been repaired and have tested tight. During the excavation to the manway ports and vent lines, a petroleum odor was detected in the soils around the tanks.

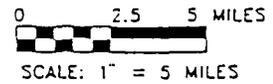
Site 2866 is 1,400 feet downgradient of the North Fuel Farm (Site 1467) at NAS Whiting Field. The North Fuel Farm is a highly contaminated site, and it is possible that contaminants from that site could eventually migrate to Site 2866.



SITE MAP



MAP LOCATION



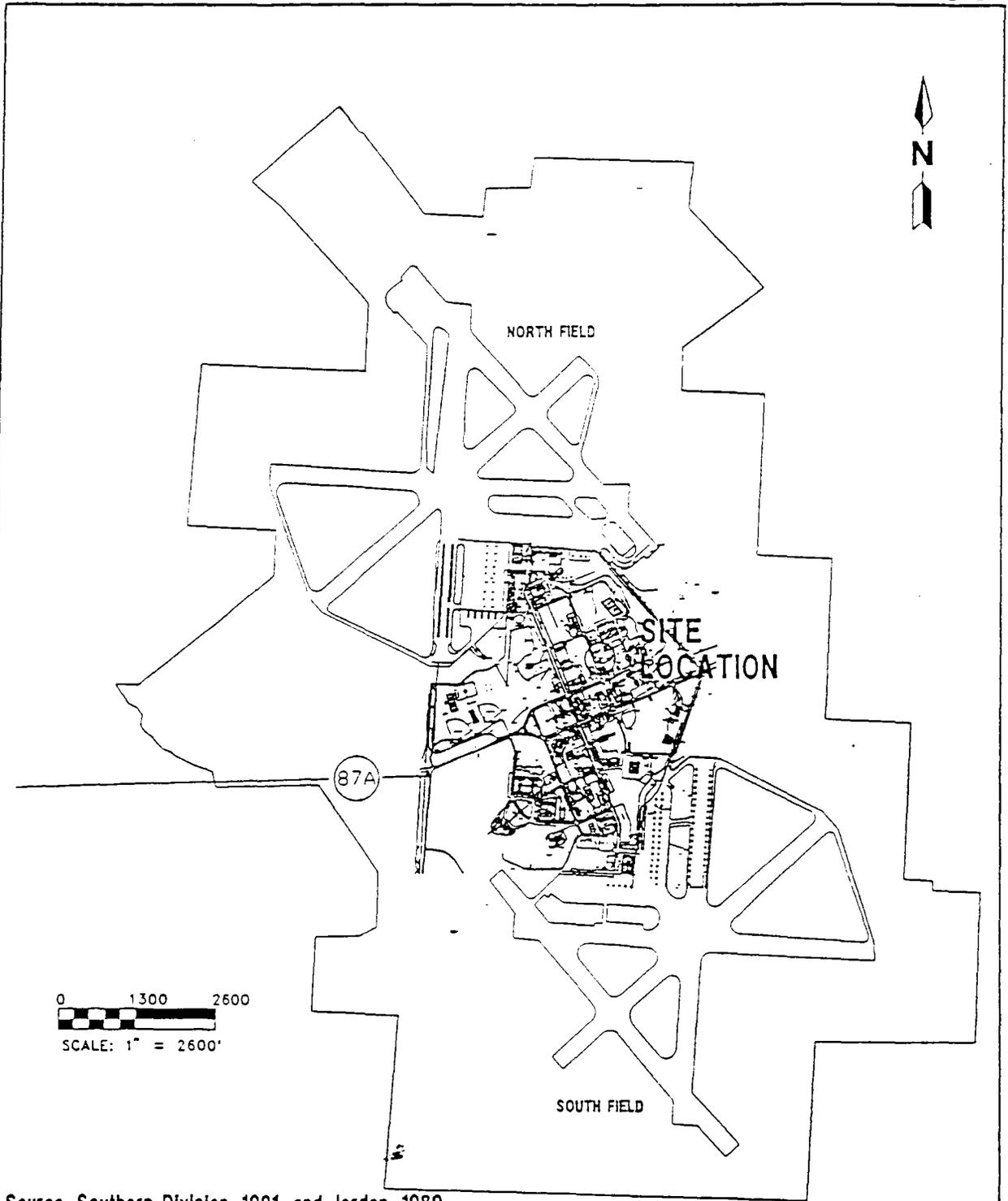
Source: ABB Environmental Services Inc. 1992

FIGURE 2-1  
FACILITY LOCATION MAP



CONTAMINATION ASSESSMENT  
REPORT, SITE 2866

NAS WHITING FIELD  
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Source: Southern Division, 1991, and Jordan, 1989

**FIGURE 2-2**  
**SITE LOCATION MAP**



**CONTAMINATION ASSESSMENT**  
**REPORT, SITE 2866**

**NAS WHITING FIELD**  
**MILTON, FLORIDA**

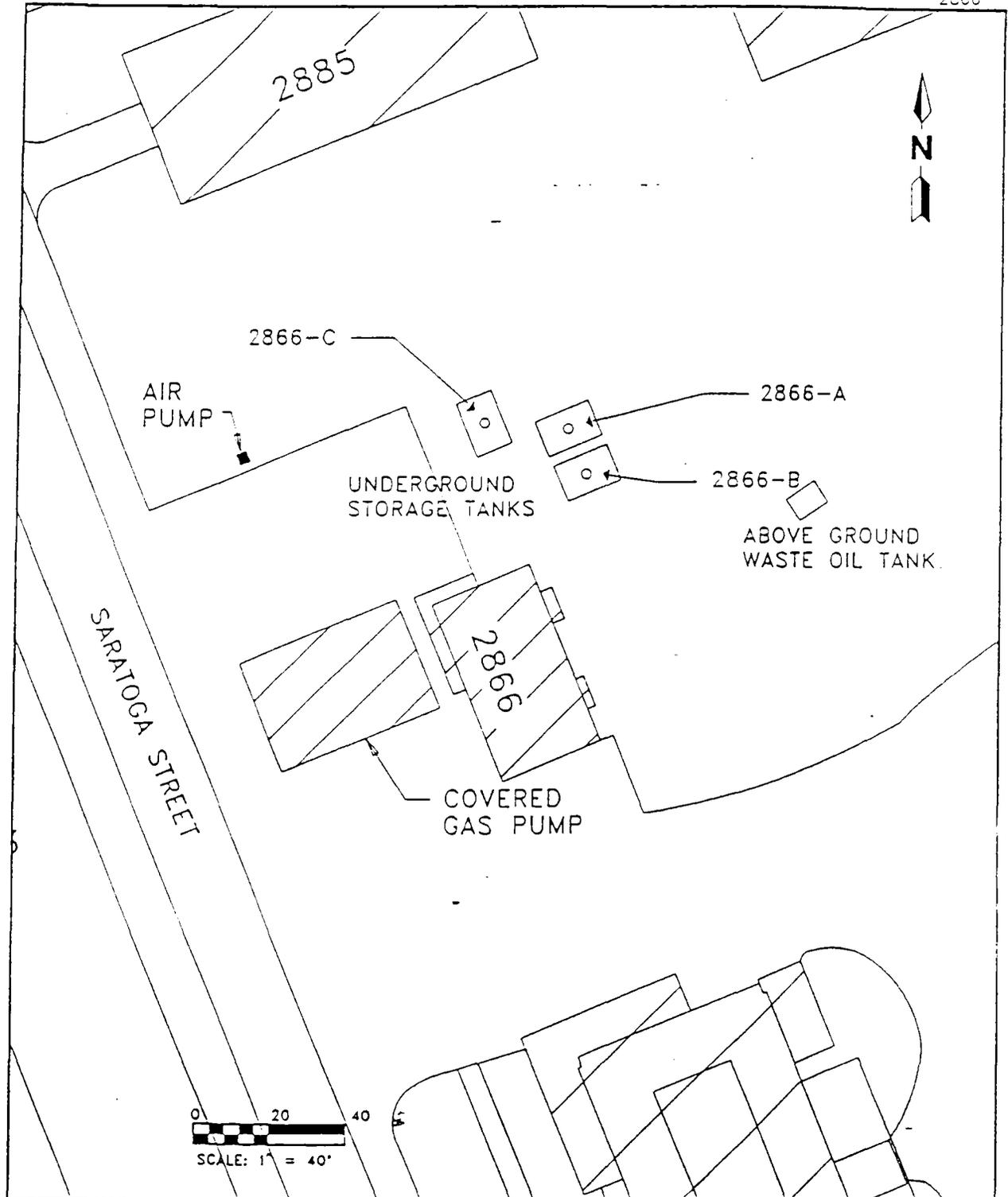
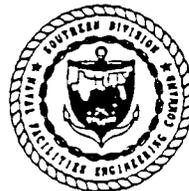


FIGURE 2-3  
SITE SKETCH



CONTAMINATION ASSESSMENT  
REPORT, SITE 2866

NAS WHITING FIELD  
MILTON, FLORIDA

### 3.0 SITE CONDITIONS

3.1 PHYSIOGRAPHY. The regional physiography is discussed in Appendix B, Site Conditions. NAS Whiting Field lies within the Western Highland physiographic region of Florida. Site elevations range from 150 to 190 feet above mean sea level (msl). Surface water runoff is conveyed to Clear Creek (west and south) and Big Cold Creek (east) by a system of ditches and storm drains (Figure 2-1). The drainage system was installed when the base was constructed in the early 1940's.

### 3.2 HYDROGEOLOGY.

3.2.1 Regional There are three major aquifers in the NAS Whiting Field area. The uppermost aquifer, the sand-and-gravel aquifer, exists under both artesian and non-artesian conditions depending on the presence or absence of semi-confining clay lenses. The two other aquifers, the Upper Floridan and the Lower Floridan, are deep artesian aquifers of the Floridan aquifer system. Virtually all groundwater withdrawn in Escambia and Santa Rosa Counties comes from the lower part of the sand-and-gravel aquifer (Geraghty & Miller, 1986). Descriptions of the aquifers are presented in Appendix B.

3.2.2 Site Specific Site 28 is capped by low permeability sediments consisting of clayey sands. These sediments range in thickness from approximately 20 to 40 feet. Beneath these sediments the lithology consists of very fine- to very coarse-grained sands with randomly interbedded lenses and layers of gravel and clay (Geraghty & Miller, 1986).

The sand-and-gravel aquifer is recharged by infiltration of rainwater at the surface. Due to a clay layer of variable thickness and lateral extent at NAS Whiting Field, there are locally perched water tables present. This is the case at Site 2866 where the clay layer, at least 10 feet thick, is located 95 feet below land surface (bls). This clay layer forms an aquitard and subsequently creates a locally perched water table. Henceforth, this perched water table will be referred to as the upper zone of the sand-and-gravel aquifer.

A more extensive water bearing zone, the lower zone of the sand-and-gravel aquifer, exists below this clay layer. Both upper and lower zones have similar lithologies and hydrogeologic characteristics. Complete lithologic logs for all site soil borings and monitoring wells are presented in Appendix C, Lithologic Logs.

Monitoring well WHF-2866-1, screened in the upper part of the sand-and-gravel aquifer, has a water level of 94.92 feet bls or an elevation of 174.64 feet. Site-specific aquifer characteristics and other hydrogeologic parameters are discussed in Section 5.1.

## 4.0 METHODOLOGIES AND EQUIPMENT

4.1 SOIL BORING PROGRAM. The soil boring program for Site 2866 was conducted from November 13 to November 15, 1991, and completed on November 23, 1992. Nine soil borings, NES-SB-1, NES-SB-2, NES-SB-3, NES-SB-4, NES-SB-5, NES-SB-6, NES-SB-7, WHF-2866-SB-8, and WHF-2866-SB-9, associated with Site 2866 were completed to depths varying from 97 to 112 feet bls. These borings were drilled at the site to:

- assess the extent and level of petroleum contamination in the soil,
- identify the types of subsurface material, and
- aid in the placement of subsequent groundwater monitoring wells.

Soil boring locations are shown in Figure 4-1. Appendix D, Field Methodologies, describes methodologies for conducting the soil borings. The results of the soil boring program are discussed in Section 5.2.

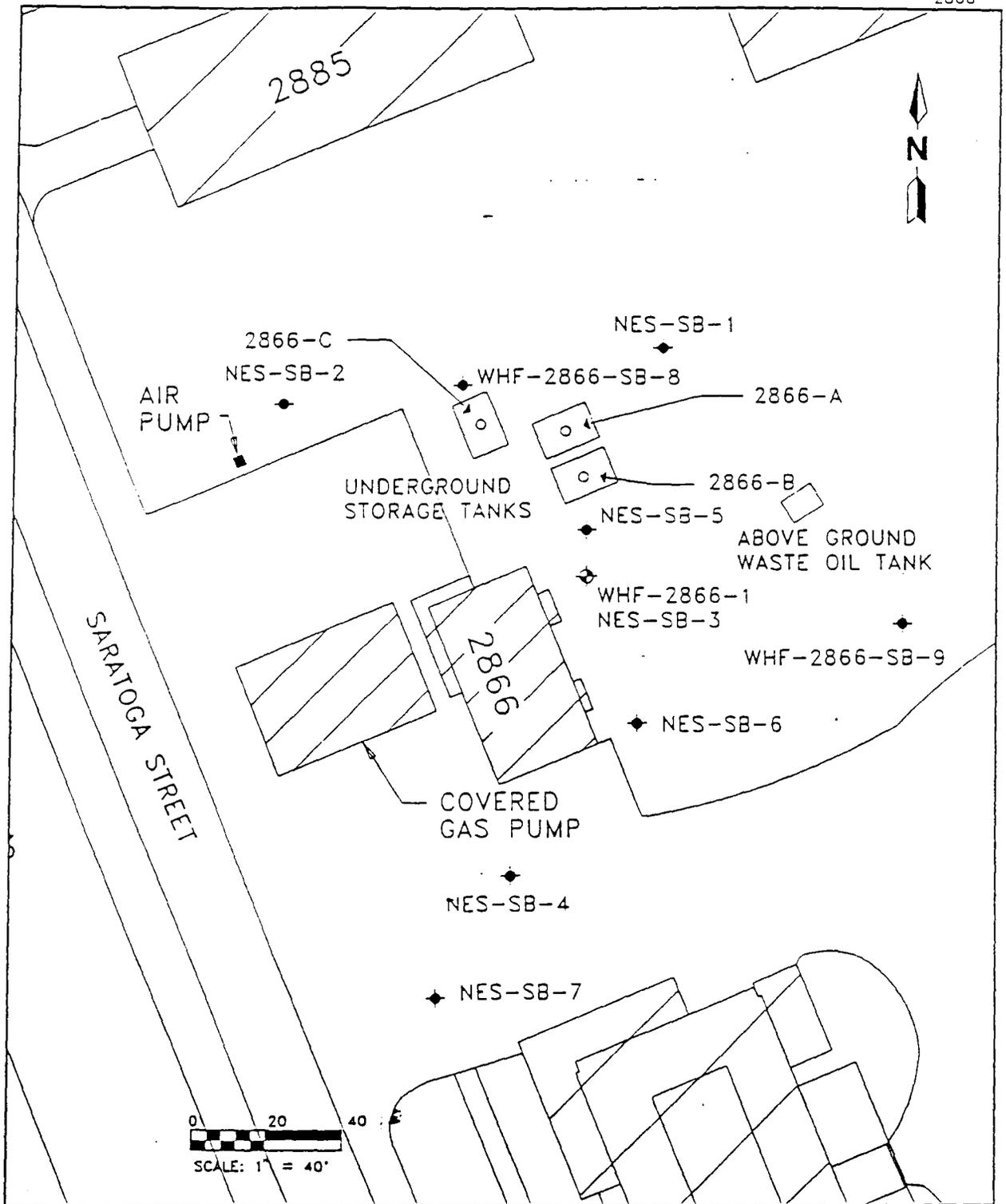
4.2 MONITORING WELL INSTALLATION PROGRAM. One well, WHF-2866-1, was installed at the site in the upper zone of the sand-and-gravel aquifer. The location of the monitoring well is shown in Figure 4-1. Monitoring well construction methodologies and materials are discussed in Appendix D.

4.3 GROUNDWATER ELEVATION SURVEY. The elevation and slope of the water table were determined by surveying the top of the well casing for the monitoring well to a common reference datum using a surveyor's level and stadia rod. A benchmark, stamped "C 113 1945," referencing the National Geodetic Vertical Datum (NGVD) of 1929 was used as the common reference datum.

Groundwater level measurements were collected on July 31 and November 21, 1992. Procedures for groundwater level measurements are contained in Appendix D.

4.4 SAMPLING PROGRAM. Groundwater samples were collected from monitoring well, WHF-2866-1 on November 21, 1992. The samples were sent to Wadsworth/ALERT Laboratories in Tampa, Florida, for analysis. One laboratory blank, one field blank, one equipment blank, one duplicate, and two trip blanks were analyzed as part of ABB-ES' Comprehensive Quality Assurance Plan (CompQAP) approved by the Florida Department of Environmental Regulation (FDER). Procedures for collection of groundwater samples are presented in Appendix D.

4.5 AQUIFER SLUG TESTS. Three rising head slug tests were conducted in monitoring wells WHF-4-1 and WHF-5-1 (Figure 4-2) to estimate the hydraulic conductivity of the sand-and-gravel aquifer during the IR investigation (ABB Environmental Services, 1992b). Monitoring well WHF-4-1 has a screen interval of 142.5 feet to 152.5 feet bls. This well is screened in the lower zone of the sand-and-gravel aquifer. Monitoring well WHF-5-1 has a screen interval of 137 feet to 147 feet bls. This well is screened in the upper zone of the sand-and-gravel-aquifer in a location in which the confining clay layer is absent.

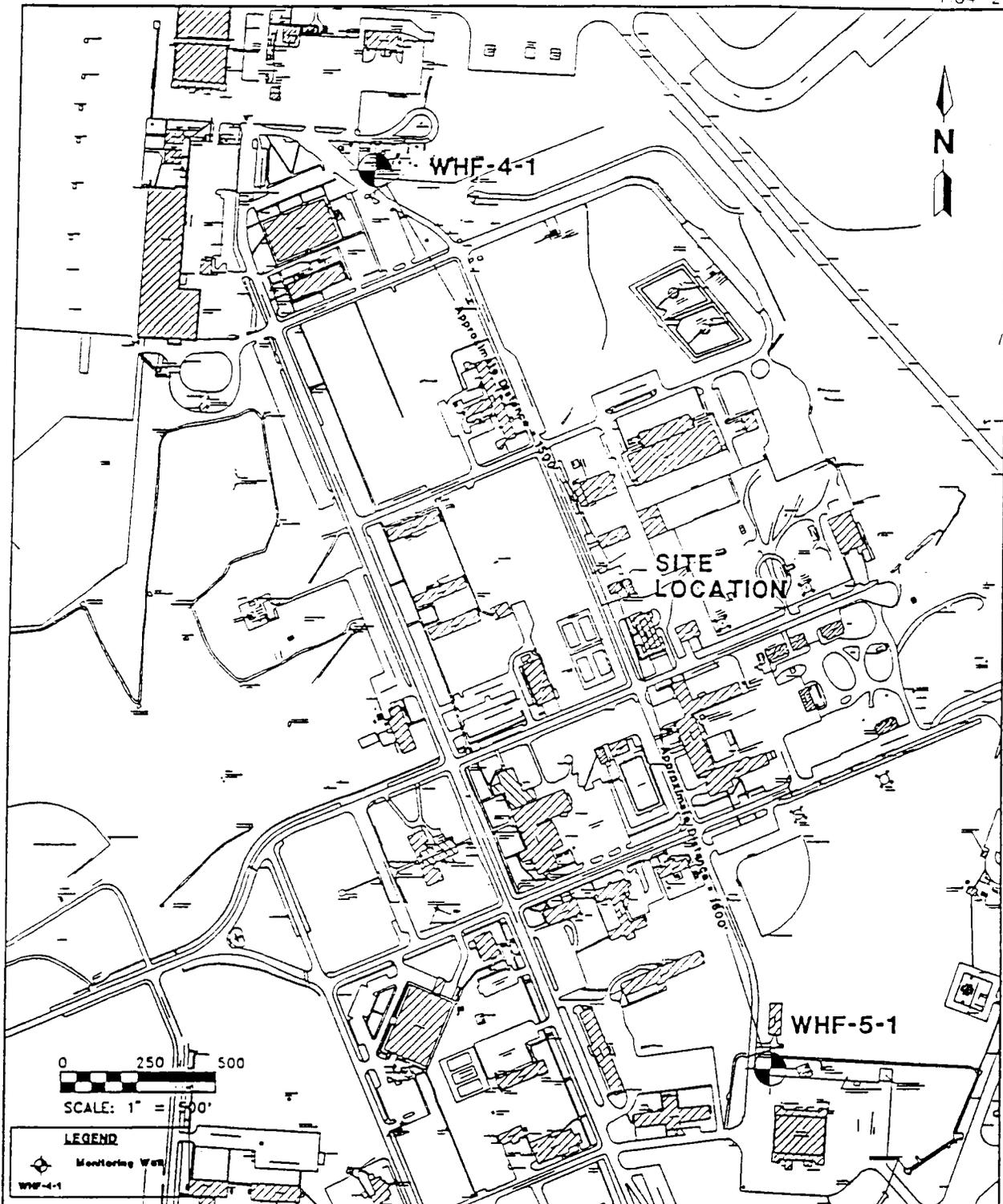


**FIGURE 4-1**  
**SOIL BORING AND MONITORING WELL**  
**LOCATIONS**



**CONTAMINATION ASSESSMENT**  
**REPORT, SITE 2866**

**NAS WHITING FIELD**  
**MILTON, FLORIDA**



**FIGURE 4-2**  
**LOCATION OF MONITORING WELLS**  
**WHF-4-1 AND WHF-5-1**



**CONTAMINATION ASSESSMENT**  
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## 5.0 CONTAMINATION ASSESSMENT RESULTS

5.1 AQUIFER CHARACTERISTICS AND HYDROGEOLOGIC PARAMETERS. The sand-and-gravel aquifer is the primary water-bearing interval of concern at the site. The groundwater table was encountered at a depth of approximately 95 feet bls.

As previously stated, groundwater level measurements in the site monitoring well were collected on July 31 and November 21, 1992. These measurements are shown in Table 5-1.

**Table 5-1**  
**Top of Casing and Groundwater Elevations,**  
**August 3 and November 21, 1992**

Contamination Assessment Report  
Site 2866, Naval Air Station Whiting Field  
Milton, Florida

Well Number	July 31, 1992			November 21, 1992	
	TOC (feet)	DTW (feet)	Groundwater Elevation	DTW (feet)	Groundwater Elevation
WHF-2966-1	174.64	94.82	79.82	95.20	79.44

Notes: TOC = Top of Casing.  
DTW = Depth to Water.

The average hydraulic gradient across the site is  $1.6 \times 10^{-3}$  feet per foot (ft/ft) and slug tests results indicate an average horizontal hydraulic conductivity (K) of 9.55 feet per day (ft/day) (ABB Environmental Services, Inc., 1992b). The calculated pore water velocity (V) is 0.07 ft/day (ABB Environmental Services, Inc., 1992b). Equations used to calculate these values are presented in Appendix E, Aquifer Parameter Calculations.

## 5.2 CONTAMINANT PLUME DEFINITION AND CHARACTERIZATION.

5.2.1 Soil Contamination Discrete soil samples were collected from November 13 to November 15, 1991, and November 23, 1992, from soil borings using a standard penetration test (SPT) sampler at 5-foot intervals beginning at ground surface. Soil samples were analyzed using organic vapor analyzer (OVA) headspace techniques. A summary of the OVA analytical data is presented in Table 5-2. Volatile organic compounds (VOCs) were detected in very low concentrations in the nine borings. All nine borings, NES-SB-1 through NES-SB-7, WHF-2866-SB-8, and WHF-2866-SB-9, indicated VOC contamination in the soil at levels far below the State target concentration of 50 parts per million (ppm). The sample results indicate that petroleum soil contamination at the site is not significant.

5.2.2 Groundwater Assessment In Escambia County, which borders Santa Rosa County, the surficial zone of the sand-and-gravel aquifer has been demonstrated to be hydraulically connected with the main producing zone of the sand-and-gravel aquifer, making potable water supplies susceptible to contamination in these areas. Data gathered from previous studies indicate this condition is also

**Table 5-2**  
**Summary of Soil Sample Organic Vapor Analyzer (OVA) Headspace Analyses,**  
**November 13 through November 15, 1991, and November 23, 1992**

Contamination Assessment Report  
 Site 2866, Naval Air Station Whiting Field  
 Milton, Florida

Depth (feet)	NES-SB-							WHF-2866-SB-	
	1	2	3	4	5	6	7	8	9
0 to 5	0.6	0	1	0	0	0	0	0	0
5 to 7	1.8	0.2	0.6	0	0.2	0	0	1	0
10 to 12	1.4	0	1.2	0	0.3	0	0	0	0
15 to 17	0.2	0	1.2	0.2	0.4	0	0.1	0	0
20 to 22	0.2	0.2	0.4	0.3	0.1	0.2	NR	0	0
25 to 27	0.1	0	0.4	0.4	0.1	0	0.2	0	0
30 to 32	0.7	1.6	0.4	0	0.1	0	NR	0	0
35 to 37	0.1	1.4	0.6	0.5	0.4	0.2	0.1	0	1
40 to 42	0.3	2.3	0.4	0	0.2	0	0.1	0	0
45 to 47	0.4	3.8	0.4	0	0.3	0	0.3	1	0
50 to 52	NR	0	0.1	1	0.1	0	0.2	0	1
55 to 57	0.2	1	0.3	0	0	0	0.1	1	2
60 to 62	0.4	1.2	0.2	0	0.1	0	0.1	2	1
65 to 67	1	0	0.3	0.2	0.2	0	0.2	0	1
70 to 72	0.4	0.6	0.2	0.6	1.3	0.6	0.2	0	0
75 to 77	0	2	0.3	1.2	0.2	0.2	0.1	0	0
80 to 82	0.4	1	0.7	0.4	0	0	0.3	0	1
85 to 87	1.2	0	0.2	0	0.2	NR	0.3	0	1
90 to 92	NR	4	0.6	NR	0.2	0	0.1	0	1
95 to 97	0.4	0	0.3	NR	0	0		NR	NR
100 to 102	0.2	Wet	0.1	NR	0	0		NR	NR
105 to 107	0.2	Wet						NR	NR
110 to 112									NR

Notes: Concentrations are in parts per million.  
 Wet = saturated sample interval.  
 NR = no recovery.

present in the NAS Whiting Field area due to the regionally discontinuous clay lenses (ABB Environmental Services, Inc., 1992a). Therefore, the surficial zone at NAS Whiting Field will be considered a Class G-II water source as defined by FDER Chapter 17-3, Florida Administrative Code (FAC), and Class G-II State regulatory standards will be applied throughout this report.

Groundwater samples from the surficial zone were collected from monitoring well WHF-2866-1 on November 21, 1992. Samples were submitted to Wadsworth/ALERT Laboratories, Inc., in Tampa, Florida, for VOC analysis using U.S. Environmental Protection Agency (USEPA) Methods 601, 602, and for ethylene dibromide (EDB) analysis, and for lead analysis. These analyses were performed for constituents of the gasoline analytical group as outlined in FDER Chapter 17-770, FAC. Results of these analyses are presented in Appendix F.

Laboratory analyses detected methyl tert-butyl ether (MTBE), a constituent of the gasoline analytical group, in the groundwater sample at a concentration of 5 parts per billion (ppb). The State regulatory standard for MTBE is 50 ppb. 1,1-Dichloroethene and 1,1,1-trichloroethane were detected in the sample at concentrations of 4 ppb and 5 ppb, respectively. There are no State guidance standards for dichloroethene and trichloroethane.

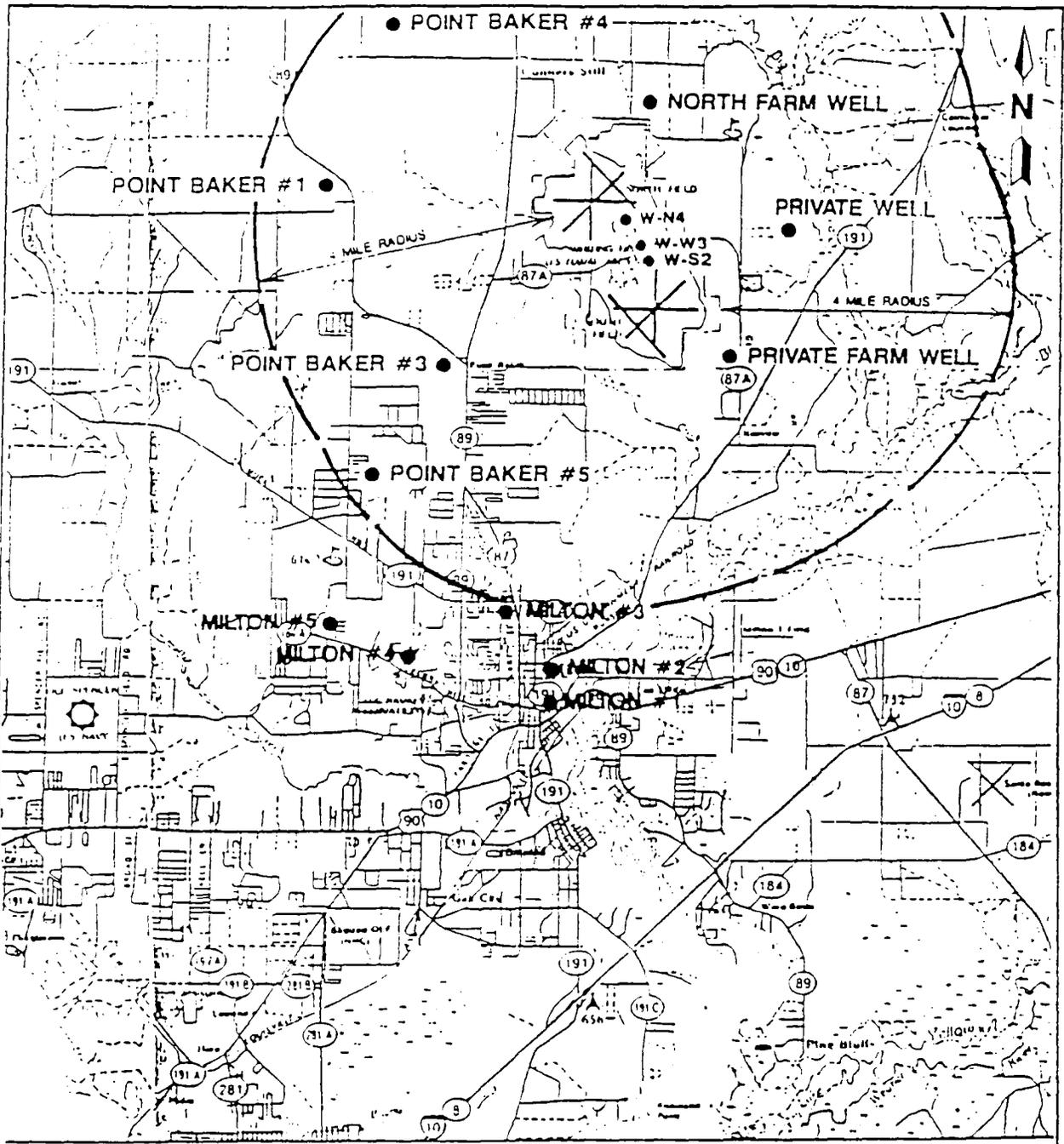
5.3 POTABLE WELL INVENTORY. An inventory of potable water wells near NAS Whiting Field was conducted as part of the Hazard Ranking System (HRS) II scoring performed by ABB-ES in May 1991.

All potable and industrial water supplies in the NAS Whiting Field vicinity are obtained from the sand-and-gravel aquifer. This aquifer extends from the surface to an approximate depth of 300 feet bls. Screened intervals of most production wells are at a depth of about 150 to 350 feet bls, depending on the surface elevation and the presence of clay lenses. A map showing the location of wells within 5 miles of NAS Whiting Field is presented in Figure 5-1.

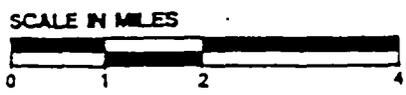
Water for the City of Milton is supplied by five wells, for East Milton by two wells, and for the Point Baker-Allentown area by three wells; all of which are screened in the sand-and-gravel aquifer and are outside a 4-mile radius of NAS Whiting Field.

Within the 4-mile radius of NAS Whiting Field, there are 10 wells. Four of these wells are part of the Point Baker municipal water system, and another three wells are privately controlled wells. The remaining three wells are the supply wells for NAS Whiting Field. Two of these wells, W-N4 and W-W3, are within the 0.25-mile radius of Site 2866. Both wells are upgradient of Site 2866.

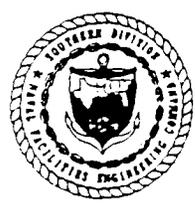
Potable water on base is currently supplied by three production wells: the north (W-N4), south (W-S2), and west (W-W3) production wells (Figure 5-2). These production wells replaced previously existing wells that were abandoned because of insufficient capacity or poor water quality. Current average pumping capacities from the wells at NAS Whiting Field are: north well (W-N4), 600 gallons per minute (gpm); west well (W-W3), 700 gpm; and south well (W-S2), 500 gpm. Pumping



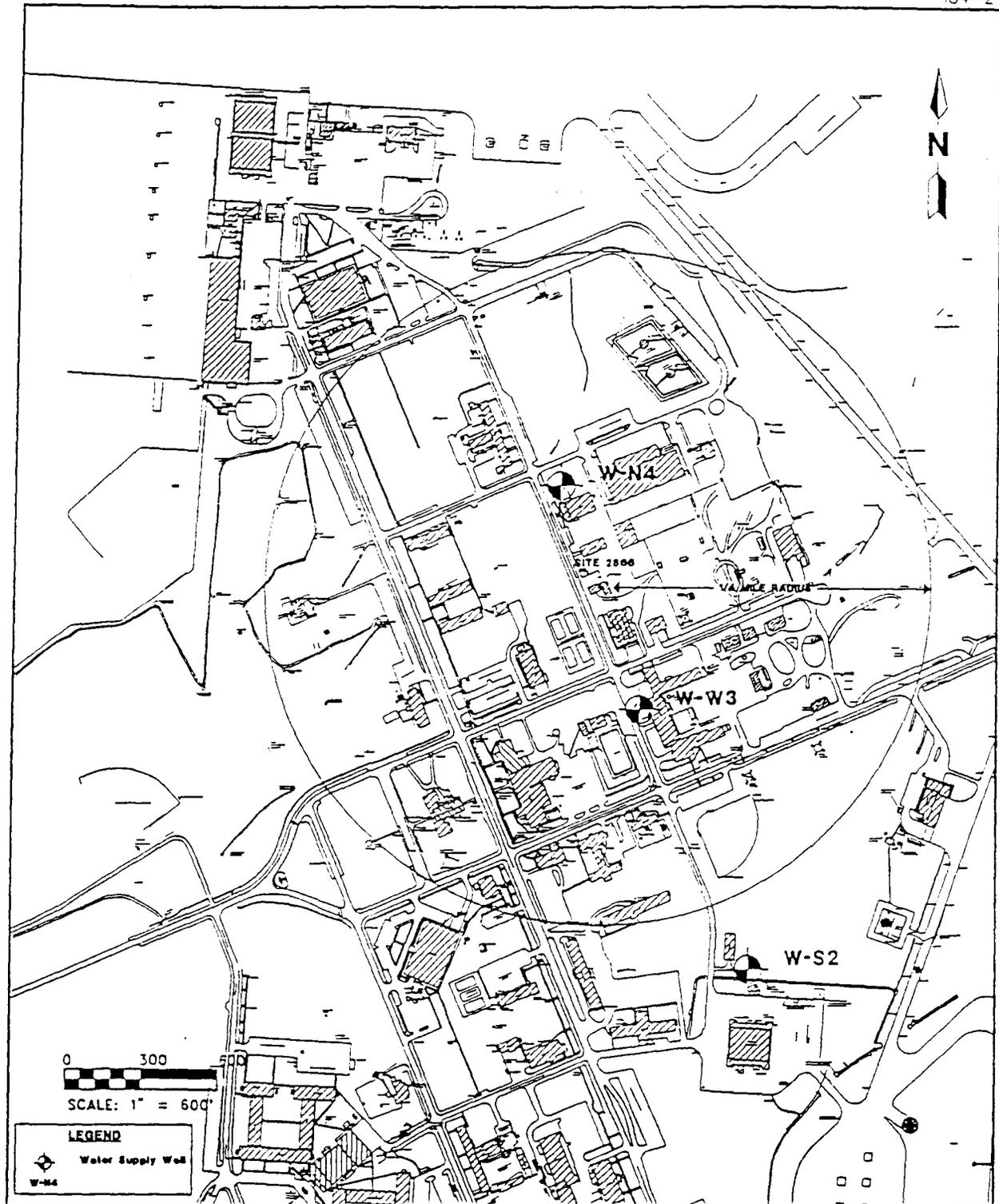
SOURCE: ATLAS AND GAZETEER  
DELOME PUBLISHING CO.



**FIGURE 5-1**  
**POTABLE WATER WELL LOCATIONS IN THE**  
**VICINITY OF NAVAL AIR STATION,**  
**MILTON, FLORIDA**



**CONTAMINATION ASSESSMENT**  
**REPORT, SITE 2866**  
  
**NAS WHITING FIELD**  
**MILTON, FLORIDA**



**FIGURE 5-2**  
**ACTIVE NAVY PRODUCTION WELLS**  
**AT NAS WHITING FIELD**



**CONTAMINATION ASSESSMENT**  
**REPORT, SITE 2866**

**NAS WHITING FIELD**  
**MILTON, FLORIDA**

rates, well depths, and screen intervals for the three base production wells are shown in Table 5-3 (Locklear, 1983).

**Table 5-3**  
**Production Rates for NAS Whiting Field Supply Wells**

Contamination Assessment Report  
Site 2866, Naval Air Station Whiting Field  
Milton, Florida

Well Designation	Pumping Rate (gpm)	Total Depth (feet)	Screen Interval
W-N4	600	230	156 - 230
W-W3	700	263	179 - 263
W-S2	500	234	160 - 234

Note: gpm = gallons per minute.

When the base was built in 1943, three production wells were drilled: the original north (W-N1), south (W-S1), and west (W-W1) wells. In 1951, these wells were abandoned and replaced by new wells (W-N2, W-S2, and W-W2) each within 75 feet of the original wells. These new wells were probably constructed to deliver increased yields.

The west (W-W2) and north (W-N2) wells, however, contained objectionable levels of iron and were replaced by W-W3 in 1965 and W-N3, respectively, in 1975. The replacement north well, originally drilled as a test well, was also found to have unacceptable iron concentrations and was subsequently abandoned and replaced by the currently used north production well (W-N4).

At the request of the FDER, supply well W-S2 was shut down on August 28, 1986, due to concentrations of benzene exceeding the Florida drinking water standard of 1 microgram per liter ( $\mu\text{g}/\ell$ ) in the groundwater. Production well W-W3 was also shut down on September 25, 1986, due to concentrations of trichloroethene greater than 3  $\mu\text{g}/\ell$ . Production well W-W3 has a granular activated carbon filter unit installed to reduce the concentration of trichloroethene detected in the groundwater.

NAS Whiting Field operated with service from only the north production well throughout most of 1987. Wells W-W3 and W-S2 were reactivated after installation of groundwater treatment systems. The treatment systems consist of granular activated carbon treatment at the wellhead followed by chlorination, pH adjustment, and addition of a sequestering agent to reduce iron precipitation. Testing of an activated carbon adsorption filtration system to treat water from the west well (W-W3) for trichloroethene removal began on November 3, 1987. Upon completion of the operational tests on December 1, 1987, the west well was returned to service. At the south production well (W-S2), an activated carbon filtration system was installed in early 1990.

## 6.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 SUMMARY. Based on data collected during the CA at NAS Whiting Field and literature on regional hydrologic conditions, the following conclusions can be made.

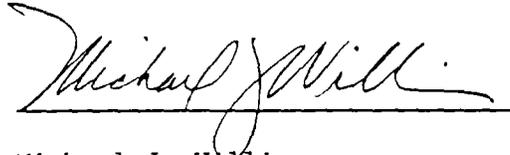
- In the vicinity of the site, the sand-and-gravel aquifer consists of an upper water-bearing zone and a lower water-bearing zone.
- The upper water-bearing zone and lower water-bearing zone are separated by a locally extensive clay layer approximately 10 feet thick in the vicinity of the site.
- Both surficial and deep zone sediments consist of poorly sorted, fine-to coarse-grained sand with gravel and lenses of clay.
- Surficial zone groundwater in the vicinity of the site was encountered at depths approximately 95 feet bls and is classified G-II.
- The calculated average hydraulic gradient across the site is 0.0016 ft/ft.
- The calculated average hydraulic conductivity at the site is 9.55 ft/day.
- The calculated average pore water velocity is 0.07 ft/day.
- OVA headspace analyses indicate minimal petroleum contamination in soils at the site.
- MTBE was detected in the groundwater sample at 11 parts per billion (ppb). The State regulatory standard for MTBE is 50 ppb.
- 1,1-Dichloroethene and 1,1,1-trichloroethane were detected in the sample at concentrations of 4 ppb and 5 ppb, respectively. There are no State guidance standards for dichloroethene and trichloroethane.
- Two potable wells are within the 0.25-mile radius of the site, but both are upgradient of the site and are not likely to be impacted by contamination at the site.

6.2 CONCLUSIONS. The level of soil and groundwater contamination identified at Site 2866 was minimal and does not exceed State regulatory standards.

6.3 RECOMMENDATIONS. Field screening of soil samples and laboratory analytical results of groundwater samples indicate concentrations of petroleum constituents well below State target levels. Therefore, a No Further Action Proposal (NFAP) is requested for Site 2866. However, due to the proximity of this site to the North Fuel Farm (Site 1467), a known highly contaminated site upgradient to Site 2866, a Monitoring Only Proposal (MOP) is recommended for WHF-2866-1. This MOP shall consist of quarterly sampling for a period of at least 1 year of monitoring well WHF-2866-1 for the gasoline analytical group. This plan allows the leading edge of the contaminant plume from the North Fuel Farm to be monitored.

7.0 PROFESSIONAL REVIEW CERTIFICATION

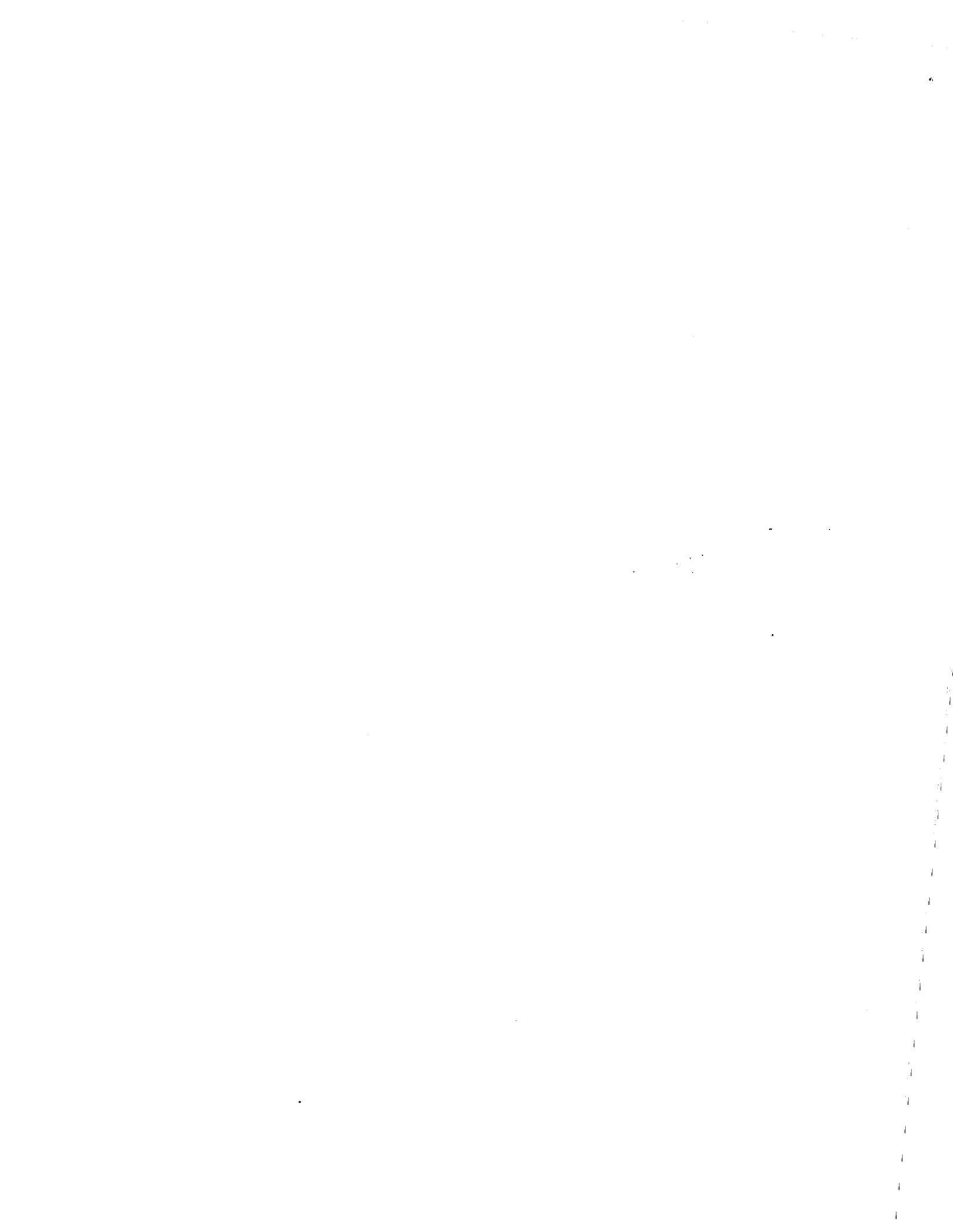
The contamination assessment contained in this report was prepared using sound hydrogeologic principles and judgment. This assessment is based on the geologic investigation and associated information detailed in the text and appended to this report. If conditions are determined to exist that differ from those described, the undersigned geologist should be notified to evaluate the effects of any additional information on the assessment described in this report. This Contamination Assessment Report was developed for Site 2866 at the NAS Whiting Field in Milton, Florida, and should not be construed to apply to any other site.



Michael J. Williams  
Professional Geologist  
P.G. No. 000344

2/2/93

Date



## REFERENCES

- ABB Environmental Services, Inc., 1991, Documentation Support for Hazard Ranking System II Scoring, Naval Air Station, Whiting Field, Milton, Florida.
- ABB Environmental Services, Inc., 1992a, Technical Memorandum No. 1, Geologic Assessment.
- ABB Environmental Services, Inc., 1992b, Technical Memorandum No. 2, Hydrogeologic Assessment.
- Bouwer, H., and Rice, J., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resource Research, Vol. 12, No. 3, p. 423-428.
- E.C. Jordan Company, 1990, Release Detection Program for Underground Storage Tanks, Naval Activities in the Florida Panhandle Area.
- Fetter, C.W., 1980, Applied Hydrogeology: Columbus, Ohio, Charles E. Merrill Publishing Company.
- Geraghty & Miller, Inc., 1989, AQTESOLV™, Aquifer Test Design and Analysis Computer Software: Version 1.1.
- Geraghty & Miller, Inc., 1986, Verification Study, Assessment of Potential Groundwater Pollution at Naval Air Station Whiting Field, Milton, Florida.
- Locklear, D., June 28, 1983, Memorandum of Verbal Communication between Locklear of Naval Air Station Whiting Field Public Works Department and Pat Scott of Layne Central.
- Puri, H.S., and Vernon, R.O., 1964, Summary of the Geology of Florida and a Guidebook to the Classic Exposures: Florida Geological Survey Special Publication No. 5, Revised edition, p. 7-15.
- Marsh, O.T., 1966, Geology of Escambia and Santa Rosa Counties, Western Florida Panhandle: Florida Bureau of Geology Bulletin No. 46, 140 p.
- Naval Energy and Environmental Support Activity, 1985, Initial Assessment Study of Naval Air Station Whiting Field, Milton, Florida: NEESA 13-072.
- Schmidt, W., 1978, Environmental Geology Series, Pensacola Sheet: Florida Bureau of Geology Map Series No. 78.



**APPENDIX A**  
**Precision Tests**



# ACUTEST

November 3, 1989

Mr. Ken Busen  
C.E. Environmental  
E.C. Jordon  
2571 Executive Center E.  
Suite 100  
Tallahassee, FL 32301

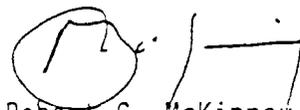
Test No. : 891028  
Test Date : October 28, 1989  
Location : NAS Whiting Field  
(near) Milton, FL

Dear Mr Busen:

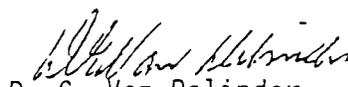
A precision test was performed on tanks at the above location using the LEAK COMPUTER® System. We have reviewed the data produced in conjunction with this test for purposes of verifying the results and certifying the tank systems. The testing was performed in accordance with AcuTest protocol, and therefore satisfies all requirements for such testing as set forth by NFPA 329-87 and USEPA 40 CFR part 280.

The results of testing are shown on the following page, and indicate whether the full systems, including the tank and all nonpressurized piping, or just the individual tank passed or failed. Included with the report are computer printouts of the data compiled during the last hour of each test. Each printout shows leak rate, and the confidence level (three times standard deviation) of that leak rate. This information is stored in a permanent file if future verification of test results is needed.

QUALITY ASSURANCE BY:

  
Robert G. McKinney  
T/A #004

TEST CERTIFIED BY:

  
D. G. Van Delinder  
A/T #049

OGV:smc\13

Test No. : 891028  
Test Date : October 28, 1989  
Location : NAS Whiting Field  
(near) Milton, FL

TEST RESULTS

PRODUCT	VOLUME (GAL)	WATER IN TANK (INCHES)	HIGH LEVEL LEAK RATE (GPH)	LOW LEVEL LEAK RATE (GPH)	FULL SYSTEM	TANK ONLY
UNLEADED	10,000	1"	-0.02 @ 23"	0.01 @ 6"	PASS	PASS

COMMENTS: The field technician could not run the product line test, because the line could not be isolated. The line needs to be broken at the union and capped off. When this is achieved AcuTest will schedule a line test of this system.

IP CHART FOR DATA RECORD: 89102883.A23 OF 10000 GALLON UNLEAD TANK @ N.S. WHITEING FIELD MILTON FL.

OPERATOR: CLARK/MOREY

Avg of 10 Cycles / Line Feed: 6 IPH / Total Test Time: 290.4 Min / Density: .72 / Tank Temp @ Start: 71 F / COE: .000664

----- a = 10 F ----->  
 ----- t = .1 F ----->  
 ----- V = .1 gal ----->

AVG THREE  
 LEAK STD  
 RATE DEV

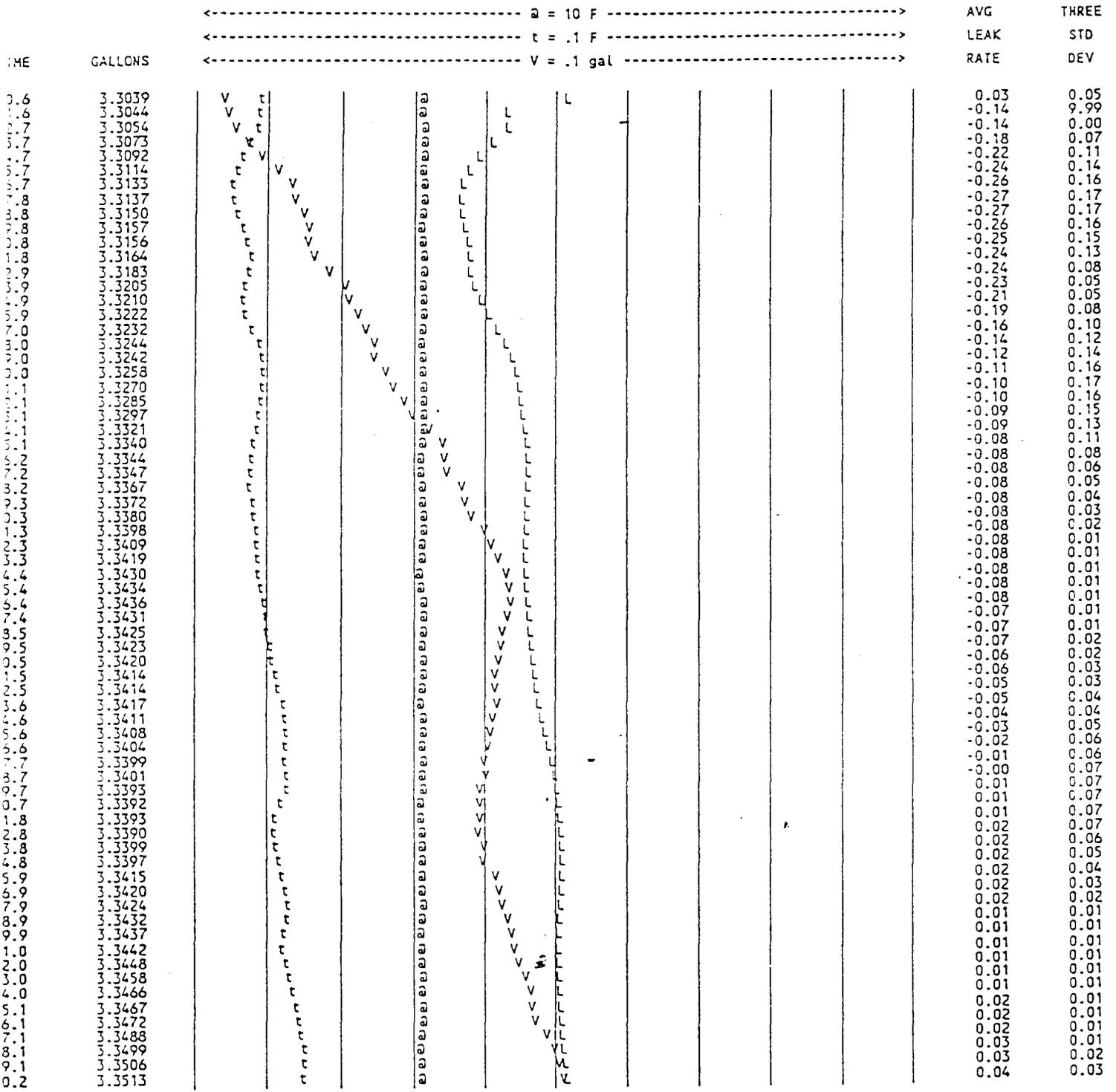
TIME	GALLONS	AVG LEAK RATE	THREE STD DEV
3.2	3.7149	-0.03	0.03
4.2	3.7167	-0.28	9.99
48.3	3.7179	-0.16	0.24
49.3	3.7195	-0.07	0.31
5.3	3.7210	-0.00	0.36
1.3	3.7228	0.05	0.39
2.4	3.7241	0.08	0.41
3.4	3.7259	0.10	0.41
4.4	3.7279	0.12	0.42
5.4	3.7293	0.13	0.42
6.4	3.7310	0.14	0.42
7.4	3.7322	0.19	0.32
8.5	3.7339	0.21	0.25
9.5	3.7351	0.21	0.21
10.5	3.7369	0.20	0.17
11.5	3.7383	0.19	0.15
12.5	3.7405	0.17	0.12
13.5	3.7420	0.15	0.10
14.6	3.7438	0.13	0.09
15.6	3.7456	0.11	0.10
16.6	3.7472	0.10	0.12
17.6	3.7489	0.08	0.14
18.7	3.7504	0.08	0.15
19.7	3.7520	0.07	0.14
20.7	3.7536	0.06	0.13
21.7	3.7548	0.06	0.12
22.8	3.7563	0.06	0.10
23.8	3.7579	0.06	0.08
24.8	3.7582	0.06	0.06
25.8	3.7580	0.06	0.04
26.9	3.7585	0.06	0.03
27.9	3.7599	0.06	0.02
28.9	3.7614	0.06	0.01
29.9	3.7633	0.05	0.01
30.9	3.7646	0.05	0.01
31.9	3.7665	0.05	0.01
33.0	3.7680	0.05	0.01
34.0	3.7692	0.05	0.01
35.0	3.7708	0.05	0.01
36.0	3.7733	0.05	0.01
37.0	3.7742	0.05	0.01
38.0	3.7758	0.04	0.01
39.0	3.7776	0.04	0.02
40.0	3.7790	0.03	0.02
41.0	3.7803	0.03	0.03
42.0	3.7824	0.02	0.03
43.1	3.7843	0.01	0.04
44.1	3.7854	0.00	0.05
45.1	3.7870	-0.00	0.05
46.2	3.7882	-0.01	0.06
47.2	3.7901	-0.02	0.07
48.2	3.7919	-0.03	0.07
49.2	3.7929	-0.03	0.07
50.3	3.7943	-0.04	0.07
51.3	3.7957	-0.04	0.06
52.3	3.7951	-0.03	0.05
53.3	3.7961	-0.03	0.04
54.3	3.7970	-0.03	0.03
55.3	3.7954	-0.03	0.02
56.3	3.7945	-0.03	0.02
57.3	3.7960	-0.03	0.01
58.4	3.7974	-0.02	0.01
59.4	3.7988	-0.02	0.01
60.4	3.8005	-0.02	0.01
61.4	3.8010	-0.02	0.01
62.4	3.8011	-0.02	0.01
63.5	3.8018	-0.02	0.01
64.5	3.8031	-0.02	0.01
65.5	3.8046	-0.02	0.00
66.5	3.8063	-0.03	0.00

END OF STRIP CHART 89102883.A23 DATA COLLECTED ON LEAK COMPUTER S/N 87081307

STRIP CHART FOR DATA RECORD: 89102882.A06 OF 10000 GALLON UNLEAD TANK @ W.S. WHITEING FIELD MILTON FL.

OPERATOR: CLARK/MOREY

RATE AVG OF 10 CYCLES / LINE FEED: 6 IPH / TOTAL TEST TIME: 80.8 MIN / DENSITY: .71 / TANK TEMP @ START: 71 F / COE: .000664



END OF STRIP CHART 89102882.A06 DATA COLLECTED ON LEAK COMPUTER S/N 87081307

## HOW TO READ AN ACUTEST STRIP CHART

NOTE: The example which follows is a record of an actual test performed in Austin, Texas on December 15, 1988. (The customer's name and location have been changed) The tank was found to be leaking at 3" above tank top and was subsequently repaired by replacement of a pipe fitting and returned to service. Two different leak rates were obtained with two levels of fluid in the riser which permitted identification of the leak source at tank top. While each test was run for a period of several hours, only the last hour of data is recorded in each final report, with each line showing a calculated leak rate based on an average of 250 readings of temperature and volume change during a period of approximately one minute.

DATA RECORD. This line identifies an individual test with a number representing the date (YYMMDD) followed by a two-digit serial number, the alphabetic channel designation and a number representing the height of fluid in the riser in inches. The Tank Volume and Product in the tank are also shown on this line.

LOCATION. Site location is shown on the second line, together with operator name.

LEAK RATE AVERAGE. The number of cycles (minutes) of data used to calculate average leak rate and standard deviation is shown. This number is selected based on the variability of data values, and can be as high as 60 cycles (1 hour of data).

LINE FEED. This is the travel in inches/hour of the strip chart (e.g. 7.5 vertical inches - 1 hour on the chart). Time (in minutes since midnight) is recorded along the left-hand margin of the strip chart.

DATA CONSTANTS. Coefficient of expansion for the product tested and its measured density are shown on the fourth line.

@ = MID-TANK TEMPERATURE. The initial value is shown in degrees Fahrenheit in the heading. Subsequent values are recorded on the strip chart according to the scale given in the heading. This variable is plotted for information purpose only, and is not used in calculation of leak rate. Mid-tank temperature increases toward the right.

t = AVERAGE TANK TEMPERATURE. These symbols record the change in average liquid temperature. Each chart division represents 0.01 degrees F, and positive change is toward the right.

- V = LIQUID VOLUME. This is the volume of liquid in the measuring cylinder. The amount at the end of each cycle is given under the column titled GAL, and is also plotted on the strip chart with each division line representing a change of 0.01 gallons. Movement to the left means liquid added to the underground tank in order to maintain a constant level (i.e., underground liquid volume is decreasing).
- L = LEAK RATE. The leak rate is the average value of leak rate for the number of cycles shown in the heading. Each cycle is, in turn, an average of 150 actual measurements and is printed out as one line on the strip chart. The leak rate value is printed out in gal/hr near the right edge of the chart.

Zero for the plotted value of leak rate is the center of the strip chart. Each division line represents 0.2, 2, or 20 gal/hr depending upon the calculated value of average leak rate. A positive leak rate value is a leak out of the tank, and will plot toward the right of the center line. A negative leak rate value is an "in-leak" (e.g. drain-back from a pipe or the effect of a vapor pocket), and will plot toward the left of the center line.

NOTE: The starting point for plotting of each variable except leak rate is arbitrary, and has no significance regarding absolute value. since only change is being plotted.

THREE TIMES STANDARD DEVIATION. THE STANDARD DEVIATION (a statistical measure) of leak rate for the number of cycles used to calculate the average leak rate (usually 30) is calculated once per cycle and multiplied by 3. The smaller this number becomes, the less random variation there is in the sampled data and the greater confidence that the leak rate has stabilized and is accurate. For example, a leak rate of .20 with a THREE TIMES STANDARD DEVIATION of .04 means we are 99% sure that the true value of leak rate will lie in the range  $.20 \pm .04$ , or between .24 and .16 gal/hr. Conversely, there is only a 1% chance it will fall outside that range, and the MOST LIKELY VALUE is the calculated leak rate of .20 gal/hr.





# ACUTEST

November 20, 1989

Mr. Ken Busen  
C.E. Environmental  
E.C. Jordon  
2571 Executive Center E.  
Suite 100  
Tallahassee, FL 32301

Test No. : 891028                      REVISED REPORT  
Test Date : October 28, 1989  
Location : NAS Whiting Field  
          (near) Milton, FL

Dear Mr Busen:

A precision test was performed on tanks at the above location using the LEAK COMPUTER® System. We have reviewed the data produced in conjunction with this test for purposes of verifying the results and certifying the tank systems. The testing was performed in accordance with AcuTest protocol, and therefore satisfies all requirements for such testing as set forth by NFPA 329-87 and USEPA 40 CFR part 280.

The results of testing are shown on the following page, and indicate whether the full systems, including the tank and all nonpressurized piping, or just the individual tank passed or failed. Included with the report are computer printouts of the data compiled during the last hour of each test. Each printout shows leak rate, and the confidence level (three times standard deviation) of that leak rate. This information is stored in a permanent file if future verification of test results is needed.

QUALITY ASSURANCE BY:



Robert G. McKinney  
T/A #004

TEST CERTIFIED BY:



Andrew R. Herdman  
A/T #005

DGV:smc\13

Test No. : 891028 (REVISED)  
 Test Date : October 28, 1989  
 Location : NAS Whiting Field  
 (near) Milton, FL

TEST RESULTS

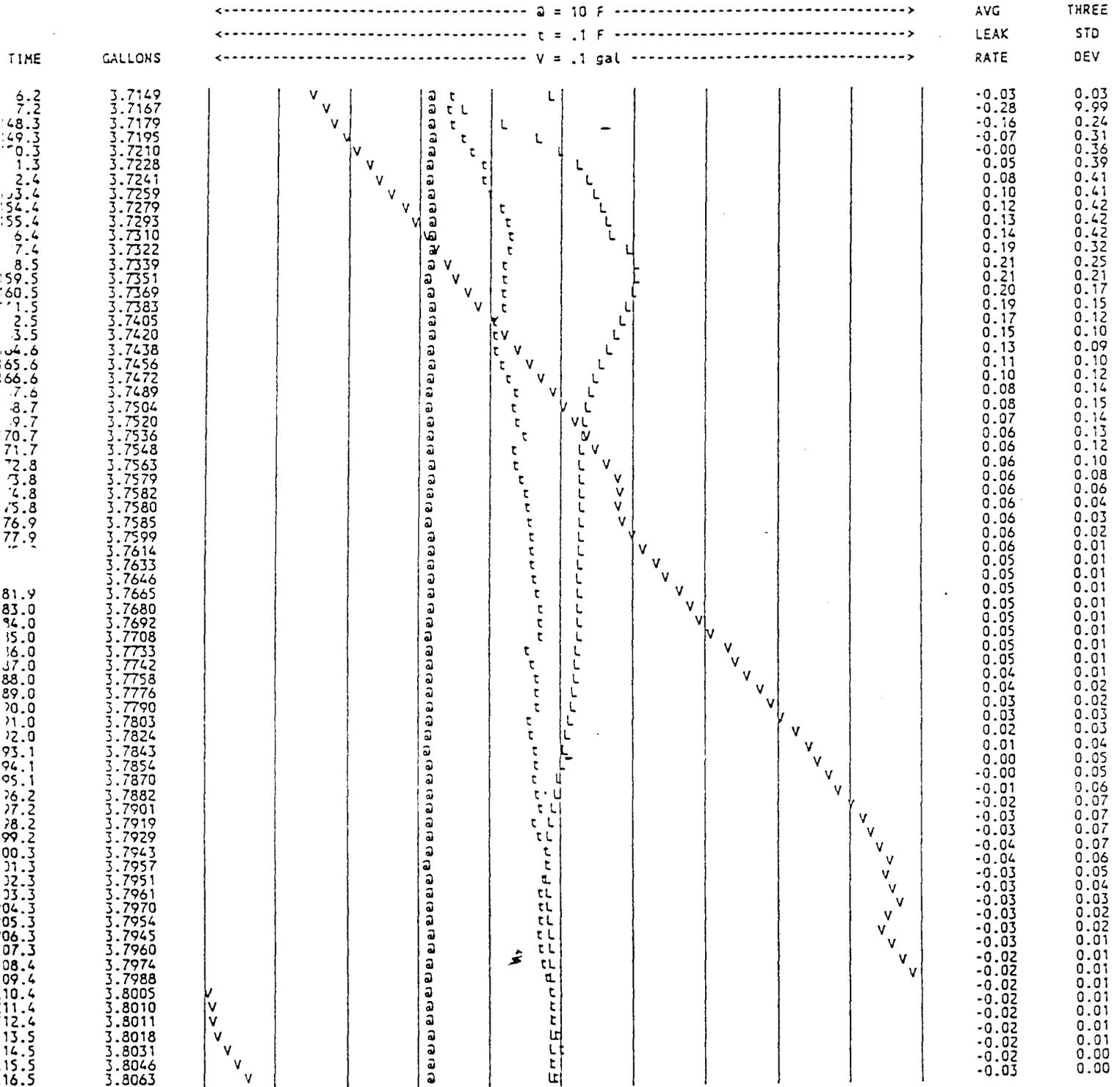
PRODUCT	VOLUME (GAL)	WATER IN TANK (INCHES)	HIGH LEVEL LEAK RATE (GPH)	LOW LEVEL LEAK RATE (GPH)	FULL SYSTEM	TANK ONLY
UNLEADED	10,000	1"	-0.02 @ 23"	0.01 @ 6"	PASS	PASS
UNLEADED	10,000	-	V I S I B L E	L E A K	FAIL	FAIL
LEADED	10,000	-	V I S I B L E	L E A K	FAIL	FAIL

COMMENTS: The field technician could not run the product line test, because the line could not be isolated. The line needs to be broken at the union and capped off. When this is achieved AcuTest will schedule a line test of this system.

TRIP CHART FOR DATA RECORD: 89102883.A23 OF 10000 GALLON UNLEAD TANK @ N.S. WHITEING FIELD MILTON FL.

OPERATOR: CLARK/MOREY

TEST AVG OF 10 CYCLES / LINE FEED: 6 IPH / TOTAL TEST TIME: 290.4 MIN / DENSITY: .72 / TANK TEMP @ START: 71 F / COE: .000664

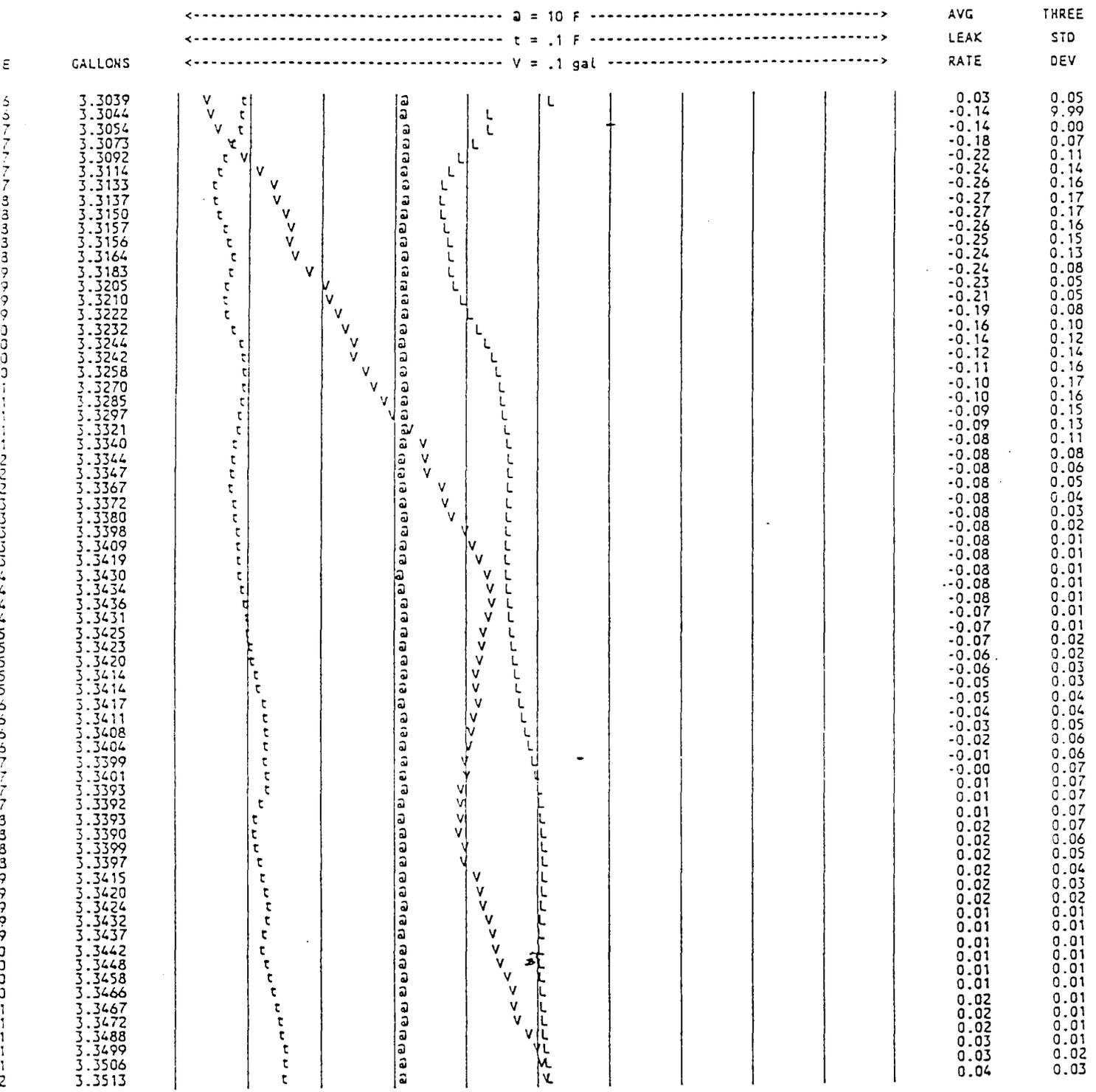


END OF STRIP CHART 89102883.A23 DATA COLLECTED ON LEAK COMPUTER S/N 87081307

CHART FOR DATA RECORD: 89102882.A06 OF 10000 GALLON UNLEAD TANK @ H.S. WHITEING FIELD MILTON FL.

OPERATOR: CLARK/MOREY

RATE AVG OF 10 CYCLES / LINE FEED: 6 IPH / TOTAL TEST TIME: 80.8 MIN / DENSITY: .71 / TANK TEMP @ START: 71 F / COE: .000664



END OF STRIP CHART 89102882.A06 DATA COLLECTED ON LEAK COMPUTER S/N 87081307

**APPENDIX B**  
**Site Conditions**



## Physiography

The Northern Highlands are divided into a number of smaller zones. Naval Air Station (NAS) Whiting Field is located within the Western Highlands subdivision. This zone is characterized by southward sloping hills and plateaus, which have been cut by numerous streams. Elevations generally range from 50 to 200 feet above mean sea level (msl).

## Hydrogeology

Sand-and-Gravel Aquifer. The uppermost sediments, extending to a depth of approximately 350 feet below land surface (bls), comprise the sand-and-gravel aquifer, which is subdivided into two units. The water table or upper part of the sand-and-gravel aquifer does not constitute a source for large water supplies; however, its primary importance is to recharge the lower, more productive zone of the aquifer. The results of an aquifer test in the Milton area indicate the clayey sand confining unit separating the upper and lower aquifer zones is very leaky. Most large capacity wells in the area, such as the NAS Whiting Field supply wells, are screened in the lower part of the aquifer from about 180 to 300 feet bls (Geraghty & Miller, 1986).

The sand-and-gravel aquifer includes the upper Miocene coarse clastics, the Citronelle Formation, and marine terrace deposits. These three units have similar hydraulic properties and are sometimes indistinguishable. The aquifer consists of poorly sorted, fine- to coarse-grained sand with gravel and lenses of clay. The clay may be as much as 60 feet thick. In some areas, the formation also contains wood fragments. The part of the formation that contains the wood fragments may be as much as 25 feet thick (Marsh, 1966). However, boring logs of wells drilled at NAS Whiting Field do not indicate the presence of these wood fragments (Geraghty & Miller, 1986).

The aquifer contains lensatic zones within the sand that are cemented by iron-oxide minerals. The lenses, known locally as hardpans, have lower permeabilities and, along with the clay lenses, are responsible for the occurrence of perched water tables and semi-artesian conditions in the aquifer. In the NAS Whiting Field area, clay lenses occur in the uppermost 30 feet and in the depth interval of approximately 100 to 170 feet bls (elevation 10 to 70 feet above msl). Although the clays appear to be continuous, they may contain permeable zones or windows (NEESA, 1985). The direction of groundwater flow is generally to the southwest.

Floridan Aquifer System. Underlying the sediments of the sand-and-gravel aquifer is the thick (approximately 300 feet), relatively impermeable Pensacola Clay. Below the Pensacola Clay are thick layers of limestone and shale to a depth of nearly 2,000 feet.

The limestone layers constitute the regionally extensive Floridan aquifer system. In the area of NAS Whiting Field, the Floridan aquifer is divided into an upper and lower part separated by the Bucatunna Clay. The Floridan aquifer system receives little or no recharge from the sand-and-gravel aquifer because of the Pensacola Clay confining unit. The potentiometric surface of the Upper Floridan aquifer in the NAS Whiting Field area is about 50 to 55 feet above msl.



**APPENDIX C**

**Lithologic Logs**

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-1
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 105 FT.
LOGGED BY: R. Durham	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH F.T.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5			0.6	SAND: Brown-orange, very fine- to medium-grained, trace silt, trace clay.		SM		POSTHOLE
	2.0/2		1.8	SANDY CLAY: Orange-brown to red-brown, low plasticity.		CL	12,12,20,20	
10			1.4	CLAYEY SAND: Orange-brown to red-brown, very fine-grained.		SC		
	1.8/2			CLAY: Red-brown, trace sand, moderate plasticity.		CL	12,12,14,18	
15			0.2	CLAYEY SAND: Buff to light pink, very fine-grained.		SC	7,7,10,9	
	2.0/2		0.2	CLAYEY SAND: Orange-brown to red-brown.		SC	4,6,5,5	
25			0.1	SAND: Light orange-brown to red-brown, very fine- to medium-grained with some clay lenses, damp.		SM	4,5,5,5	

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-1
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 105 FT.
LOGGED BY: R. Durnam	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
				Continued from PAGE 1				
		1.2/2	0.7			SM	7.7,6.7	
35		1.4/2	0.1	SAND: Buff to light orange to pink, very fine- to fine-grained.		ML	10,15,20,22	
40		1.8/2	0.3	SAND: Buff to light pink, very fine- to fine-grained with some quartz gravel.			7,11,17,12	
45		1.8/2	0.4	SAND: Buff, very fine- to fine-grained.			12,17,17,25	
50		1.6/2	N/A	SAND: Buff, very fine- to medium-grained.		SM	7,10,10,12	
55		1.6/2	0.2	SAND: Buff, very fine- to fine-grained.		ML	10,9,9,7	
60						SM		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-1
CLIENT: SOUTHNAVFACENGCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 105 FT.
LOGGED BY: R. Durham	WELL DEVELOPMENT DATE:	SITE: 2866	

DEPTH FT	LABORATORY SAMPLE ID	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
		1.5/2	0.4	SAND: Buff to orange-red to pink, very fine- to medium-grained.		SM	15,20,10,9	
65		1.5/2	1.0	SANDY CLAY: Rust to yellow-brown, high plasticity.		CL	2,1,2,R	
70		2.0/2	0.4	SAND: Buff to pink-orange, very fine- to fine-grained, damp.		ML	10,9,9,15	
75		1.8/2	0.0	SAND: Buff, very fine- to fine-grained, damp.			8,15,20,19	
80		1.8/2	0.4				17,17,17,30	
85		2.0/2	1.2	SAND: Buff to red-orange, very fine- to very coarse-grained with some fine gravel, poorly sorted, damp.		GM	29,30,30,33	
90								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-1
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 105 FT.
LOGGED BY: R. Curham	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		1.6/2	N/A	SAND: Buff to pink to brown-yellow to light purple, fine- to coarse- grained, poorly sorted, damp.		GM	40,50,59,63	
95		2.0/2	0.4	CLAY: Red-orange, high plasticity, slightly sandy, slightly moist.		CH	6,7,16,19	
100		2.0/2	0.2	SAND: Yellow to white mottled red, trace silt, trace clay, slightly moist.		ML	8,8,7,7	
105		2.0/2	0.2	CLAY: Red to gray, high plasticity, silty, slightly moist.		CH	10,8,9,9	
110								
115								
120								

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-2
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/13/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107 FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
0.0			0.0	CLAYEY SAND. Brown, very fine-grained.		SC		POSTHOLE
5		2.0/2	0.2	SILTY CLAY: Brown and red mottled, poor plasticity.		CL	3,4,6,6	
10		1.6/2	0.0	CLAY: Red, brown, and gray mottled, high plasticity.		CH	6,8,9,12	
15		1.5/2	0.0	SILTY CLAY: Red, tan and pale yellow mottled, poor plasticity.		CL	7,4,6,6	
20		2.0/2	0.2	CLAY: Dark red and light brown mottled, moderate plasticity, some silt.		CH	5,5,8,8	
25		1.4/2	0.0	SAND: Red, light red, very fine- to medium-grained, trace silt. CLAY: Gray and red mottled, moderate to poor plasticity, some silt.		SM CL	2,3,4,5	
30								

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-2
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/13/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro		WELL DEVELOPMENT DATE:	SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
	1.8/2	1.6		SAND: Red, light red, white, very fine- to fine-grained, well-sorted, heavy minerals.		CL ML	9,7,9,7	
35	1.5/2	1.4		SAND: Light red and white, very fine-grained, well-sorted, some large grained quartz gravel.			8,8,15,14	
40	1.2/2	2.3		SAND: White, red, very fine-grained, well-sorted, trace of quartz gravel.			6,11,18,17	
45	2.0/2	3.8		SAND: Light gray to white to light tan, very fine-grained, well-sorted.			14,15,18,19	
50	1.8/2	0.0		SAND: White, medium-grained with some gravel-sized quartz grains, well-sorted.		SP	12,16,20,20	
55	1.6/2	1.0		SAND: White to light gray with black layers, very fine-grained, well-sorted, some mica, slightly damp.		ML	5,8,10,12	
60								



TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-2
CLIENT: SOUTHNAVFACENCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/13/91	COMPLTD: 11/13/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		1.4/2	4.0	SAND: Light red, light gray, light brown, medium- to coarse-grained, trace silt, poorly sorted.		SW	22,23,25,27	
95		2.0/2	0.0	SAND: Light red, light brown, medium-grained, well-sorted. SAND: Dark red, medium- to coarse-grained, moderate to well-sorted, wet.		SP	10,10,2,4,14	
100		2.0/2	N/A	SILTY CLAY: Red, brown mottled, poor plasticity, silty, saturated.		CL	4,3,5,4	
105		NA	N/A	CLAY: Brown, light brown, red-gray, and black, high plasticity, trace silt, trace sand.		CH	Wt. of Rod	
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-3
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT OPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: C. King/R. Durham		WELL DEVELOPMENT DATE:	SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5			1.0			SC		
			0.6	CLAYEY SAND: Dark brown to orange-brown, fine-grained, slightly clayey.				POSTHOLE
	1.0/2							6,5,5,5
10			1.2	CLAY: Brown to red, high plasticity.		CH		
	1.5/2							6,7,7,5
15			1.2	SAND: Brown-red, fine-grained, trace clay.		ML		
	0.5/2							8,10,9,9
20			0.4					
	1.0/2							5,11,10,10
25			0.4	CLAYEY SAND: Buff to pink, fine-grained.		SC		
	2.0/2							7,8,8,9
30						SM		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-3
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: C. King/R. Durham	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA	
Continued from PAGE 1									
		1.5/2	0.4	SAND: Buff to white to pink, very fine- to medium-grained, well- sorted.	[Diagonal Hatching]	SM	8,8,9,8		
35		1.5/2	0.6					10,18,17,18	
40		1.5/2	0.4	SAND: Buff to white, fine- to medium-grained.				17,20,21,20	
45		1.0/2	0.4					25,30,30,27	
50		1.2/2	0.1	SAND: Buff to light orange, very fine- to medium-grained.				20,22,23,22	
55		2.0/2	0.3	SAND: Buff, very fine- to fine-grained. CLAY: Mauve, high plasticity.			ML CH	13,8,6,7	
60									

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-3
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: C. King/R. Durham	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
		2.0/2	0.2	CLAY: Orange-red to light pink, moderate plasticity, grading to yellow-brown sandy clay.		CH	6.7.7.6	
65		1.4/2	0.3	SAND: Orange-red to yellow-brown to pink, very fine- to medium- grained, damp.		SM	7.7.8.8	
70		1.3/2	0.2	SAND: Pink to orange-red to yellow, very fine- to medium- grained.		ML	20.15.10.10	
75		2.0/2	0.3	SAND: Light pink to white, very fine- to fine-grained.		ML	20.20.22.23	
80		1.3/2	0.7	SAND: Buff, very fine- to medium-grained.		SM	30.31.20.30	
85		1.5/2	0.2	SAND: Buff to red, fine-grained.		ML	15.23.30.39	
90						SW		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-3
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO ∇ 95 FT.
LOGGED BY: C. King/R. Durham	WELL DEVELOPMENT DATE:	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
				Continued from PAGE 3				
		1.5/2	0.6	SAND: white to pink to yellow, medium- to coarse-grained, slightly damp.		SW	12,15,15,20	
95		2.0/2	0.3	SAND: Tan to light brown and light red, very fine- to coarse-grained, well-graded, saturated.		GM	15,17,30,35	
100		2.0/2	0.1	CLAY: Brown-red to yellow-brown, high plasticity.		CH	12,9,7,7	
105								
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-4
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 07518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
0.0				CLAYEY SAND: Red, very fine-grained.		SC		POSTHOLE
5		1.5/2	0.0	CLAY: Red, poor plasticity, trace silt, trace sand.		CL	2,3,2,4	
10		1.2/2	0.0	CLAY: Red and gray mottled, high plasticity, stiff.		CH	7,5,7,14	
15		1.3/2	0.2	SANDY CLAY: Gray mottled red, poor plasticity.		CL	3,4,7,8	
20		1.2/2	0.3	CLAY: Red and gray mottled, dark red, high plasticity, trace silt.		CH	5,4,5,6	
25		1.5/2	0.4	SILTY CLAY: Gray mottled red, moderate to high plasticity; trace silt.		CL	5,7,7,5	
30								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-4
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 07518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
		1.6/2	0.0	SAND: Pink to gray, very fine-grained, poorly sorted, trace clay.	CL ML		6,9,9,8	
35		1.2/2	0.5	SAND: Light gray, red and pale yellow, fine- to medium-grained, well- sorted, trace mica.	SM		11,12,14,15	
40		1.0/2	0.0	SAND: Red, light gray and tan, very fine- to fine-grained, moderately sorted, some mica.	ML		11,12,15,16	
45		1.6/2	0.0	SAND: Light gray to off-white, fine-grained, well sorted, some heavy minerals.	SM		8,14,16,17	
50		1.7/2	1.0	SAND: Light gray to buff, very fine- to medium-grained, with some gravel-sized quartz grains, poorly sorted.	ML		3,11,17,17	
55		1.0/2	0.0	SAND: Light gray to buff, very fine-grained, well-sorted, some mica.	ML		6,8,15,12	
60								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-4
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 07518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVER %	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
	1.4/2	0.0		SAND: Light gray to red, very fine- to coarse-grained with some gravel-sized quartz grains, poorly sorted.		ML GM	8,11,11,10	
65	0.9/2	0.2		SAND: Light gray to red, very fine-grained with some gravel-sized quartz grains, well-sorted.		ML	Wt. of Rod	
70	1.6/2	0.6				ML	11,18,18,19	
75	1.8/2	1.2		SAND: Light gray to buff to pink with trace black mineral grains, very fine-grained, well-sorted.		ML	9,15,18,18	
80	1.7/2	0.4				ML	9,14,21,23	
85	1.7/2	0.0		SAND: Light gray to pink, very fine-grained, well-sorted.		ML	12,42,44,46	
90								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-4
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 07518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		2.0/2	N/A	SAND: Light gray to red, very fine-grained, well-sorted, some mica, some heavy minerals, damp.		ML	21,42,44,46	
95		1.5/2	N/A	SAND: Brown to light gray, very fine- to coarse-grained, poorly- sorted, some large quartz gravel, saturated.		GM	16,16,25,33	2
100		2.0/2	N/A	SAND: Light red, gray and pale yellow, medium-grained, well-sorted. CLAY: Dark red and gray mottled, high plasticity.		SP		
						CH	3,7,5,5	
105								
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: R. Durnam/C. King	WELL DEVELOPMENT DATE:	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5						SC		
							POSTHOLE	
	1.5/2	0.2		CLAYEY SAND: Dark brown to orange, very fine-grained.			5,5,6,8	
10						CL		
	1.2/2	0.3		SANDY CLAY: Orange-brown. CLAY: Red to buff, trace silt. trace fine sand.			10,12,15,15	
15						ML		
	1.3/2	0.4		SAND: Orange-red to buff, silty.			10,12,12,12	
20						SC		
	1.2/2	0.1		CLAYEY SAND; Red-brown. SANDY CLAY: Red-brown to yellow, moderate plasticity.		CL	7,5,7,7	
25						SC		
	1.5/2	0.1		CLAYEY SAND: Red-brown, very fine- to medium-grained.			18,9,9,10	
30						ML		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENGCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: R. Durham/C. King	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
				Continued from PAGE 1				
		1.6/2	0.1	SAND: Buff to light pink, very fine- to fine-grained.		ML	14,14,14,14	
35		1.2/2	0.4	SAND: Buff to pink to yellow-brown, very fine- to fine-grained.		ML	15,14,14,12	
40		1.0/2	0.2	CLAYEY SAND: Yellow-brown. SAND: Buff to light pink, very fine- to fine-grained.		SC	10,10,9,10	
45		1.6/2	0.3	SANDY CLAY: Yellow-brown. SAND: Buff, very fine- to fine-grained.		CL	15,15,15,17	
50		1.7/2	0.1	SANDY CLAY: Yellow-brown. SAND: Buff, very fine- to fine-grained, trace clay.		ML	15,20,20,19	
55		1.0/2	0.0	CLAY: Mauve-colored. SAND: Buff, very fine- to fine-grained.		CL	15,20,26,32	
60						ML		
						CL		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: R. Durham/C. King		WELL DEVELOPMENT DATE:	SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
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Continued from PAGE 2

65	1.4/2	0.1	SANDY CLAY: Yellow-brown to orange-brown. SAND: Buff, very fine- to fine-grained, trace silt.	CL ML	20,30,32,35
	0.9/2	0.2	SAND: Buff to orange-yellow, very fine- to medium-grained.	SM	12,22,29,29
	1.6/2	1.3	CLAYEY SAND: Yellow-brown. SAND: Buff, very fine- to medium-grained with some coarse quartz grains and occasional gravel.	SC SM	19,20,20,21
	1.8/2	0.2	SAND: Buff, very fine- to medium-grained.	SM	20,20,19,20
	1.7/2	0.0		SM	15,15,19,19
85	1.7/2	0.2	SAND: Buff, fine- to medium-grained with occasional fine gravel.	SM	25,25,45,62
90				SW	

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/14/91	COMPLTD: 11/14/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: R. Durham/C. King	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		2.0/2	0.2	SAND: Dark pink to light pink, medium- to coarse-grained with some gravel, poorly sorted, saturated.		SW	15,20,20,30	
95		1.5/2	0.0	CLAY: Orange-red to yellow to tan, moderate to high plasticity, damp.		CH	10,12,18,18	
100		2.0/2	0.0	CLAY: Red-orange to yellow-tan, silty, high plasticity, damp.			3,4,4,4	
105								
110								
115								
120								

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-6
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/15/91	COMPLTD: 11/15/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 100 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
0.0			0.0	SAND: Light brown, very fine-grained, trace silt, poorly sorted.		ML		POSTHOLE
5	1.8/2		0.0	CLAYEY SAND: Brown to light brown, very fine-grained, poorly sorted.		SC	4,4,5,5	
10	1.6/2		0.0	CLAY: Red and light gray mottled, high plasticity.		CH	6,7,9,10	
15	1.4/2		0.0	SANDY CLAY: Red and light gray mottled, moderate to low plasticity, silty.		CL	4,5,5,9	
20	1.7/2		0.2	SANDY CLAY: Red and white mottled, low plasticity, silty.		CL	3,5,5,5	
25	1.2/2		0.0	SAND: White, pink, very fine-grained, well-sorted. SILT: Tan with trace clay.		ML	4,5,6,7	

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-6
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/15/91	COMPLTD: 11/15/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\bar{q}$ 100 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
		2.0/2	0.0	SAND: White, pink, very fine-grained, well-sorted. CLAY: Gray and red mottled, high plasticity. SANDY CLAY: Red to gray, low plasticity.		ML CH CL	4.6,9.9	
35		1.8/2	0.2	SAND: Light gray to white, very fine-grained, well-sorted, trace heavy minerals.		ML	8,10,14,11	
40		1.2/2	0.0			SM	12,14,12,14	
45		1.2/2	0.0	SAND: Light gray, light brown, pink, fine- to medium-grained, well-sorted.		SM	10,12,11,10	
50		1.6/2	0.0	SAND: White, very fine- to very-coarse grained, poorly sorted, large quartz gravel, some mica.		SM	6,10,14,17	
55		1.4/2	0.0	CLAY: Light purple, moderate to high plasticity.		CH ML	11,17,16,17	
60								

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-6
CLIENT: SOUTHNAVFACENGCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/15/91	COMPLTD: 11/15/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO ∇ 100 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
		1.2/2	0.0	SAND: White, very fine- to fine-grained, moderately sorted, some mica, some heavy minerals.		ML	8,22,23,22	
65		1.2/2	0.0	SAND: White to light red, very fine- to coarse-grained, poorly sorted, little mica.		GM	21,23,26,25	
70		1.4/2	0.6	SAND: Light gray, pink, red, and tan, fine-grained, well-sorted, much large gravel.		ML	15,13,13,15	
75		1.8/2	0.2	SAND: White with red to light red layers, very fine-grained, well-sorted, some heavy minerals.		ML	8,17,14,15	
80		1.6/2	0.0	SAND: White, very fine-grained, well-sorted, damp. SILT: Light gray and pink.		ML	8,12,12,13	
85		0.0/2	N/A	NO RECOVERY		SP	NOT OBTAINED	
90								

TITLE: Nas Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-6
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/15/91	COMPLTD: 11/15/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 102FT.	DPTH TO $\nabla$ 100 FT.
LOGGED BY: A. DeSandro	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		1.0/2	0.0	SAND: White to light red, medium- to coarse-grained, well-sorted, trace heavy minerals.		SP	32,25,21,26	
95		1.4/2	0.0	SAND: White to red, very fine- to coarse-grained, some clay, poorly sorted, some gravel, saturated.		GM	W.R.,20,19	
100		2.0/2	0.0	SILTY CLAY: Brown to light gray, low plasticity, some mica.		CL	4,4,5,4	
105								
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-7
CLIENT: SOUTHNAVFACENCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/23/91	COMPLTD: 11/23/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 97FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: J. Koch	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5						ML		
								POSTHOLE
								3,6,10,14
10						CL		
								6,12,19,22
15						SC		
								3,7,8,10
20								
								6,9,9,10
25								
								3,5,7,8
30								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-7
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/23/91	COMPLTD: 11/23/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 97FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: J. Koch	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
		0.0/2	N/A	NO RECOVERY		SC	6,10,14,16	
35		1.5/2	0.1	SAND: Light pink to orange to red, fine-grained, well-sorted.		ML	7,9,17,19	
40		1.2/2	0.1	SAND: Light pink to orange, fine- to medium-grained, with quartz gravel.		SM	12,18,20,19	
45		1.5/2	0.3	SAND: Light pink, fine- to coarse-grained with quartz gravel, poorly sorted.		GM	12,12,12,14	
50		2.0/2	0.2	CLAYEY SAND: Light gray, very fine-grained, well-sorted. CLAY: Light gray.		SC CL	6,5,10,14	
55		1.2/2	0.1	SAND: Light pink, fine- to coarse-grained with quartz gravel, poorly sorted.		GM	10,15,16,15	
60						ML		

Continued from PAGE 1

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-7
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/23/91	COMPLTD: 11/23/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 97FT.	DPTH TO ∇ 95 FT.
LOGGED BY: J. Koch	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
		1.5/2	0.1	SAND: Light pink, fine-grained, well-sorted.		ML	17,25,28,35	
65		1.5/2	0.2	SAND: Light pink, fine- to coarse-grained.		GM	23,26,32,45	
70		1.3/2	0.2	SAND: Light pink, fine-grained with small clay lenses.		ML	19,28,31,34	
75		1.5/2	0.1	SAND: Light pink, fine-grained, well-sorted.		ML	21,38,50	
80		1.5/2	0.3	SAND: Light pink, fine-grained, well-sorted.		ML	32,38,50	
85		1.3/2	0.3	SAND: Light pink, fine- to coarse-grained with quartz gravel.		GM	31,30,32,30	
90								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. NES-SB-7
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 11/23/91	COMPLTD: 11/23/91
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 97FT.	DPTH TO $\nabla$ 95 FT.
LOGGED BY: J. Koch	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3								
		1.3/2	0.1	SAND: Light pink, fine- to coarse-grained with quartz gravel and small clay lenses.		GM	23,34,38,40	
95		2.0/2	0.1	CLAYEY SAND: Light gray to orange, fine- to medium-grained, saturated		SC	10,11,17,25	$\nabla$
100								
105								
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-8
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 96 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT	LABORATORY SAMPLE ID	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
0			0			SC		POSTHOLE
5		0.8/2	1	CLAYEY SAND: Red, fine-grained, well-sorted, compacted and hard.			2.2,3,4	
10		1.0/2	0	SILTY CLAY: Tan and red, compacted, dense, non-plastic.		CL	3.5,10,10	
15		1.5/2	0	SAND: Red and tan, fine- to medium-grained, well-graded, rounded, slightly compacted.		SW	6.8,8.7	
20		1.5/2	0	SILTY CLAY: Mottled red, yellow, and tan, dense, compacted, inelastic		CL	3.3,5,6	
25		1.2/2	0	SANDY CLAY: Mottled red, yellow, and tan, dense, compacted, inelastic			4.4,5,5	
30						SW		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-8
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 96 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
		1.5/2	0	SAND: Fine- to medium-grained, well-graded, well-rounded, loose.		SW	3,4,4,5	
35		1.5/2	0	SAND: Medium- to coarse-grained grading to fine-grained, some gravel, rounded.		SW	5,7,7,9	
40		1.5/2	0	SAND: White, fine- to medium-grained, well-rounded, micaceous, loose.		ML	4,6,10,9	
45		2.0/2	1				7,10,12,17	
50		2.0/2	0	SAND: White, medium- to coarse-grained, trace of gravel, loose.		SW	6,11,12,12	
55		1.5/2	1	SAND: White, very fine- to fine-grained, well graded, micaceous, 2" clay layer near top, moist.		ML	4,6,12,16	
60								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-8
CLIENT: SOUTHNAVFACENGCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO ∇ 96 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:	SITE: 2866	

DEPTH FT	LABORATORY SAMPLE ID.	RECOVERY SAMPLE	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
				Continued from PAGE 2				
		2.0/2	2	SAND: As above with some gravel.		ML	8,15,17,16	
65		1.8/2	0	SILTY SAND: Red, very fine-grained sand to silt with some 10 mm rounded gravel, micaceous.		SW	5,10,14,14	
70		1.8/2	0	SILTY SAND: As above without gravel.		ML	6,10,14,16	
75		2.0/2		SAND: White, very fine-grained to silty, micaceous, dry.		ML	11,16,17,16	
80		2.0/2		SAND: White, fine- to medium-grained, angular.		SM	10,12,25,27	
85		1.8/2		SAND: White, fine- to coarse-grained with coarse yellow gravel in last 3", angular, some small clayey sand lenses.		GM	12,15,18,33	
90						SM		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-8
CLIENT: SOUTHNAVFACENCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 107FT.	DPTH TO $\nabla$ 96 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH F.T.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
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Continued from PAGE 3

		1.5/2		SAND: Tan with red and yellow stripes, fine- to medium-grained, sub- rounded.		SM	16,21,29,23	
95		1.5/2		SAND: Red, very coarse-grained, angular, loose, wet. CLAY: Grey, stiff.		GW	3,3,2,7	
100		2.0/2				CL	1,1,2,1	
105		1.5/2		SILTY CLAY			4,6,9,9	
110								
115								
120								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-9
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 112FT.	DPTH TO ∇ 101 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
0						SC		POSTHOLE
5		1.8/2	0	CLAYEY SAND: Red and tan, medium-grained, well-sorted, moist.				4,11,14,17
10		0.8/2	0	CLAYEY SAND: Mottled tan and red, medium-grained, well-sorted, hard, compacted.				4,11,7,13
15		1.2/2	0	SAND: Light red to tan, fine- to medium-grained, well-graded, trace of clay.		SW		3,5,6,6
20		1.5/2	0	CLAYEY SAND: Mottled yellow and red, fine-grained, well-sorted, hard, compacted.		SP		3,3,5,5
25		1.6/2	0	SAND: Tan with yellow and red layers, medium-grained, well-sorted.				4,6,8,10
30						SM		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-9
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 112FT.	DPTH TO $\nabla$ 101 FT.
LOGGED BY: N Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
		1.5/2	0	SAND: Fine- to medium-grained, well-graded, rounded. SILTY CLAY: Gray, stiff.		SM CL	7,7,10,9	
35		1.5/2	1	SAND: Fine- to medium-grained, poorly graded (>fines), angular, loose		SM	5,5,10,10	
40		1.5/2	0	SAND: White with yellow layering, fine- to medium-grained with very fine-grained sand in last 3", well-rounded, loose.		SM	4,10,12,20	
45		1.8/2	0	SAND: White, medium-grained with trace of angular coarse grains and gravel, well-rounded sand grains, micaceous.		SW	7,10,12,28	
50		2.0/2	1			SW	4,13,21,12	
55		2.0/2	2	CLAY: White, wet.		CL	7,10,18,16	
60						SM		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-9
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: 0
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 112FT.	DPTH TO $\nabla$ 101 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 2								
		1.5/2	1	SAND: White, fine- to medium-grained with some gravel, angular, micaceous.		SM	5,8,5,12	
55		1.7/2	1	SAND: Tan and yellow, fine- to medium-grained, rounded, hard, micaceous.		ML	9,8,13,14	
70		2.0/2	0	SILTY SAND: white, silty to very fine-grained, well-rounded, compacted, micaceous, slightly damp.		GM	8,11,11,13	
75		1.8/2	0				9,11,13,16	
80		1.5/2	1	SAND: Silty to very fine-grained, well-rounded, compacted, micaceous, damp.			10,14,22,25	
85		1.5/2	1	SAND: Fine-grained with some 10 mm gravel, rounded, loose, dry.		SC	24,25,27,27	
90								

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL:	BORING NO. WHF-2866-SB-9
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 12/09/92	COMPLTD: 12/09/92
METHOD: HSA	CASE SIZE:	SCREEN INT.:	PROTECTION LEVEL: D
TOC ELEV.: FT.	MONITOR INST.: OVA	TOT DPTH: 112FT.	DPTH TO $\nabla$ 101 FT.
LOGGED BY: N. Pagano	WELL DEVELOPMENT DATE:		SITE: 2866

DEPTH FT	LABORATORY SAMPLE ID.	RECOVERY HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 3							
		1.5/2	1 SANDY CLAY: Tan, yellow and red, fine- to medium-grained, damp.		SC	6,7,23,36	
95		1.0/2	SAND: Red, medium-grained, rounded, well-sorted, dry.		SP	15,36,41,66	
100		1.9/2	SAND: Red, very coarse-grained, angular, loose.		GW	4,6,8,19	
105		1.5/2	SILTY CLAY: Mottled gray and red, very fine-grained, hard, inelastic.		CL	8,14,17,15	
110		1.2/2	SILTY CLAY: Mottled tan, yellow and red, stiff.			8,10,10,12	
115							
120							

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL: WHF-2866-MW1	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 1/08/92	COMPLTD: 1/08/92
METHOD: 4.25" HSA	CASE SIZE: 4 inch	SCREEN INT.: 88.6-103.6	PROTECTION LEVEL: 0
TOC ELEV.: 174.64 FT.	MONITOR INST.: OVA	TOT DPTH: 103.6FT.	DPTH TO $\nabla$ 94.82 FT.
LOGGED BY: R. Durham/C. King	WELL DEVELOPMENT DATE: 4/15/92	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID.	RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5	1.5/2	0.2		CLAYEY SAND: Dark brown to orange, very fine-grained.	[Symbol]	SC	POSTHOLE 5.5,6.8	[Symbol]
10	1.2/2	0.3		SANDY CLAY: Orange-brown. CLAY: Red to buff, trace silt, trace fine sand.	[Symbol]	CL	10,12,15,15	[Symbol]
15	1.3/2	0.4		SAND: Orange-red to buff, silty.	[Symbol]	ML	10,12,12,12	[Symbol]
20	1.2/2	0.1		CLAYEY SAND: Red-brown. SANDY CLAY: Red-brown to yellow, moderate plasticity.	[Symbol]	SC CL	7.5,7.7	[Symbol]
25	1.5/2	0.1		CLAYEY SAND: Red-brown, very fine- to medium-grained.	[Symbol]	SC	18,9,9,10	[Symbol]
30	1.6/2	0.1		SAND: Buff to light pink, very fine- to fine-grained.	[Symbol]	ML	14,14,14,14	[Symbol]

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL: WHF-2866-MWI	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENCOM			PROJECT NO: 7518-30
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 1/08/92	COMPLTD: 1/08/92
METHOD: 4.25" HSA	CASE SIZE: 4 inch	SCREEN INT.: 88.6-103.6	PROTECTION LEVEL: D
TOC ELEV.: 174.64 FT.	MONITOR INST.: OVA	TOT DPTH: 103.6 FT.	DPTH TO $\nabla$ 94.82 FT.
LOGGED BY: R. Durham/C. King	WELL DEVELOPMENT DATE: 4/15/92	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
Continued from PAGE 1								
		1.2/2	0.4	SAND: Buff to pink to yellow-brown, very fine- to fine-grained.		ML	15,14,14,12	
40		1.0/2	0.2	CLAYEY SAND: Yellow-brown. SAND: Buff to light pink, very fine- to fine-grained.		SC	10,10,9,10	
						ML		
45		1.6/2	0.3	SANDY CLAY: Yellow-brown. SAND: Buff, very fine- to fine-grained.		CL	15,15,15,17	
						ML		
50		1.7/2	0.1	SANDY CLAY: Yellow-brown. SAND: Buff, very fine- to fine-grained, trace clay.		CL	15,20,20,19	
						ML		
55		1.0/2	0.0	CLAY: Mauve-colored. SAND: Buff, very fine- to fine-grained.		CL	15,20,26,32	
						ML		
60		1.4/2	0.1	SANDY CLAY: Yellow-brown to orange-brown. SAND: Buff, very fine- to fine-grained, trace silt.		CL	20,30,32,35	
						ML		
65		0.9/2	0.2	SAND: Buff to orange-yellow, very fine- to medium-grained.		SM	12,22,29,29	
						ML		
70						SC		

TITLE: NAS Whiting Field Navy Exchange Service Station		LOG of WELL: WHF-2866-MW1	BORING NO. NES-SB-5
CLIENT: SOUTHNAVFACENGCOM		PROJECT NO: 7518-30	
CONTRACTOR: Groundwater Protection Inc.		DATE STARTED: 1/08/92	COMPLTD: 1/08/92
METHOD: 4.25" HSA	CASE SIZE: 4 inch	SCREEN INT.: 88.6-103.6	PROTECTION LEVEL: D
TOC ELEV.: 174.64 FT.	MONITOR INST.: OVA	TOT DPTH: 103.6FT.	DPTH TO $\nabla$ 94.82 FT.
LOGGED BY: R. Durham/C. King	WELL DEVELOPMENT DATE: 4/15/92	SITE: 2866	

DEPTH FT.	LABORATORY SAMPLE ID	SAMPLE RECOVERY	HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION AND COMMENTS	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
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Continued from PAGE 2

75	1.6/2	1.3	1.3	CLAYEY SAND: Yellow-brown.	[Diagonal Hatching]	SC	19.20.20.21	[Well Data]
				SAND: Buff, very fine- to medium-grained with some coarse quartz grains and occasional gravel.		SM		
80	1.8/2	0.2	0.2	SAND: Buff, very fine- to medium-grained.	[Diagonal Hatching]		20.20.19.20	[Well Data]
85	1.7/2	0.0	0.0	SAND: Buff, fine- to medium-grained with occasional fine gravel.	[Diagonal Hatching]		15.15.19.19	[Well Data]
90	1.7/2	0.2	0.2	SAND: Buff, fine- to medium-grained with occasional fine gravel.	[Diagonal Hatching]		25.25.45.62	[Well Data]
95	2.0/2	0.2	0.2	SAND: Dark pink to light pink, medium- to coarse-grained with some gravel, poorly sorted, saturated.	[Dotted Pattern]	SW	15.20.20.30	[Well Data]
100	1.5/2	0.0	0.0	CLAY: Orange-red to yellow to tan, moderate to high plasticity, damp.	[Horizontal Hatching]	CH	10.12.18.18	[Well Data]
105	2.0/2	0.0	0.0	CLAY: Red-orange to yellow-tan, silty, high plasticity, damp.	[Horizontal Hatching]		3.4.4.4	[Well Data]



**APPENDIX D**  
**Field Methodologies**



### Soil Boring

Boreholes were advanced using a drill rig equipped with 4½-inch inside diameter hollow-stem augers. Soil samples were collected from each borehole at 5-foot intervals using a standard penetration test (SPT) split-spoon sampler. The soil samples were placed in 16-ounce glass jars and headspace analysis was performed using an organic vapor analyzer (OVA) with a flame ionization detector (FID) following Florida Department of Environmental Regulation (FDER) Chapter 17-770.200(2), Florida Administrative Code (FAC), guidelines. Additional analysis was performed using a portable gas chromatograph (GC) calibrated to detect benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tert-butyl ether (MTBE), trichloroethene (TCE), and tetrachloroethene (PCE) to the parts per billion (ppb) level. The additional analysis was performed on both water and soil samples at and near the water surface. The purpose of the OVA and GC screening procedure was to optimize monitoring well placement during the investigation. The soil borings varied in depth from 50 to 117 feet below land surface (bls). Upon completion of sampling, the borehole was filled with neat cement (Portland Type I) to approximately 6 feet bls and then backfilled with soil.

### Monitoring Well Construction

The monitoring well was installed using a drill rig equipped with 6½-inch inside diameter hollow-stem augers. Soil samples were collected from the monitoring well borehole prior to well installation using an SPT split-spoon sampler. The soil samples were collected approximately 1 to 3 feet above the water surface and from there at 5-foot intervals to the bottom of the borehole. These samples were analyzed using a portable GC calibrated to detect BTEX, MTBE, TCE, and PCE to the ppb level.

The monitoring well installed during the investigation was constructed of schedule 40 polyvinyl chloride (PVC) casing with flush-threaded joints and 0.010-inch slotted screen. The well was constructed of 4-inch PVC with a 15-foot screen section placed at a depth that should encompass seasonal water table fluctuations. The well casings extend from the top of the screen to land surface. A 20/30 grade silica filter pack was placed in the annular space around the well to approximately 2 feet above the top of the screen. A 2-foot fine sand seal, 30/65 grade, was placed on top of the filter pack. The remaining annular space was grouted to the surface with a neat cement grout. A protective traffic-bearing vault was installed to complete well installation. The monitoring well is equipped with a locking well cap and a padlock. Figure C-1 depicts a typical monitoring well installation.

### Water Level Measurements

The groundwater levels were measured using an electronic water level indicator with an accuracy to 0.01 foot. Water level elevations were calculated by subtracting the measured depth to groundwater from the elevation at the top of the well casing. This information was plotted on a scaled water table contour map where flow lines (depicting groundwater flow direction) were drawn perpendicular to the groundwater elevation contours. The groundwater hydraulic

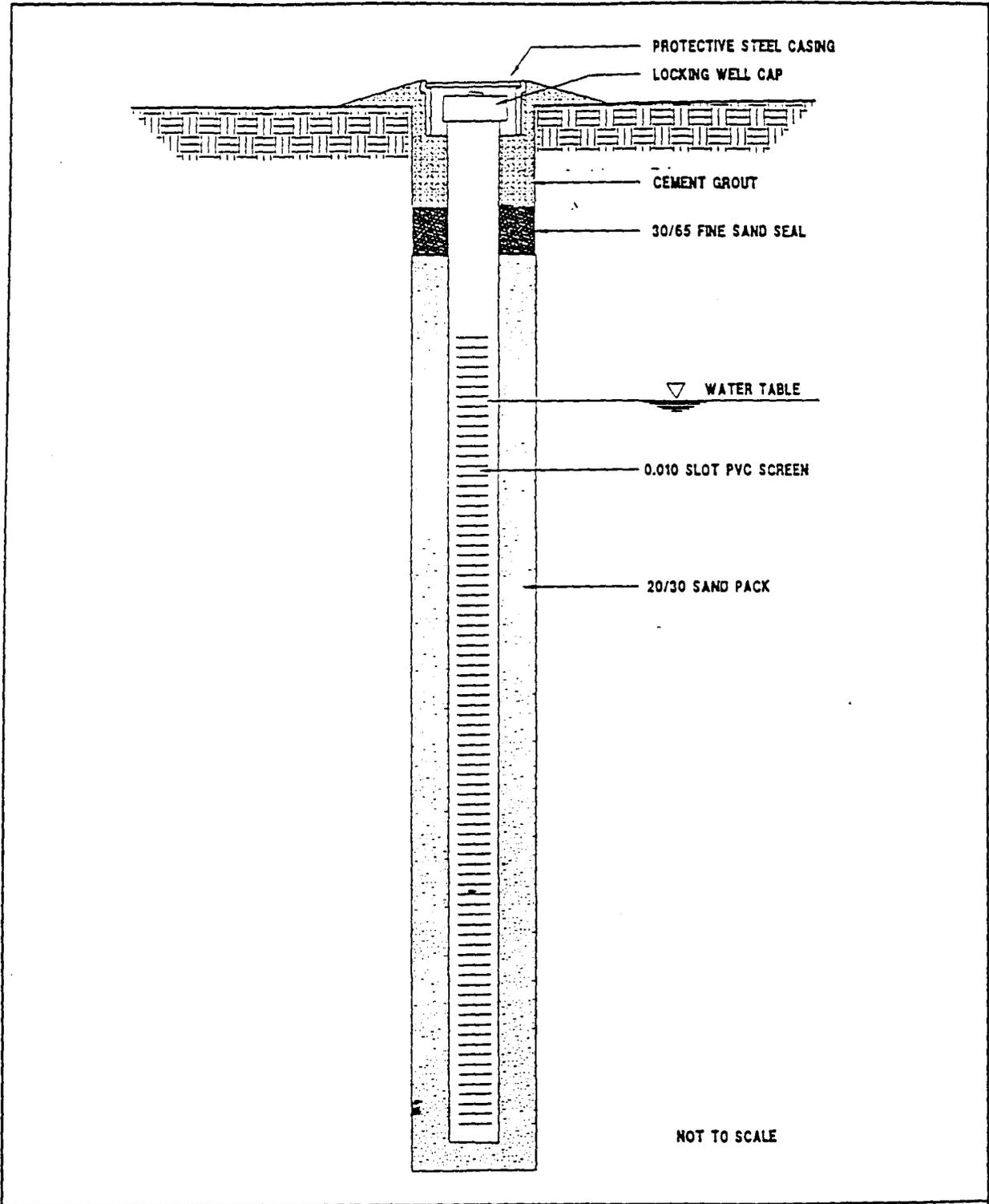


FIGURE D-1  
 TYPICAL MONITORING WELL  
 CONSTRUCTION DETAIL



CONTAMINATION ASSESSMENT  
 REPORT, SITE 2866

NAS WHITING FIELD  
 MILTON, FLORIDA

gradient was calculated by subtracting the differences in groundwater elevation (in feet) between two points on the map and dividing the elevation difference by the distance between two points to obtain a resulting gradient in feet per foot.

#### Groundwater Sampling

The groundwater samples were collected in accordance with the ABB-ES, FDER-approved Comprehensive Quality Assurance Plan (CompQAP). The monitoring well was purged with a Teflon™ bailer. Purging continued until water quality parameters (specific conductance, temperature, and pH) had stabilized. Groundwater samples were collected using an extruded Teflon™ bailer. The samples were placed into appropriate containers, properly preserved, and placed on ice. Samples were then shipped to Wadsworth/ALERT Laboratories, Inc., Tampa, Florida, for analyses within 24 hours after collection. All groundwater samples collected during the contamination assessment (CA) were analyzed for the kerosene analytical group compounds outlined in FDER Chapter 17-770, FAC.

#### Slug Tests

Slug testing was conducted as part of the Installation Restoration (IR) investigation (ABB Environmental Services, Inc., 1992b)

**APPENDIX E**

**Aquifer Parameter Calculations**

## Aquifer Parameter Calculations

Estimates of average pore water velocity were obtained using the following formula:

$$V = (K*i)/n \quad (1)$$

where

- V = seepage velocity in feet per day (ft/day),
- K = hydraulic conductivity in ft/day,
- i = hydraulic gradient, and
- n = estimated porosity.

The effective porosity for silty sands and well sorted sands ranges from 0.18 to 0.27 (Fetter, 1980). An average value for effective porosity of 0.23 was selected for the seepage velocity calculations. The average hydraulic gradient across the site is  $1.6 \times 10^{-3}$  feet per foot (ft/ft), and slug test results indicate an average horizontal hydraulic conductivity (K) of 9.55 ft/day (ABB Environmental Services, Inc., 1992b). Using these values, the average pore water velocity was calculated as follows:

$$v = \frac{(9.55 \text{ ft/day} * 0.0016 \text{ ft/ft})}{0.23}$$

$$V = 0.07 \text{ ft/day}$$

