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FINAL REMEDIAL INVESTIGATION AND FEASIBILITY STUDY AND TECHNICAL MEMORANDUM 6 PHASE 1 DATA SUMMARY AND PHASE 2A WORK PLAN NAS WHITING FIELD FL

5/1/1992

ABB ENVIRONMENTAL

FINAL

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

TECHNICAL MEMORANDUM NO. 6
PHASE I DATA SUMMARY AND PHASE II - A WORK PLAN

NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

MAY 1992

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
29411-0068

ID 00229

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

PHASE I

NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA

Technical Memorandum No. 6
Phase I Data Summary and Phase II-A Workplan

UIC: N60508

Contract No. N62467-88-C-0382

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FOREWORD

The Department of the Navy developed the Installation Restoration (IR) Program to locate, identify, and remediate environmental contamination from the past disposal of hazardous materials at Navy and Marine Corps installations. The Navy IR Program follows the Department of Defense's Environmental Restoration Program as created by the Superfund Amendments and Reauthorization Act of 1986.

The IR Program consists of three phases. Phase one consists of the Preliminary Assessment and Site Inspection to identify the location (site) and presence of pollutants and assess their potential or actual threat to public health and the environment. Phases two and three are initiated based on the degree of threat and the need for remediation of the contamination. Phase two consists of a Remedial Investigation and Feasibility Study to analyze the site contamination and determine the optimum remediation solution. Phase three is the implementation of the solution.

Preliminary Assessment results for Naval Air Station (NAS) Whiting Field indicated past potential releases to the environment have taken place at 16 sites. A Site Inspection, in the form of a Verification Study was performed to verify the nature of contamination at each site. An additional two sites for a total of 18 were evaluated in the verification program. An Hazard Ranking Score II (HRS II) and documentation has been developed based on the Verification Study results. The HRS II is a ranking tool that is used to determine the priority for remedial response at a site and the need to include the site on the National Priorities List.

A Phase I Remedial Investigation was performed on 15 of the 18 sites to characterize the nature and extent of contamination at each site. The remaining three sites are being investigated under the Navy's underground storage tank program.

Upon completion of the Phase I Remedial Investigation, five additional sites were identified and scheduled for investigation under the Phase II-A Remedial Investigation. Data gaps were also identified for 12 of the 14 sites and additional investigation was proposed for these sites during Phase II-A. The remaining two sites from Phase I will not be investigated during Phase II-A because of their no further action status. Currently a Phase II-A Remedial Investigation is underway at NAS Whiting Field.

Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) has assisted NAS Whiting Field in implementing this program.

Questions regarding this report should be addressed to the Commanding Officer, NAS Whiting Field, or to SOUTHNAVFACENGCOM, Code 1859, at AUTOVON 563-0341 or (803) 743-0341.

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Phase I Remedial Investigation and Feasibility Study

GLOSSARY

ABB-ES	ABB Environmental Services Inc.
AIMD	aircraft intermediate maintenance
AOC	area of concern
ARARs	Applicable or Relevant and Appropriate Requirements
AVGAS	aviation gasoline
BAT	Bengt-Arne-Torstensson
BEHP	bis-(2-ethylhexyl)phthalate
bls	below land surface
BX	Base Exchange
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm/sec	centimeters per second
CWA	Clean Water Act
DCA	dichloroethane
DCE	dichloroethylene
DQOs	data quality objectives
EM	electromagnetic
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulation
FEMA	Federal Emergency Management Agency
FIRMs	Floodplain Insurance Rate Maps
FS	Feasibility Study
ft/day	feet per day
ft^2/day	square foot per day
ft/ft	feet per foot
GC/MS	gas chromatography/mass spectroscopy
GPR	ground penetrating radar
GTGS	Geotechnical Graphics Software™
HASP	Health and Safety Plan
HRS	Hazard Ranking System
HRS II	Hazard Ranking System, Final Rule, December 1990
IAS	Initial Assessment Study
ID	inside diameter
IDW	investigation-derived waste
IR	Installation Restoration
Jordan	The E.C. Jordan Company

GLOSSARY (Continued)

MCL	maximum contaminant limit
μg/ℓ	micrograms per liter
μg/kg	micrograms per kilogram
umhos/cm	micromhos per centimeter
mph	miles per hour
mg/kg	milligrams per kilograms
mg/ℓ	milligrams per liter
mℓ	milliliters
MS/MSD	matrix spike/matrix spike duplicates
msl	mean sea level
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NGVD	National Geodetic Vertical Datum of 1929
NPL	National Priorities List
OLF	Outlying Landing Field
OVA	organic vapor analyzer
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbons
PCPT	piezocone penetrometer test
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SVOC	semivolatile organic compounds
TAL	target analyte list
TCA	trichloroethane
TCE	trichloroethene
TCL	target compound list
TCLP	Toxicity Characteristics Leaching Procedure
TRAWING-FIVE	Training Air Wing Five
TSCA	Toxic Substances Control Act
USEPA	U.S. Environmental Protection Agency
UST	underground storage tanks
VOC	volatile organic compounds

1.0 INTRODUCTION

ABB Environmental Services Inc. (ABB-ES), under contract to the Department of the Navy, is submitting Technical Memorandum No. 6 for the Phase I Remedial Investigation and Feasibility Study (RI/FS) for Naval Air Station (NAS) Whiting Field located in Milton, Florida, to the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). The RI/FS is being conducted under contract number N62467-88-C-0382.

Technical Memorandum No. 6, Remedial Investigation (RI) Phase I Data Summary and Phase II-A Workplan, is the sixth and final in a series of six technical memoranda that summarize the results and transmit data gathered during the Phase I RI. The Phase I RI field program was carried out during the period December 1990 to May 1991.

Technical Memorandum No. 6 summarizes both regional and site-specific information from technical memoranda, listed below:

No. 1, Geologic Assessment,
No. 2, Hydrogeologic Assessment,
No. 3, Soils Assessment,
No. 4, Surface Water and Sediments Assessment, and
No. 5, Groundwater Quality Assessment.

Based on results presented in Technical Memoranda No. 1 through No. 5, Phase II-A RI field investigative exploration sampling and analysis programs on site-specific and installation-wide levels are recommended.

The three-volume NAS Whiting Field Workplan (Jordan, 1990) established a phased approach to the RI/FS. This approach included a two-phased RI field program as described in Section 5.0 of the Workplan, Volume I. The Phase I program was described in specific detail and has been executed. The major elements of the Phase II RI were laid out in Section 5.3.5 of the Workplan and consist of the following:

- potential receptors survey,
- plume delineation,
- production well investigation, and
- source area characterization.

As discussed in the Workplan, the scope of these elements is dependent on the Phase I results. The Phase II RI is comprised of two parts, A and B. Technical Memorandum No. 6 (scope of work for Phase II-A) presents the additional investigation and site characterization required to describe the nature and extent of contamination at NAS Whiting Field, to support a baseline risk assessment, and to support an FS. The scope of this program addresses each of the above elements. For a number of sites, the Phase II-A RI is designed to confirm that no release has occurred or is likely to occur. The following sites are in this category:

Site 1, Northwest Disposal Area (Landfill),
Site 9, Waste Fuel Disposal Pit,

Site 10, Southeast Open Disposal Area A (Landfill),
Site 11, Southeast Open Disposal Area B (Landfill),
Site 13, Sanitary Landfill, and
Site 14, Short-term Sanitary Landfill.

At the remaining sites, the Phase I RI results and/or Verification Study Results (Geraghty and Miller, 1986) or Battery Shop Detection and Monitoring Program Results (Geraghty & Miller, 1985) indicated environmental contamination. Three sites, Site 4, the Northern aviation gasoline (AVGAS) Sludge Disposal Area; Site 7, the Southern AVGAS Sludge Disposal Area; and Site 8, AVGAS Fuel Spill Area, are undergoing a Contamination Assessment Program conducted by ABB-ES under the Navy's Underground Storage Tank (UST) Program during winter 1991 and spring 1992. This Contamination Assessment Program meets the requirements of Florida Administrative Code (FAC) Chapter 17-770 that regulates environmental investigation and remedial action of underground petroleum storage vessels.

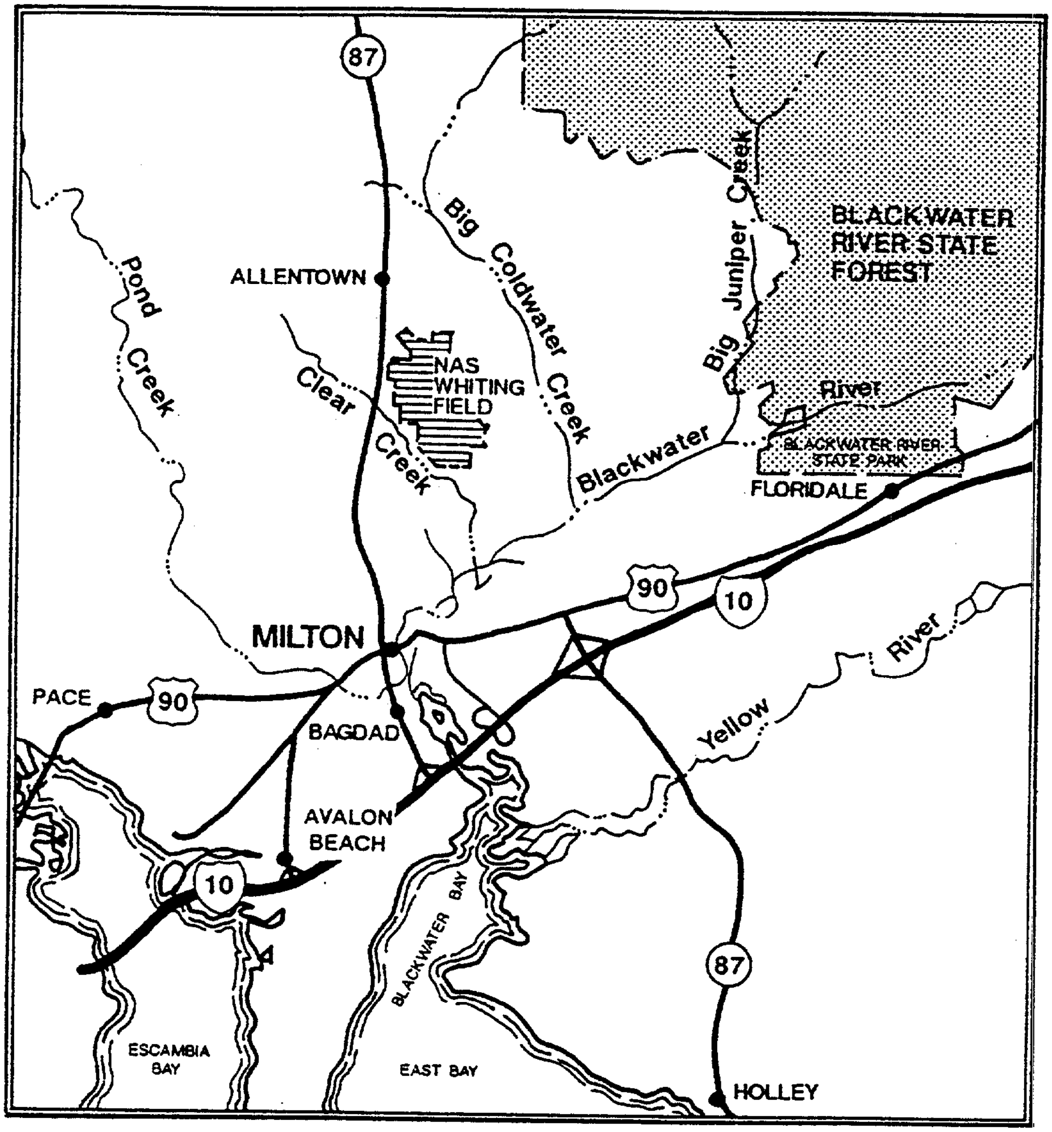
Procedures for RI Phase II-A and B activities will follow the U.S. Environmental Protection Agency (USEPA) approved three-volume RI/FS Workplan, Sampling and Analysis Plan (SAP), Health and Safety Plan (HASP), and Data Management Plan (Jordan, 1990) as applicable. Technical Memorandum No. 6 was developed to expand the Phase I Workplan to allow the RI to continue in a phased approach without developing a new workplan. As such, Technical Memorandum No. 6 identifies the specific environmental investigations to be conducted during Phase II-A and includes any changes in data quality objectives (DQOs) and additions or changes to field sampling procedures. Information collected during the Phase I RI has been presented in Technical Memoranda 1 through 5 and synthesized in Technical Memoranda No. 6. This synthesis was used to develop the RI Phase II-A field investigation. Technical Memorandum No. 6 and the 1990 Workplan provide a set of documents that support the RI Phase II activities. Through this approach the RI can continue in a timely manner.

Upon completion of the RI Phase II-A, another set of technical memoranda will be developed to present the results and findings of the Phase II-A field investigation. In addition, the technical memoranda will provide recommendations for Phase II-B to fill identified data gaps from Phase II-A to support a baseline risk assessment and an FS. The baseline risk assessment will be developed after the completion of Phase II-B.

Location and Physiography. NAS Whiting Field is located in Florida's northwest coastal area approximately 7 miles north of Milton and 20 miles northeast of Pensacola (Figure 1-1). NAS Whiting Field presently consists of two air fields separated by an industrial area and covers approximately 2,560 acres in Santa Rosa County. Figure 1-2 presents the installation layout.

NAS Whiting Field, home of Training Air Wing Five (TRAWING FIVE), was constructed in the early 1940's. It was commissioned as the Naval Auxiliary Air Station Whiting Field in July 1943 and has served as a naval aviation training facility ever since. The field's mission has been to train student naval aviators in basic instruments, formation and tactic phases of fixed-wing, propeller-driven aircraft, and in basic and advanced helicopter training.

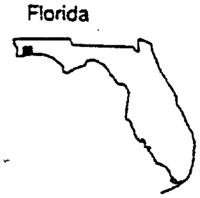
NAS Whiting Field lies within the Western Highland physiographic division of Santa Rosa County in the Coastal Plain Province. The Western Highlands are



SCALE IN MILES

0 5

SITE MAP



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MAP LOCATION

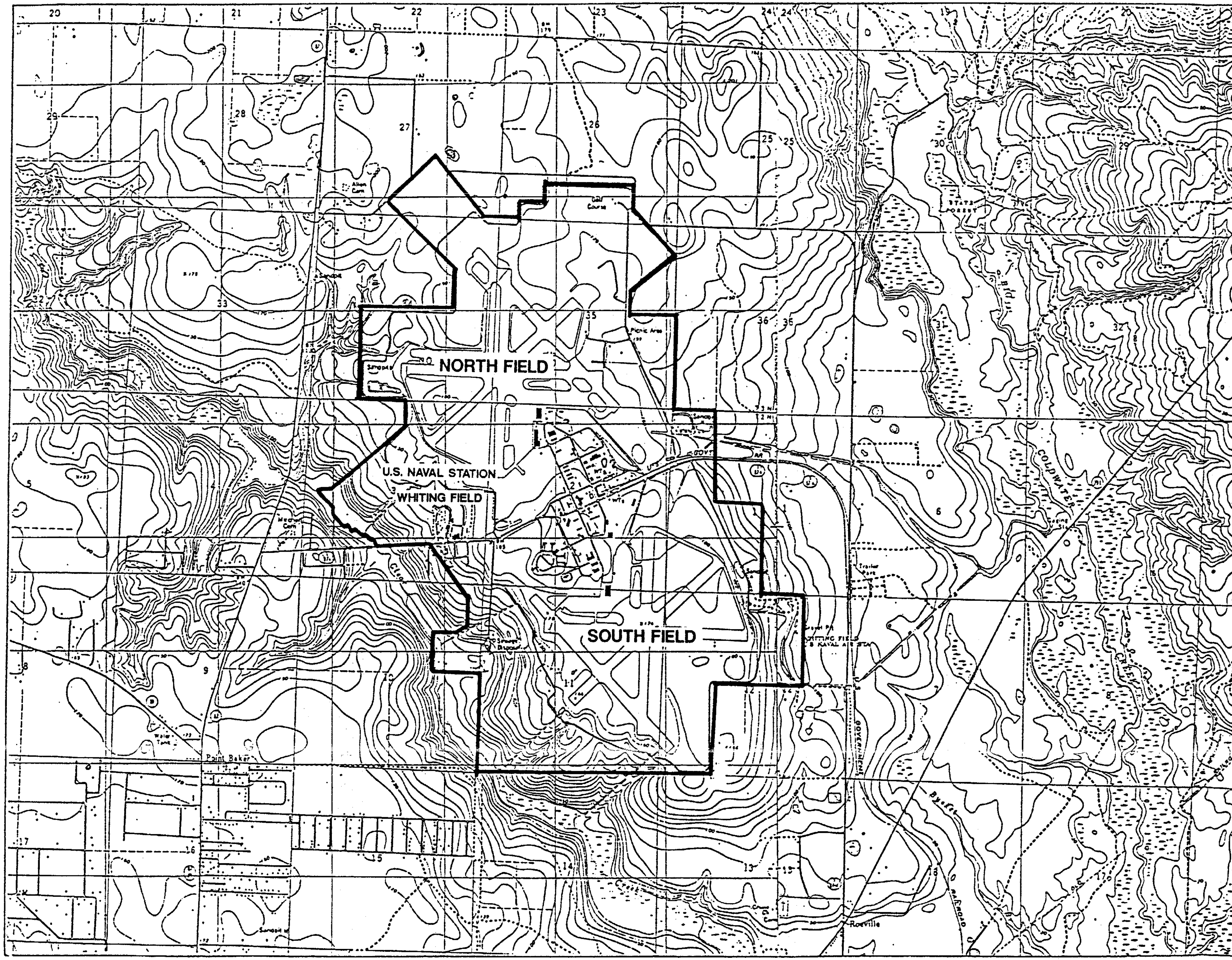
SOURCE: ABB ENVIRONMENTAL SERVICES, INC., 1991

FIGURE 1-1

FACILITY LOCATION MAP

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



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NOTE
SEE SECTION 4.0 FOR
LOCATION AND SITE DOCUMENTATION

BOLD LINE REPRESENTS
INSTALLATION BOUNDARY

SCALE IN FEET
0 3000 6000

SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 1-2

NAS WHITING FIELD

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

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characterized by a well-drained, southward sloping, plateau with numerous streams. Land surrounding NAS Whiting Field primarily consists of agricultural land to the northwest, residential and forested areas to the south and southwest, and forested land around the remaining boundaries. This distribution is shown in Figure 1-3.

Located on an upland area, elevations at Whiting Field range from 150 to 190 feet above sea level. The facility is bounded by low-lying receiving waters; Clear Creek to the west and south and Big Coldwater Creek to the east. These two streams are tributaries of the Blackwater River, which discharges to the estuarine waters of the East Bay of the Escambia Bay coastal system.

<u>1.1 **PURPOSE AND BACKGROUND**</u>. The purpose of the NAS Whiting Field RI/FS is to identify a range of remedial alternatives to address any identified risks to public health and the environment posed by toxic or hazardous chemicals present as a result of past waste disposal practices or spills. To achieve this objective, the RI must collect data sufficient to assess the nature and distribution of chemicals associated with each site. The data collected in the RI will be used in the FS to screen, evaluate, and select remedial alternatives to provide permanent, feasible solutions to environmental contamination problems at NAS Whiting Field.

The Navy Installation Restoration (IR) Program was designed to identify and abate or control contaminant migration resulting from past operations at naval installations. The IR Program is the Navy response authority under Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and Executive Order 12580. CERCLA requires that Federal facilities comply with the act, both procedurally and substantively. SOUTHNAV-FACENGCOM is the agency responsible for the Navy IR Program in the Southeastern United States. Therefore, SOUTHNAVFACENGCOM has the responsibility to process NAS Whiting Field through Preliminary Assessment (PA), Site Inspection (SI), priority listing, RI/FS, and remedial response selection in compliance with the guidelines of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300).

Section 105(a)(8)(A) of SARA required USEPA to develop criteria in order to set priorities for remedial action based on relative risk to public health and the environment. To meet this requirement, USEPA has established the Hazard Ranking System (HRS) as Appendix A to the NCP. The HRS is a scoring system designed to assess relative threat due to documented or potential releases at a site. First promulgated in 1982, the HRS was amended in December 1990 (HRS II), effective March 14, 1991 (55 Federal Register No. 241:51532-51667), to comply with requirements of Section 105(c)(1) of SARA to increase the accuracy of the assessment of relative risk. The newly promulgated HRS II has been substantially revised and is designed to prioritize sites after the SI phase of the CERCLA process. The SI, or extended SI, is used to present the required data to expeditiously perform an HRS II ranking. At NAS Whiting Field, the SI was conducted as a Contamination Study, Verification Phase.

The RI/FS conducted at NAS Whiting Field is a component of the Navy IR Program. The preliminary HRS score for NAS Whiting Field indicates that it may qualify for the National Priorities List (NPL). As such, the RI/FS for NAS Whiting Field

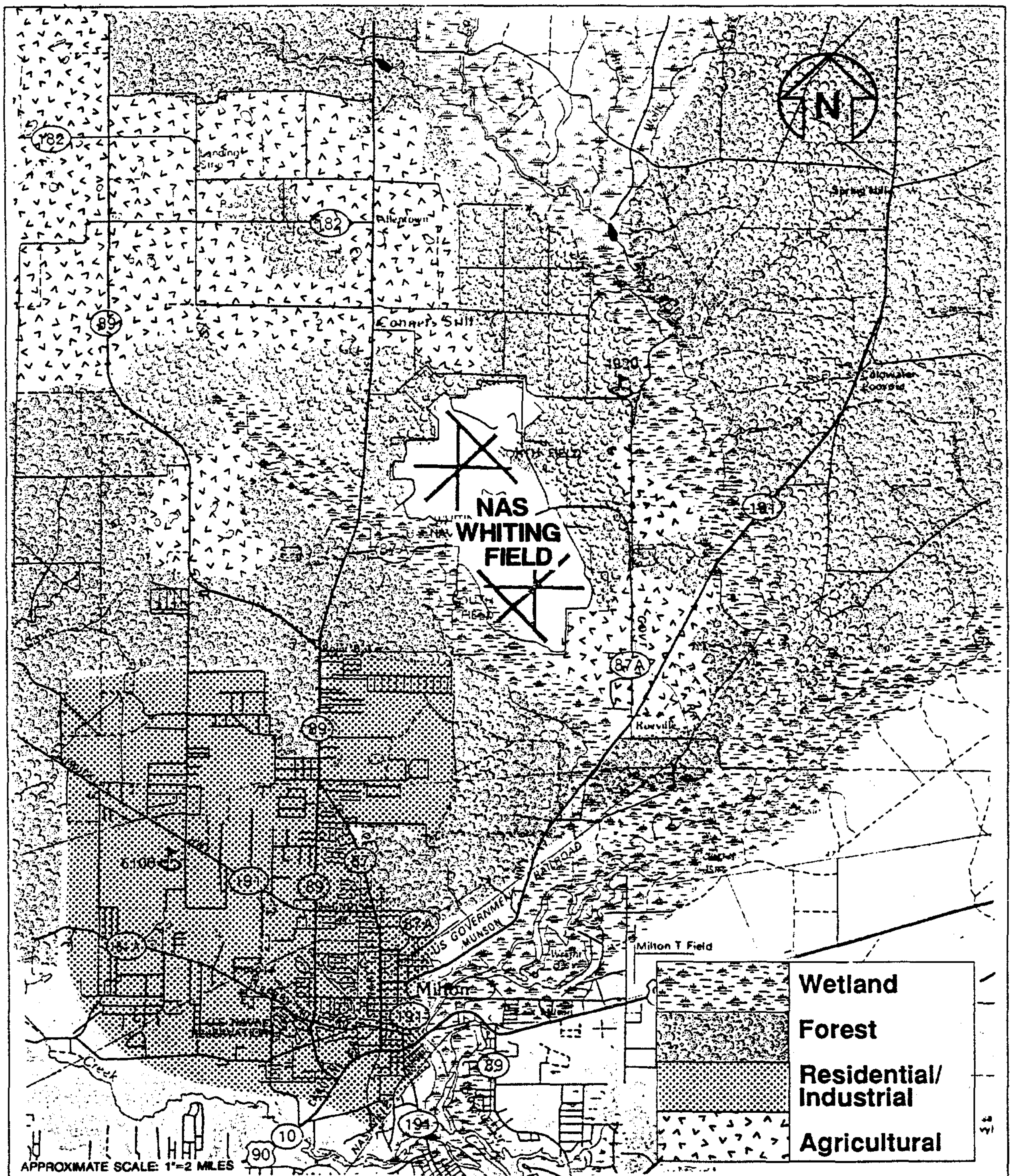


FIGURE 1-3

Land Use Distribution in the Vicinity of NAS Whiting Field

FLORIDA ATLAS & GAZETTEER, DeLORME MAPING COMPANY, 1987

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

follows the requirements of the NCP, as amended by SARA, and guidance for conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, October 1988).

Prior to the implementation of the Phase I RI/FS Program, a PA and two sampling and analysis programs had been conducted at NAS Whiting Field. The PA, conducted as an Initial Assessment Study (IAS), was performed by Envirodyne Engineers in 1984 and published in 1985 (Naval Energy and Environmental Support Activity, 1985, Report No. 13-072). Based on historical data, aerial photographs, field inspections, and personnel interviews, 16 disposal or spill sites were initially identified at NAS Whiting Field by the IAS team. These are sites where waste disposal or spill accidents have occurred in the past.

The May 1985 IAS concluded that 15 of the 16 sites warranted further investigation, under the Navy's IR Program, to assess potential long-term impacts. Only Site 2, the Northwest Open Disposal Area, was judged to not warrant further consideration. A Confirmation Study, including sampling and monitoring of the sites, was recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems that may exist. The results of the Confirmation-Verification Study would then be used to evaluate the necessity of conducting mitigating actions or cleanup operations.

In November 1985, Geraghty & Miller, Inc., prepared for the Navy a plan of action entitled *Naval Assessment and Control of Installation Pollutants, Verification Study, NAS Whiting Field*, which was subsequently submitted to the Florida Department of Environmental Regulation (FDER). This plan contained details of the proposed scope of work for the Verification Study. During discussion with FDER in December 1985, two additional sites (17 and 18) were added to the Verification Study. Both were active sites at that time where waste oils and fuels were burned in fire fighting training exercises. Sites 17 and 18 became inactive in 1991 with no expected future use.

Five additional sites were identified after the completion of the Phase I RI field investigation and subsequently added to the Phase II-A RI program for assessment of contamination. The site numbers and names are as follows:

- Site 29, Auto Hobby Shop,
- Site 30, South Field Maintenance Hangar,
- Site 31, Sludge Drying Beds and Disposal Areas,
- Site 32, North Field Maintenance Hangar, and
- Site 33, Midfield Maintenance Hangar.

Site numbers 19 through 28 will not be used at Whiting Field because they identify sites located at one of Whiting Field's outlying landing fields (OLF Barin) in Foley, Alabama.

The locations of the 23 sites are shown in Figure 1-4. Each of Sites 1 through 18 was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. Table 1-1 summarizes the information collected on these sites. Sites 29 through 33 will be evaluated during the Phase II-A RI.

Table 1-1
Summary of Potential Disposal Sites

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site No.	Site Name and Type	Location	Period of Operation	Types of Material Disposed	Comments
1	Northwest Disposal Area (landfill)	North Field, west side	1943-1965	Refuse, waste paints, thinners, solvents, waste oils, and hydraulic fluids.	Secondary disposal area during this period; site covers 5 acres.
2	Northwest Open Disposal Area (landfill)	North Field, west side	1976-1984	Construction and demolition debris, tires, and furniture.	Former borrow pit location, commonly referred to as the "Wood Dump."
3	Underground Waste Solvent Storage Area (tank)	North Field, south of Building 2941	1980-1984	Waste solvents, paint stripping residue, and 120-gallon spill.	Wastes generated by paint stripping operations.
4	North AVGAS Tank Sludge Disposal Area	North Field, north of Tow Lane	1943-1968	Tank bottom sludge containing tetraethyl lead.	Sludge disposal in shallow holes near tanks.
5	Battery Acid Seepage Pit (contaminated soil)	South Field, near Building 1478	1964-1984	Waste electrolyte solution containing heavy metals and waste battery acid.	Pits located 110 feet from potable supply well (W-S2).
6	South Transformer Oil Disposal Area (contaminated soil)	South Field, Building 1478	1940's-1960's	PCB-contaminated dielectric fluid.	Disposal in "0-2" drainage ditch.
7	South AVGAS Tank Sludge Disposal Area (landfill and tanks)	South Field, west of Building 1406	1943-1968	Tank bottom sludge containing tetraethyl lead.	Sludge disposed in shallow holes near tanks.
8	AVGAS Fuel Spill Area (contaminated soil)	South Field, south of Building 1406	Summer 1972	AVGAS containing tetraethyl lead.	Fuel spill of about 25,000 gallons on an area of about 2 acres.
9	Waste Fuel Disposal Pit (landfill)	South Field, east side	1950's-1960's	Waste AVGAS containing tetraethyl lead.	Fuel disposed in former borrow pit.
10	Southeast Open Disposal Area (A) (landfill)	South Field, southeast area	1965-1973	Construction and demolition debris, waste solvents, paint, oils, hydraulic fluid, PCBs, pesticides, and herbicides.	Secondary disposal area during this period; site covers about 4 acres.

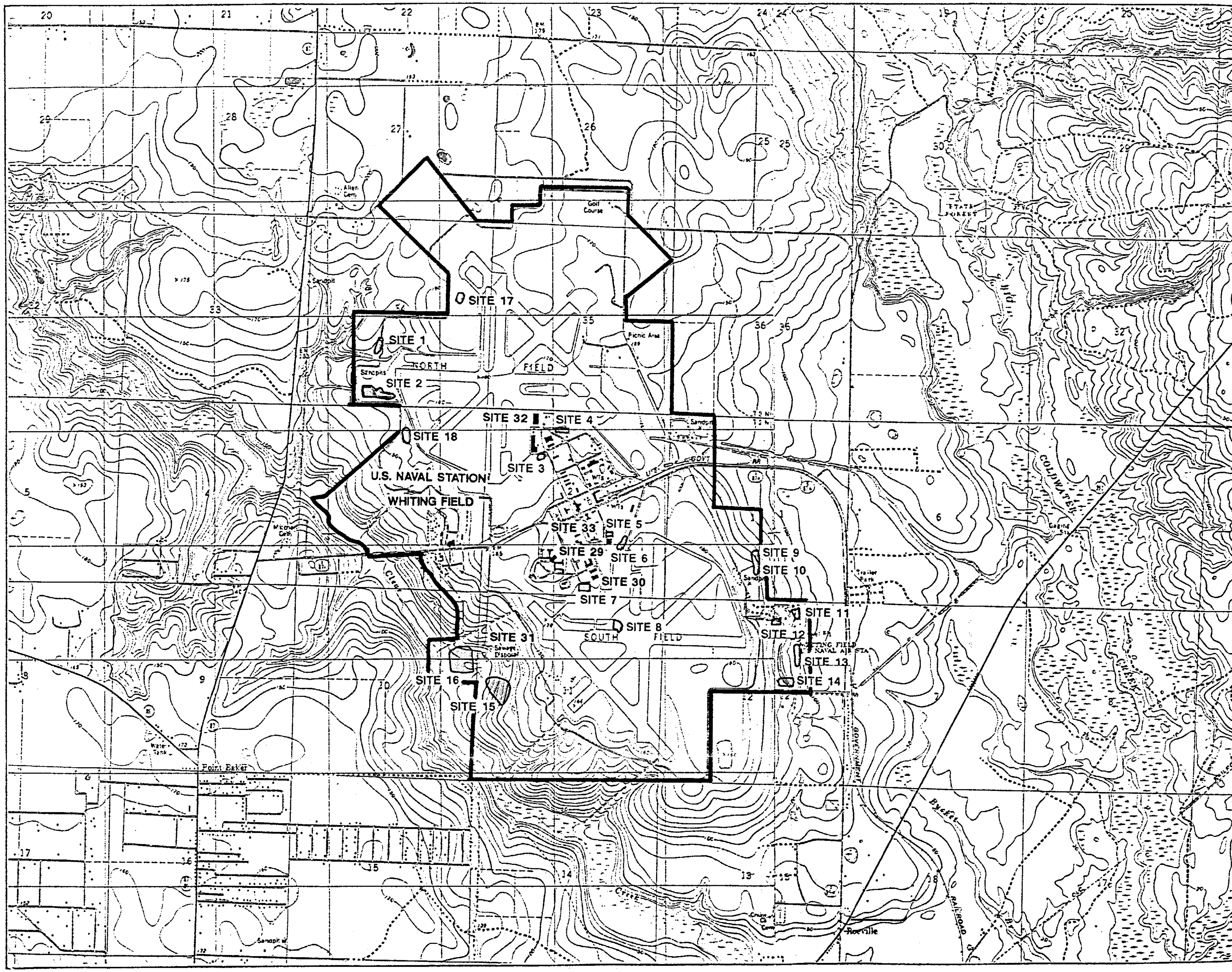
See notes at end of table.

Table 1-1
Summary of Potential Disposal Sites

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site No.	Site Name and Type	Location	Period of Operation	Types of Material Disposed	Comments
11	Southeast Open Disposal Area (B) (landfill)	South Field, southeast area	1943-1970	Construction and demolition debris, waste solvents, paint, oils, hydraulic fluid, and PCBs.	Secondary disposal area during this period; site covers about 3 acres.
12	Tetraethyl Lead Disposal Area (waste pile)	South Field, southeast area	May 1, 1968	Tank bottom sludge and fuel filters contaminated with tetraethyl lead.	Disposal area posted with warning; site consists of two earth covered mounds; 25 foot by 25 foot area.
13	Sanitary Landfill (landfill)	South Field, southeast area	1979-1984	Refuse, waste solvents, paint, hydraulic fluids, and asbestos.	Primary sanitary landfill, potentially received hazardous wastes the first year of operation.
14	Short-Term Sanitary Landfill (landfill)	South Field, southeast area	1978-1979	Refuse, waste solvents, oils, paint, and hydraulic fluids.	Primary sanitary landfill for brief period; relocated due to drainage problems.
15	Southwest Landfill (landfill)	South Field, southwest area	1965-1979	Refuse, waste paints, oils, solvents, thinners, asbestos, and hydraulic fluid.	Primary landfill for this time period; covers about 15 acres.
16	Open Disposal and Burning Area (landfill)	South Field, southwest area	1943-1965	Refuse, waste paints, oils, solvents, thinners, PCBs, and hydraulic fluid.	Primary disposal area for this time period; covers about 10 acres.
17	Crash Crew Training Area (contaminated soil)	North Field, west side	1951-Present	JP-4.	Waste fuels and some solvents ignited, then extinguished.
18	Crash Crew Training Area (contaminated soil)	North Field, west side	1951-Present	JP-4.	Waste fuels and some solvents ignited, then extinguished.

Notes: AVGAS = aviation gasoline.
PCB = polychlorinated biphenyls.



SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 1-4

Location of Sites at
NAS Whiting Field

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

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In addition, during 1985 one of the sites (Site 5, Battery Acid Seepage Pit) was investigated under a Consent Order with the FDER. Data from this investigation has been compiled in a report entitled *Detection and Monitoring Program, Battery Shop Site, NAS Whiting Field, Florida* (Geraghty & Miller, November 1985).

Work conducted during the Verification Study began with the collection and assimilation of existing data and literature pertinent to the project and included the findings from the IAS. The field work was performed in May and June of 1986. Sixteen monitoring wells were installed at locations around the facility. One surface water, 16 groundwater, and 46 soil samples were then collected for chemical analyses.

Historical records indicate that throughout the years of operation, NAS Whiting Field has generated a variety of wastes related to pilot training, the operation and maintenance of aircraft along with ground support equipment, and the station's facility maintenance activities. Prior to the establishment of hazardous waste management programs and programs to recycle waste oil, most of the hazardous wastes were reportedly disposed of onsite. Waste materials were disposed either in dumpsters that were emptied into onsite disposal areas or they went into waste oil bowsers, which probably were used for fire fighting training. Envirodyne Engineers (1985) estimated that thousands of gallons of wastes including waste paints, paint thinners, solvents, waste oils, waste gasoline, hydraulic fluids, AVGAS, tank bottom sludges, polychlorinated biphenyls (PCBs) transformer fluids, and paint stripping wastewater were potentially dumped into onsite disposal areas. These disposal areas consisted of natural or man-made depressions located within the confines of the air station. In addition to the waste materials routinely disposed of onsite in the disposal areas, additional materials were reportedly released onsite as the result of accidents or equipment failure.

The results of the Verification Study reported to SOUTHNAVFACENGCOM by Geraghty & Miller (*Verification Study: Assessment of Potential Ground-Water Pollution at Naval Air Station Whiting Field*, December 1986) provided an incomplete assessment of the physical as well as the chemical conditions currently existing at NAS Whiting Field. Groundwater contamination was detected at some sites and not at others. The study concluded that many of the monitoring wells were not located downgradient of the intended study site and that additional work was needed to characterize the hydrogeologic conditions and the chemical contamination conditions that exist at NAS Whiting Field. The Verification Study is the former IR program counterpart to the SI.

Of the 23 sites identified to date, 18 are scheduled for further study under the Navy's IR program. Because it only received construction and demolition debris, Site 2, the Northwest Open Disposal Area, was judged to warrant no further consideration early in the IR Program. Site 5, the Battery Acid Seepage Pit, was extensively studied in 1985 (Geraghty & Miller, 1985) in response to an FDER Consent Order (84-0253). Results indicated no significant contamination resulting from past activities at the Battery Acid Shop and the Consent Order was recommended to be rescinded on April 15, 1987. However, the presence of benzene in the existing monitoring wells surrounding the seepage pit warrants further consideration. As such, the investigation of benzene contamination around Site 5 is coupled with the field and laboratory investigation proposed for production well W-S2. Sites 4, 7, and 8 are slated for investigation and remediation, if necessary, under the Navy's UST Program and, therefore, are not incorporated in the Navy's IR Program. Table 1-2 presents a summary of past and projected investigative programs for Sites 1 through 18 within the RI/FS and UST programs.

The E.C. Jordan Phase I RI Workplan (June 1990) provides a summary of the regional and installation-specific environmental setting, current and historical industrial operations, summary of the verification study, and the Site 5, Battery Shop data, which will not be repeated in the technical memoranda. As appropriate, data from these sources has been incorporated into the assessment.

Table 1-2
Summary of Site Investigations

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Number	Site Name	Previous Studies			Ongoing RI/FS	Navy's UST Program
		IAS	Verification Study	Consent Order		
1	Northwest Disposal Area	*	*		*	
2	Northwest Open Disposal Area	*				
3	Underground Waste Solvent Storage Area	*	*		*	
4	North AVGAS Tank Sludge Disposal Area	*	*			*
5	Battery Acid Seepage Pit	*		*		
6	South Transformer Oil Disposal Area	*	*		*	
7	South AVGAS Tank Sludge Disposal Area	*	*			*
8	AVGAS Fuel Spill Area	*	*			*
9	Waste Fuel Disposal Pit	*	*			
10	Southeast Open Disposal Area (A)	*	*		*	
11	Southeast Open Disposal Area (B)	*	*		*	
12	Tetraethyl Lead Disposal Area	*	*		*	
13	Sanitary Landfill	*	*		*	
14	Short-Term Sanitary Landfill	*	*		*	
15	Southwest Landfill	*	*		*	
16	Open Disposal and Burning Area	*	*		*	
17	Crash Crew Training Area		*		*	
18	Crash Crew Training Area		*		*	

Notes: IAS = Initial Assessment Study.
RI/FS = Remedial Investigation/Feasibility Study.
UST = underground storage tank.
* = included in above investigation.
AVGAS = aviation gasoline.

2.0 SUMMARY OF TECHNICAL MEMORANDUM NO. 1, GEOLOGIC ASSESSMENT

Technical Memorandum No. 1, Geologic Assessment, is the first in a series of six technical memoranda that summarize the results and transmit data gathered during the Phase I RI. The following sections provide a summary of the geologic assessment presented in Technical Memorandum No. 1.

2.1 OBJECTIVES OF GEOLOGIC INVESTIGATION. The objectives of the RI Phase I geologic investigation and assessment included the following:

- characterizing the soils of the vadose and saturated zones underlying the installation,
- installing piezometers and observation wells to support aquifer testing in the Industrial Area of NAS Whiting Field,
- installing upgradient monitoring wells for background characterization and to confirm groundwater flow direction,
- providing a qualitative guide for lithologic correlation to govern additional subsurface exploration, and
- determining whether a continuous subsurface confining clay layer is present throughout NAS Whiting Field.

Several subsurface exploration techniques were used to evaluate and characterize the stratigraphy at the installation. Exploration techniques included: soil borings, monitoring well and piezometer installations, borehole geophysics, and piezocone penetrometer test (PCPT) soundings. Details and summaries of these explorations are presented in Technical Memorandum No. 1. Geologic information from the soil borings drilled for the monitoring well and piezometer installation provides support for the hydrogeologic assessment presented in Technical Memorandum No. 2 (Section 3.0 of this report).

2.2 REGIONAL GEOLOGY. NAS Whiting Field is underlain by a thick sequence of Tertiary sedimentary formations. A generalized geologic column of these formations is presented in Figure 2-1. The regional geologic characterization presented in this section has been taken from the Workplan, Volume I (Jordan, 1990), the Verification Study (Geraghty & Miller, 1986), the IAS (Envirodyne Engineers, 1985), and Marsh (1966).

The oldest formation studied in the panhandle area (Escambia and Santa Rosa Counties) is the Hatchetigbee Formation of the early Eocene series. This formation is composed of silty clay with beds of glauconitic shale and shaly limestone. The average thickness of the Hatchetigbee Formation is 315 feet (Marsh, 1966).

Overlying the Hatchetigbee is the Tallahatta Formation of middle Eocene, which consists of shale and siltstone deposits interbedded with gray limestone and well sorted sand.

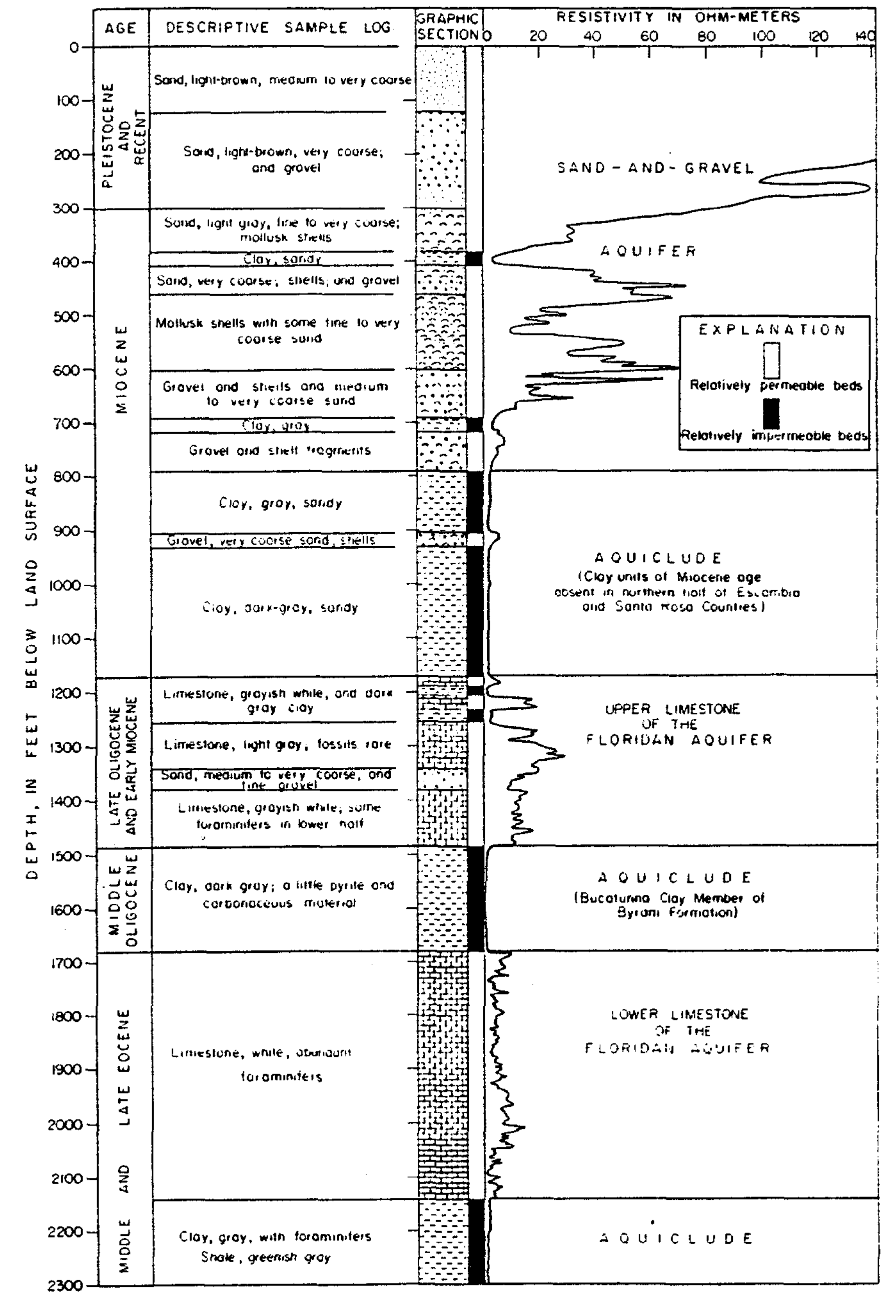


FIGURE 2-1

Generalized Hydrogeological Section of Santa Rosa County

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

Above the Tallahatta is the Lisbon equivalent that has been correlated with the Lisbon Formation of Alabama. The Lisbon is approximately 500 feet thick and consists of a shaly limestone.

The upper Eocene series is represented by the Ocala group. The Ocala is a light-gray limestone and averages 165 feet in thickness. Fifty-seven species of Foraminifera were identified in this group. Unconformably overlying the Ocala is the Bucatunna Clay Member of the Byram Formation. The Bucatunna is a dark gray, soft clay averaging 125 feet in thickness throughout the western Florida Panhandle.

The Chickasawhay Limestone and Tampa Formation are so similar in the western panhandle that they are presented as undifferentiated on the geologic column. The Chickasawhay is a gray dolomitic limestone and the Tampa is a light gray to white, hard limestone (generally not dolomitic). These undifferentiated sediments range in thickness from 30 to 270 feet.
Above the Chickasawhay-Tampa Formation lies the Pensacola clay, which consists of an upper and lower member of dark to light gray sandy clay. These two members are separated by the Escambia sand member of gray, fine- to coarse-grained sand. The upper member of the Pensacola clay is not present in the immediate vicinity of NAS Whiting Field and the lower member pinches out east of Big Coldwater Creek and is also not below NAS Whiting Field.

Miocene coarse clastics, however, are present throughout the western Florida Panhandle. These coarse clastics are described as brown to gray, poorly sorted sand and gravel with thick lenses of clay. These sediments overlie the Chickasawhay Limestone in the vicinity of NAS Whiting Field.

The Citronelle Formation of Pleistocene age overlies the Miocene clastics and is very similar in composition. The two units are differentiated by the abundance of shells in the Miocene clastics. The thickness of the Citronelle ranges from 40 to 800 feet in westernmost Florida. The Citronelle also contains layers of fossil wood, hardpan, shells, and kaolinitic burrows of aquatic animals (Marsh, 1966).

Three marine shorelines can be recognized from existing topographic profiles across Escambia and Santa Rosa Counties. The shoreline at 30 feet above the National Geodetic Vertical Datum (NVGD) of 1929 is represented by the Pimlico terrace. The Penholoway terrace has a relic shoreline at 70 feet NVGD and the third shoreline is a seaward-sloping upland surface ranging from 70 to 270 feet above NVGD.

The geologic structure of the western Florida panhandle is a simple homocline with a few faults and folds present in northern Santa Rosa County where the Pollard graben is located.

2.3 SITE-SPECIFIC GEOLOGY. Geologic data from the individual sites at NAS Whiting Field were obtained from existing boring logs, and from RI Phase I subsurface exploration including monitoring well borings, PCPT soundings, and geophysical logging.

Boring logs for wells WHF-1-1, WHF-3-1, WHF-4-1, WHF-7-1, WHF-8-1, WHF-9-1, WHF-10-1, WHF-11-1, WHF-12-1, WHF-13-1, WHF-14-1, WHF-15-1, WHF-16-1, WHF-17-1, and

WHF-18-1 were developed by Geraghty & Miller, Inc. (1986), from data collected during the Verification Study. These logs were recorded only as intervals of major lithologic units. Lithologic data were collected from the RI Phase I monitoring well installation program at 5-foot intervals. Because of the lack of definition of the geologic data from the Geraghty & Miller logs, the Geraghty & Miller logs were supplanted by RI Phase I data for interpretation of geological cross sections. PCPT explorations were logged continuously throughout the sounding. Geophysical logging was conducted to total depth of the existing monitoring wells.

To tie together the various forms of geologic data collected from the above methods, the data were input to a geotechnical software package called Geotechnical Graphics Software™ (GTGS). Information (if available) entered into the GTGS borelogs included depth, soil recovery, organic vapor analyzer (OVA) readings, soil description, unified soil classification, and soil symbols code.

By creating a large lithologic column database through GTGS, geologic cross sections across the installation and the individual site groups could be developed. Interpretation of the geologic cross sections will verify the existence of any confining clay unit, the orientation (e.g., direction of dip) and thickness of the unit, potential contaminant migration pathways, and relationship to the potentiometric surface.

The potentiometric surface on the cross sections was developed by connecting water level measurements or monitoring wells in the geologic profiles. Depth to the water table in the PCPT profiles could not be accurately determined and the potentiometric surface was extrapolated through the profile.

The lithology at NAS Whiting Field generally consists of sands and gravels with interbedded silt and clay layers, suggesting a low to moderate energy fluvial depositional environment. The sands ranged from very fine to coarse in grain size, with moderate to very high densities and they were generally poorly graded. The gravels were typically encountered in lenses at thicknesses at less than 1 foot or in little to trace amounts along with coarse sands.

Clay and silt layers were found at variable depths throughout NAS Whiting Field. Commonly, clays occurred with varying amounts of silt and fine sand. Moderate to highly plastic clay layers were encountered at thicknesses of up to 30 feet. Silt layers were found less frequently than clay layers and often contained small amounts of clay and very fine-grained sand. Prior to the RI Phase I field program, a continuous semi-confining to confining clay layer was believed to be present beneath NAS Whiting Field. Based on the interpretation of the geologic data, no continuous clay layer is present. However, locally confining conditions may be present where clay layers are present.

<u>2.3.1 Industrial Area</u> The geology of the industrial area at NAS Whiting Field was interpreted from geologic data collected from Sites 3, 4, 5, 7, 8, and the production well subsurface explorations.

Lithology of the soils consistently followed the pattern of sands with interbedded silts and clays found throughout the installation. Massive sand units up to 140 feet thick (WHF-S2-WP-04) were encountered below the industrial area. The interbedded clay and silt layers were found at depths ranging from ground surface to 200 feet below land surface (bls) with variable thicknesses ranging from approximately less than 1 foot to 20 feet.

Using the lithologic profiles developed from GTGS, geologic sections through the industrial area were generated (Figures 2-2 through 2-4). Cross section locations in plan view are presented in Figure 2-5. All of the cross sections are similar with respect to the interbedded stratigraphic units but little correlation between clay layers within adjacent profiles can be made.

2.3.2 Southwestern Disposal Areas Data collected from subsurface explorations conducted at Sites 15 and 16 were used to characterize the geological setting at the southwestern disposal areas. The geological data set consisted of logs from a total of three monitoring well borings and four PCPT explorations. Figure 2-6 shows a geological cross section through Sites 15 and 16. The location of the cross section is presented in Figure 2-7.

Clay and clayey sand layers were primarily located at depths of less than 40 feet bls. The thickest of these layers was approximately 20 feet at PCPT exploration WHF-15-CPT-2.

Similar to the geological conditions of the Industrial Area, no significant laterally extensive clay layer is present to impede migration of contaminants from the disposal areas to groundwater.

2.3.3 Northwestern Disposal and Fire Fighting Training Areas Geological data from three monitoring well borings and four PCPT explorations were used to evaluate the geologic conditions present at Sites 1, 2, 17, 18, the northwest landfill, rubble landfill, and the two fire fighting training areas.

The only highly plastic clay layer that had a thickness of greater than 5 feet at any of the four sites was encountered at the Site 17 PCPT exploration WHF-17-CPT-1 (approximately 30 feet thick). Such a clay layer, if laterally extensive, would provide an ideal confining unit, but due to the limited amount of geological data at Site 17 the presence of a continuous clay layer cannot be determined.

A geologic cross section through Sites 1, 2, 17, and 18 is presented in Figure 2-8. Once again, correlation of lithologic units is virtually nonexistent. Plan view of this cross section is shown in Figure 2-9.

2.3.4 Southeastern Disposal Areas A total of eight monitoring well borings and seven PCPT explorations provided geological data for Sites 9, 10, 11, 12, 13, and 14.

Subsurface soil types at the above sites included low to high plasticity clays, inorganic silts, fine- to coarse-grained sands, and gravel. Clay layers were encountered more frequently and at a greater thickness below the Southwestern Disposal Areas than at any of the other site groupings. Thickness of the clay layers was approximately 30 feet. The most laterally extensive clay layer beneath all of the site groupings was present at the Southeastern Disposal Area site grouping. Figure 2-10 presents a geologic cross section from Site 9 to Site 13. Two distinct clay layers appear to be present, one at approximately 125 feet above mean sea level (msl) and the other at approximately 75 to 50 feet above

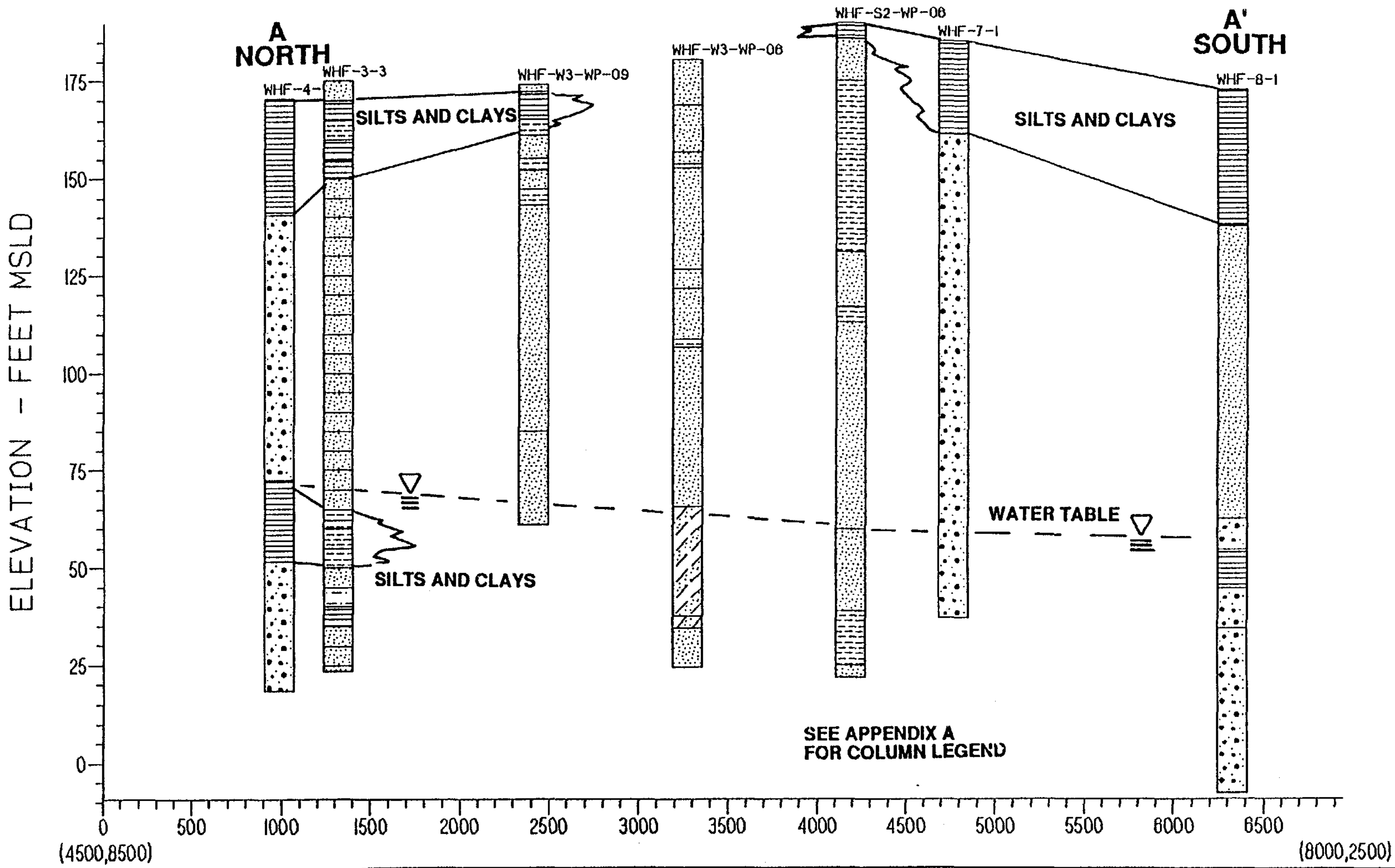


FIGURE 2-2

INTERPRETED CROSS SECTION A-A' THROUGH THE INDUSTRIAL AREA (SEE FIGURE 3-5 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

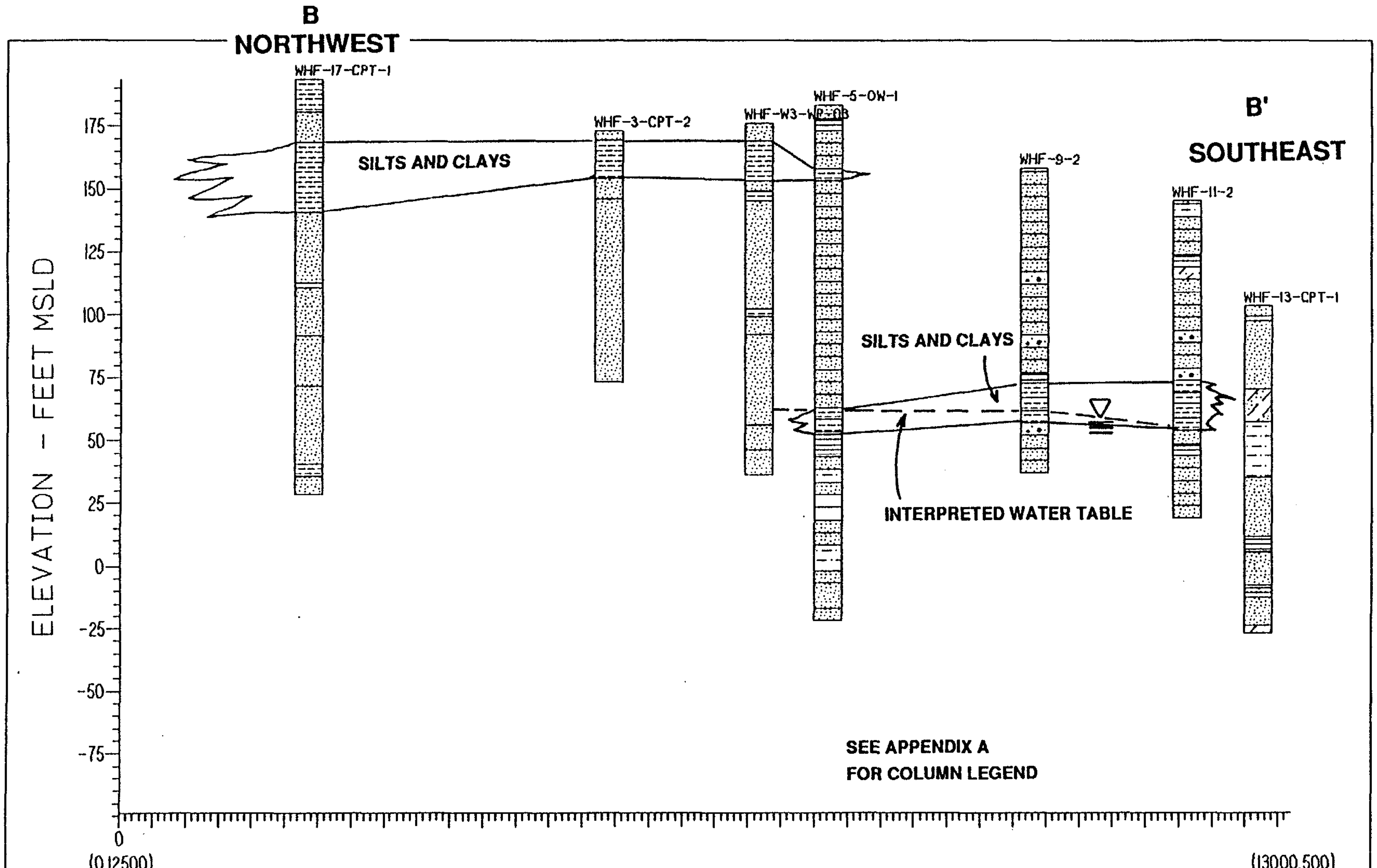


FIGURE 2-3
INTERPRETED CROSS SECTION B-B'
NORTHWEST TO SOUTHEAST,
NAS WHITING FIELD
(SEE FIGURE 3-5 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

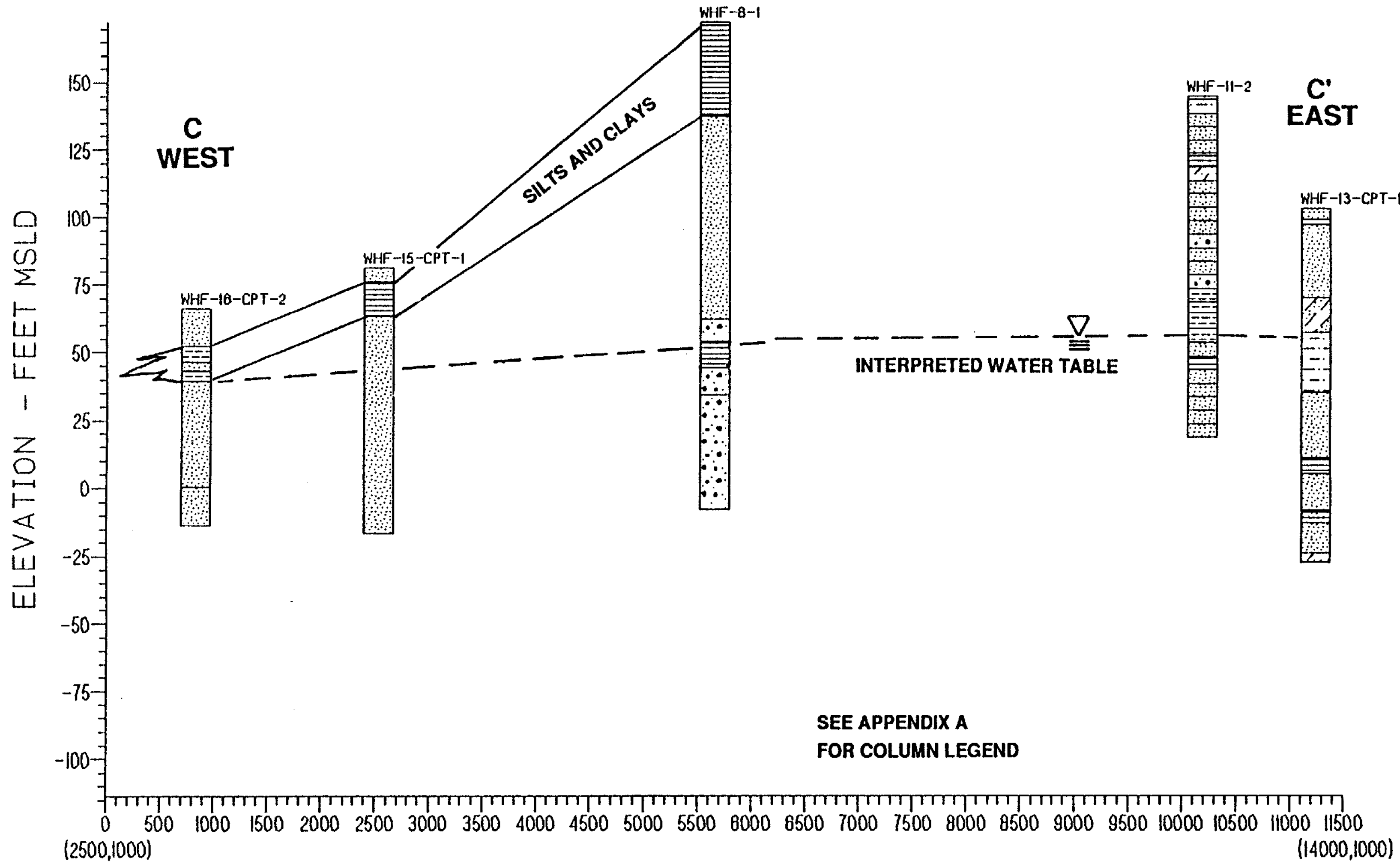
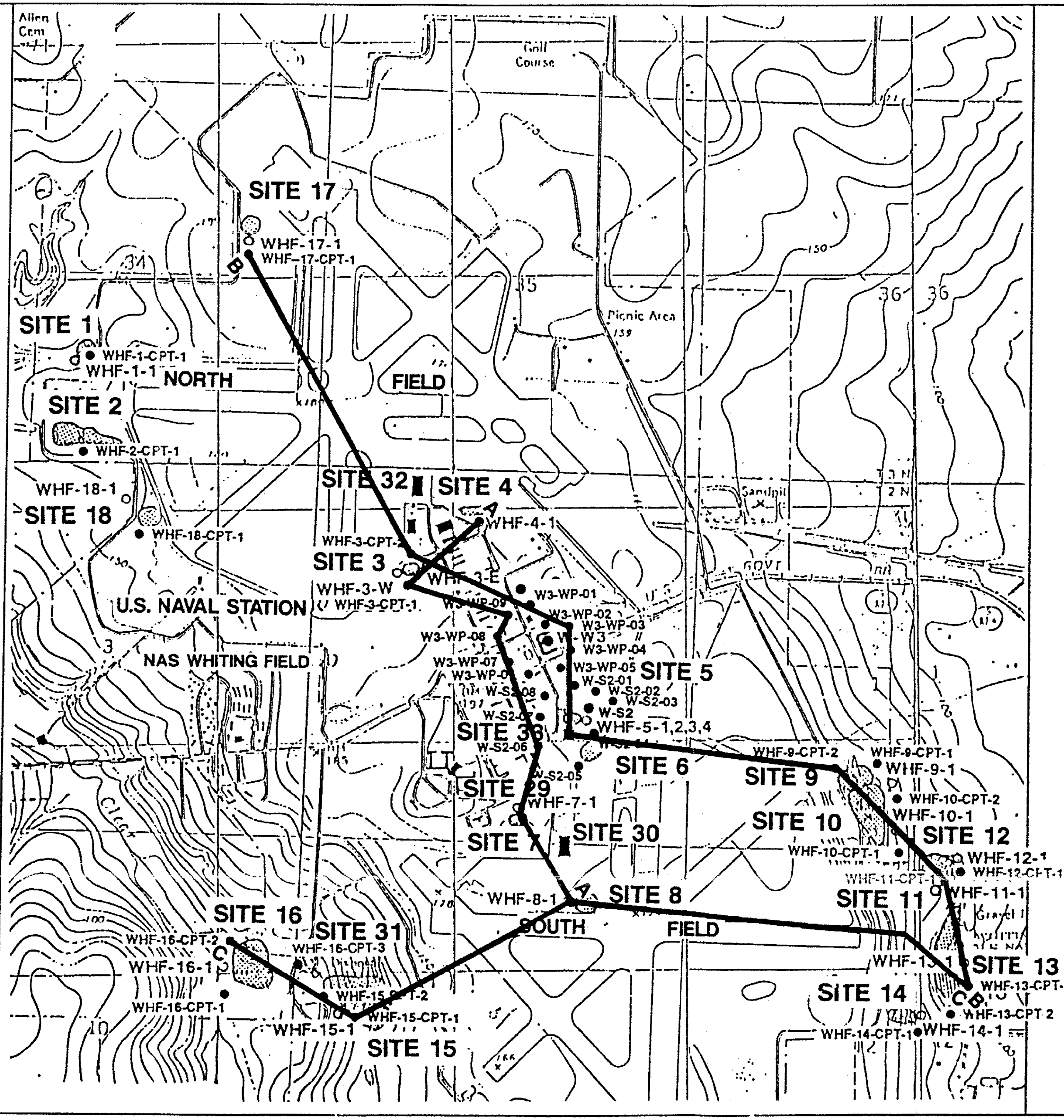


FIGURE 2-4

INTERPRETED CROSS SECTION C-C'
WEST TO EAST, SOUTH OF THE
INDUSTRIAL AREA
(SEE FIGURE 3-5 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



N

LEGEND

- ○ Existing Monitoring Well
- ● PCPT/BAT Exploration

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 2-5
PLAN VIEW OF GEOLOGIC CROSS SECTIONS ACROSS INDUSTRIAL AREA

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I03Z

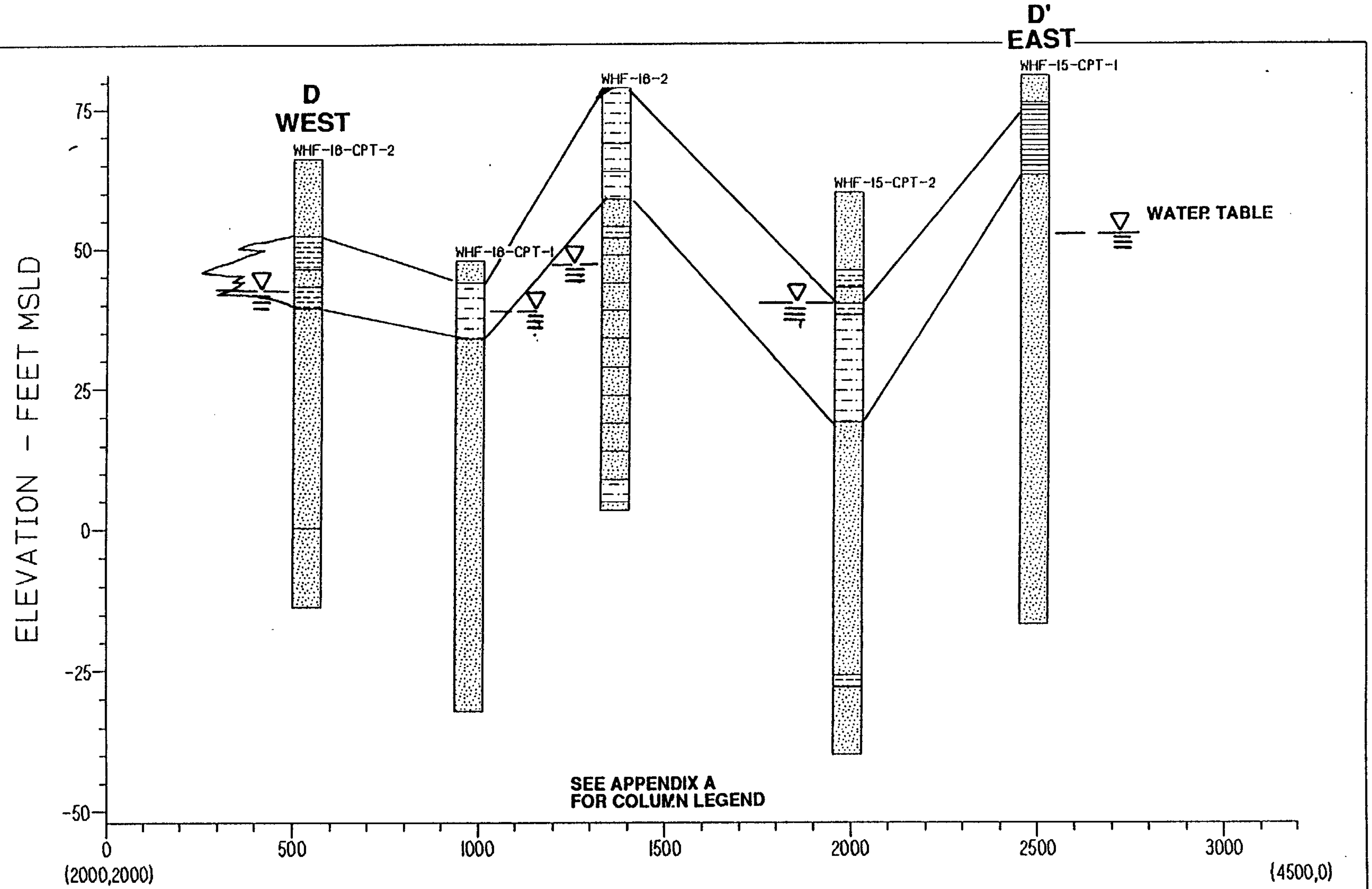
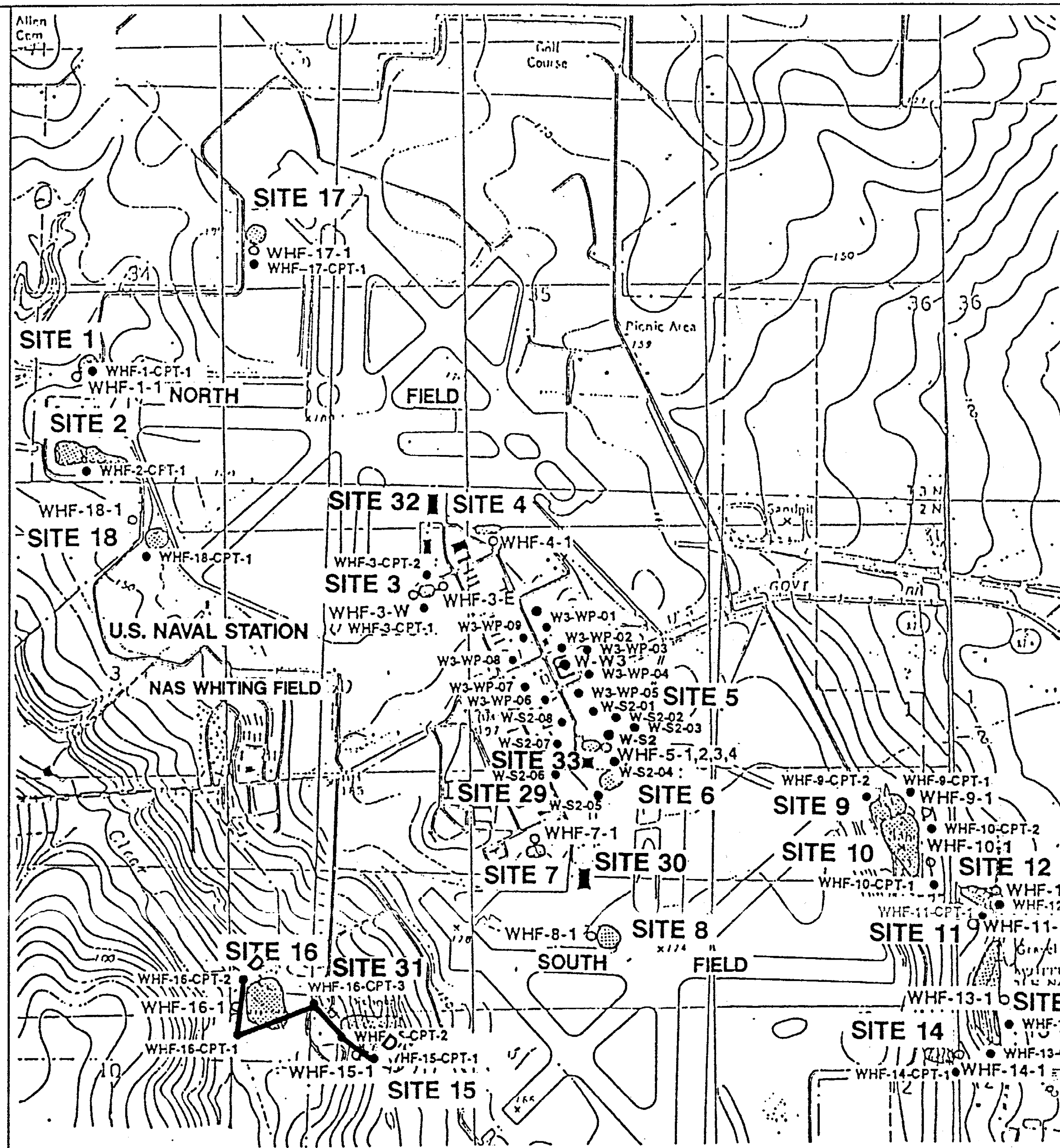


FIGURE 2-6
INTERPRETED CROSS SECTION D-D' THROUGH THE SOUTHWEST DISPOSAL AREAS
(SEE FIGURE 3-7 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



N

LEGEND

○ Existing Monitoring Well

● PCPT/BAT Exploration

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 2-7
PLAN VIEW OF GEOLOGIC CROSS SECTION D-D' THROUGH THE SOUTHWEST DISPOSAL AREAS, NAS WHITING FIELD

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I042

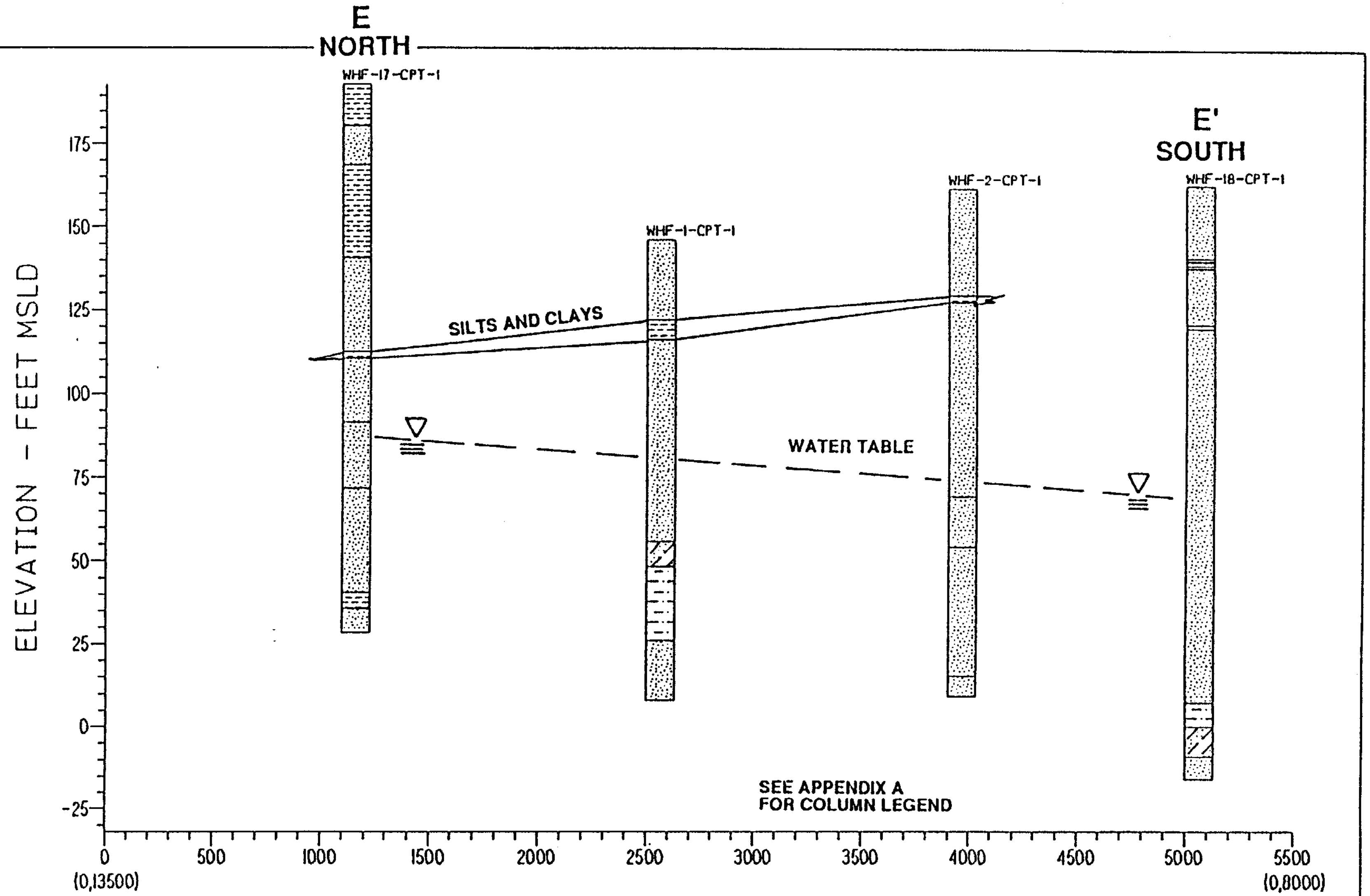
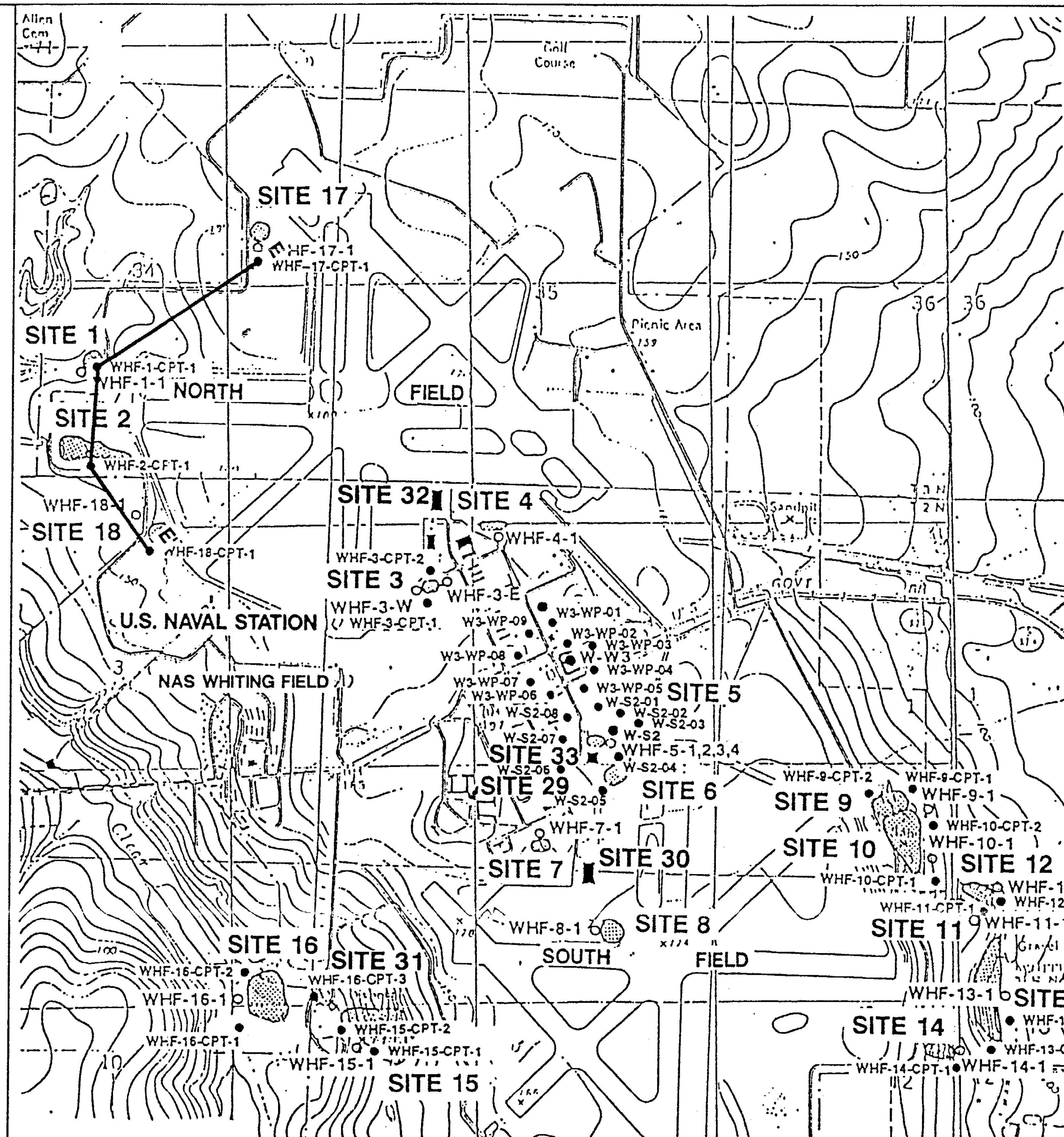


FIGURE 2-8
INTERPRETED CROSS SECTION E-E' THROUGH THE NORTHWEST AREA, NAS WHITING FIELD (SEE FIGURE 2-9 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



N

LEGEND

○ Existing Monitoring Well

● PCPT/BAT Exploration

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 2-9
PLAN VIEW OF CROSS SECTION E-E' THROUGH NORTHWEST AREA, NAS WHITING FIELD

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I052

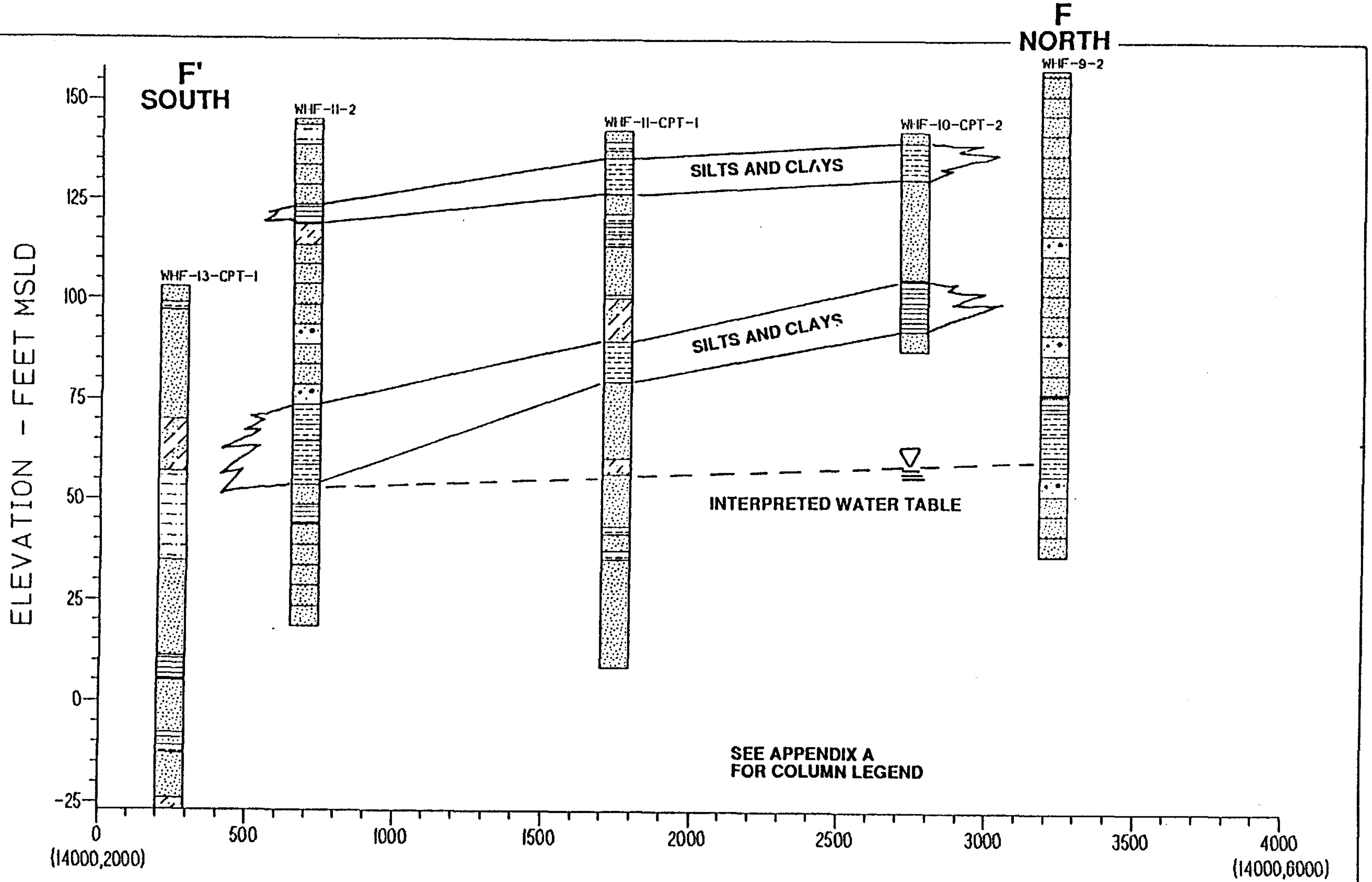


FIGURE 2-10
INTERPRETED CROSS SECTION F-F' FROM NORTH TO SOUTH AT THE EASTERN EDGE, NAS WHITING FIELD (SEE FIGURE 3-11 FOR PLAN VIEW)

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

msl. Clay layers containing various amounts of silt and sand that were located at similar elevations were considered to be of the same depositional unit. It would not be uncommon in a fluvial depositional environment to find varying amounts of silt and sand in a lithologic unit predominantly composed of clay. Plan view of this cross section is shown in Figure 2-11.

<u>2.3.5 Installation Wide Interpretation</u> Based on data collected from subsurface explorations including monitoring well borings, PCPT soundings, and geophysical logging, the following interpretations of the geological conditions at NAS Whiting Field can be made.

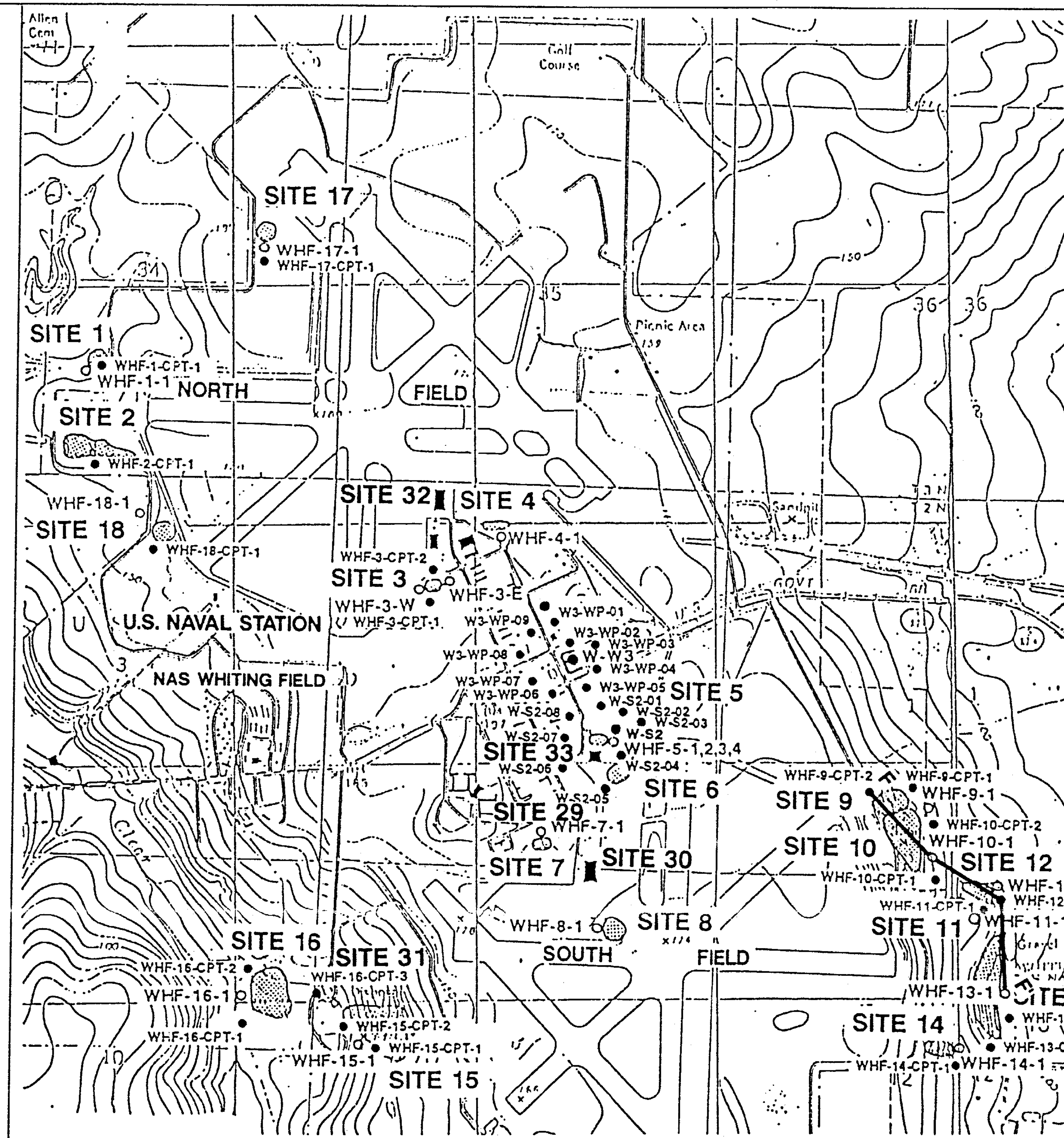
The soils encountered during the subsurface explorations generally consisted of massive, very fine- to coarse-grained sand with interbedded clay, silt, and clayey sand layers. Clay layers were often as much as 30 feet thick and typically contained varying amounts of silt and fine sand. Silt layers were encountered less frequently than clay layers and usually contained small amounts of clay and very fine-grained sand.

Sand units were generally composed of poorly graded sands ranging from very fine to coarse in grain size. Occasional layers of gravels, typically less than 1 foot thick, were found at depths greater than 40 feet bls. Gravel more commonly occurred in small amounts with coarse sands rather than in distinct layers. Lithologic logs with soil descriptions and other pertinent data collected from the subsurface explorations were presented in Appendices A and C of Technical Memorandum No. 1 (ABB-ES, 1992). Lithologic logs from various sites that have been adjusted to relative mean sea level elevations were combined to create geologic cross sections through the installation and the site groupings.

Figure 2-3 shows a geologic cross section that runs through the entire installation from the northwestern area of Site 17 to the southeastern part of Site 13. Limited correlation between the clay layers appears to be present and due to the large distance (up to 4,000 feet) separating the explorations, the interpretation of contiguous clay layers that are not measured at closely spaced intervals based solely on the elevation of the layers may not be reliable. In depositional environments like those found at NAS Whiting Field, it is difficult to correlate specific lithologic units over large distances because it is uncertain if they are associated with the same depositional event. With additional lithologic information between the existing explorations a more accurate interpretation of continuous clay layers could be made.

The lithologies of the four site groupings: Industrial Area (Sites 3, 4, 5, 7, 8, and production well areas), Southwestern Disposal Areas (Sites 15 and 16), Northwestern Disposal Areas (Sites 1, 2, 17, and 18), and the Southeastern Disposal Areas (Sites 9, 10, 11, 12, 13, and 14) were similar in that they contained massive sand units with interbedded clay and silt layers. Only thickness, depth, and frequency of the interbedded clays and silts differentiated the site groupings from one another.

At depths of approximately 50 feet bls, the lithologies of the Southwestern Disposal Areas and Northwestern landfills and fire fighting training areas (Northwestern Disposal Areas) are primarily composed of poorly graded sand with an occasional clay, silt, or clayey sand layer. In contrast, the Southeastern



N

LEGEND

- ○ Existing Monitoring Well
- ● PCPT/BAT Exploration

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 2-11

PLAN VIEW OF CROSS SECTION F-F' FROM NORTH TO SOUTH AT THE EASTERN EDGE, NAS WHITING FIELD

RI/FS PROGRAM

NAS WHITING FIELD MILTON, FLORIDA

00229I06Z

Disposal Areas and the Industrial Area appear to have a greater number of clay and silt layers that are commonly found at depths of greater than 100 feet bls.

Overall, no continuous confining clay layer is interpreted to be present at NAS Whiting Field. However, clay layers are present and laterally continuous at some areas of the installation and locally confining conditions may be present. Based on the cross sections developed by GTGS, the areas of the installation that may exhibit locally confining to semi-confining conditions would include those on the following list. At these general locations a substantial clay or silty clay layer is present at the elevations shown.

Site Grouping	Elevation of Clay Layer (feet NGVD)
Sites 10 and 11	Approximately 125 feet
Sites 9, 10, 11, and 12	Approximately 50 to 75 feet
Site 17	Approximately 130 to 160 feet
Sites 15 and 16	Approximately 30 to 60 feet

2.4 GEOLOGIC CONCLUSIONS. Based on the evaluation of the geologic data collected during Phase I of the RI the following conclusions can be made.

- The subsurface soils at NAS Whiting Field generally consist of massive sand units interbedded with clay, silt, and gravel layers.
- The clay layers ranged in thickness from less than 1 foot to 30 feet and were encountered at depths ranging from land surface to 200 feet bls.
- The clay layers were composed of low to high plasticity mottled clay with low plasticity clays containing small to moderate amounts of silt and fine- to medium-grained sand.
- The silt layers were encountered less frequently than clay layers and often contained small amounts of clay and very fine sand.
- The sand units were commonly composed of poorly graded sand of very fine to coarse grain size.
- The gravel, when encountered, was most frequently encountered with coarse sand at depths greater than 50 feet bls and in layers less than 1 foot thick.
- Based on geologic cross sections developed from subsurface exploration data, no laterally continuous confining clay layer appears to be present beneath NAS Whiting Field.
- Clay layers that were found to be partially continuous or continuous below the southeastern and northwestern disposal areas site groupings may create locally semi-confining or confining conditions.

Geologic data gaps exist in that an insufficient amount of the lithology was characterized to determine if local confining conditions present at several sites are present in the areas between the four site groupings, Industrial Area, Northwestern Disposal Areas, Southwestern Disposal Areas, and Southeastern Disposal Areas. Additional lithologic data from the unexplored areas are necessary to evaluate whether overall confining zones exist over large areas of the installation.

3.0 SUMMARY OF TECHNICAL MEMORANDUM NO. 2, HYDROGEOLOGIC ASSESSMENT

Technical Memorandum No. 2, Hydrogeologic Assessment, is the second in a series of six technical memoranda that summarize the results and transmit data gathered during the Phase I RI. The following sections provide a summary of the hydrogeologic assessment presented in Technical Memorandum No. 2.

3.1 OBJECTIVES OF THE HYDROGEOLOGICAL INVESTIGATION. The objectives of the RI Phase I hydrogeological investigation were to:

- characterize the regional groundwater flow system;
- characterize the groundwater flow system at the following site groupings; Sites 1, 2, 17, and 18; Site 3; Sites 4, 5, 7, and 8; Sites 9 and 10; Sites 11, 12, 13, and 14; and Sites 15 and 16 (no groundwater explorations were related to Site 6);
- estimate the aquifer characteristics (e.g., hydraulic conductivities, storativity, and transmissivity); and
- gain additional hydrogeologic data (e.g., horizontal gradients and seepage velocities).

Several tasks, including installation of monitoring wells and piezometers, water level measurements, slug tests, pumping tests, PCPT soundings, and *in situ* groundwater sampling, were conducted during the RI Phase I field program to define the hydrogeologic regime at NAS Whiting Field. Details of the above tasks are presented in Technical Memorandum No. 2.

Hydrogeologic information derived from the above tasks will be used to provide sufficient data to propose a no further action (for groundwater) remedial alternative or provide information to optimize explorations to further delineate the nature and extent of groundwater contamination. Results of the hydrogeologic evaluation are detailed in Technical Memoranda No. 2 and summarized in the following sections.

3.2 REGIONAL HYDROGEOLOGY. There are three major groundwater aquifers within the region. The first is a shallow aquifer, which is both artesian and non-artesian (the sand-and-gravel aquifer), and two other deep artesian aquifers (the Upper Floridan aquifer and the Lower Floridan aquifer). Virtually all groundwater withdrawn in Escambia and Santa Rosa Counties comes from the surficial sand-and-gravel aquifer. Descriptions of the aquifers and accompanying stratigraphic units (Geraghty & Miller, 1985) are presented in the NAS Whiting Field Workplan (Jordan, 1990) and summarized below. A generalized hydrogeologic section for Santa Rosa County was shown in Figure 2-1.

- Sand-and-Gravel Aquifer. The sediments, extending to a depth of about 350 feet, 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. According to an aquifer test in the Milton area, the clayey sand, locally 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 into the lower part of this aquifer from about 180 to 330 feet bls.

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 sometimes are indistinguishable. The aquifer consists of poorly sorted, fine- to coarse-grained sands with gravel and lenses of clay, which may be as thick as 60 feet. In some areas, the formation also contains wood fragments of all sizes, including whole tree trunks, occurring mostly in layers that may be as thick as 25 feet.

The formation 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.

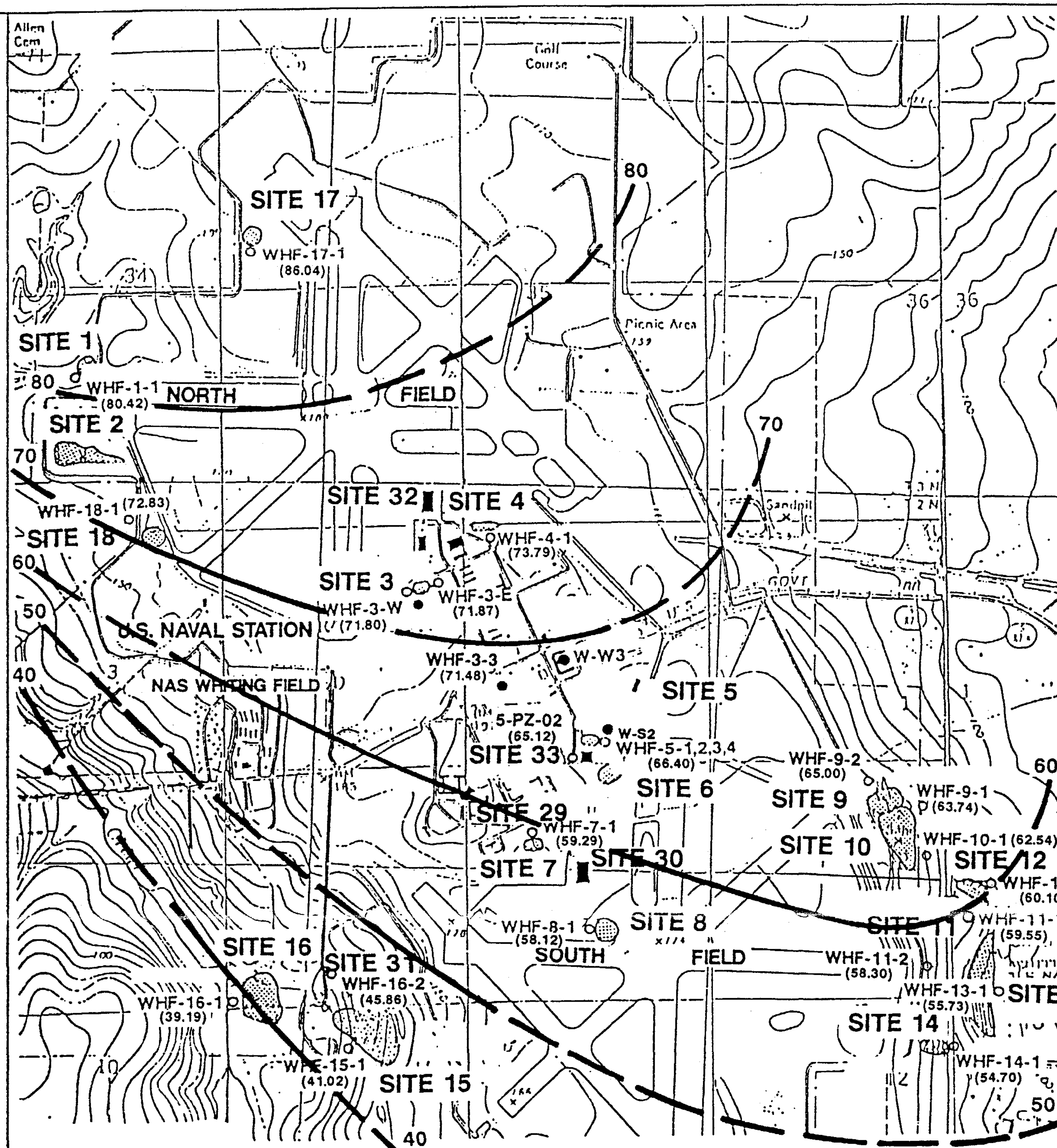
The water from the sand-and-gravel aquifer is considered to be of excellent quality. Total dissolved solids and total hardness are generally less than 50 milligrams per liter (mg/ℓ). However, because of high levels of dissolved carbon dioxide, the water is acidic with an ambient pH as low as 5.0 and locally it may contain high concentrations of iron.

- Floridan Aquifer System. Underlying the sediments of the sand-and-gravel aquifer systems is the thick (±300 feet), relatively impermeable Pensacola Clay, below which 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, which, in this area, is divided into an upper and lower part separated by the Bucatunna Clay member of the Byram Formation. The Upper Floridan aquifer is an important source of water in areas east of Santa Rosa County. However, toward the west, it is increasingly mineralized and is generally not used as a water supply. The Lower Floridan aquifer is highly mineralized in the NAS Whiting Field area and is, in fact, designated for use as a waste disposal injection zone. 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 Floridan aquifer system in the NAS Whiting Field area is about 50 to 55 feet above msl and the direction of groundwater flow is to the southeast.

3.3 INSTALLATION AND SITE-SPECIFIC HYDROGEOLOGY

Groundwater Flow Directions. The groundwater flow direction of the sand-and-gravel aquifer at NAS Whiting Field appears to be to the south-southwest (toward Clear Creek) in the western half of the installation and to the southeast (toward Big Coldwater Creek) in the eastern half (Figure 3-1).



LEGEND

○ MONITORING WELL (ELEVATIONS IN FEET NGVD)
(XX.XX) WATER LEVEL

● GROUNDWATER SUPPLY WELL

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 3-1
GROUNDWATER CONTOUR MAP
JULY 1991

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I07Z

The groundwater flow direction at the six site groupings generally follows the overall installation groundwater flow pattern. Groundwater flow directions at the site groupings are as follows (Figures 3-2 through 3-7).

Site Grouping	Groundwater Flow Direction
Sites 1, 17, and 18	South-southwest
Site 3	South
Sites 4, 5, 7, and 8	South
Sites 9 and 10	Southeast
Sites 11, 12, 13, and 14	Southeast
Sites 15 and 16	Southwest

Horizontal Gradients. Horizontal gradients of the sand-and-gravel aquifer ranged from 0.0016 foot per foot (ft/ft) to 0.0076 ft/ft. Calculated horizontal gradients across the six site groupings are as follows.

Site Grouping	Horizontal Gradient (ft/ft)
Sites 1, 17, and 18	0.0029
Site 3	0.0021
Sites 4, 5, 7, and 8	0.0016
Sites 9 and 10	0.0023
Sites 11, 12, 13, and 14	0.0034
Sites 15 and 16	0.0076

Hydraulic Conductivity. Data collected from the single-hole permeability tests (slug tests) were evaluated using the Aqtesolv™ groundwater software package to estimate hydraulic conductivity of the sand-and-gravel aquifer. The data were analyzed within the Aqtesolv™ program using a method developed by Bouwer and Rice (1976) for calculating the hydraulic conductivity of an aquifer from partially penetrating wells in an unconfined aquifer.

Three rising head and three falling head slug tests were conducted in 15 monitoring wells. Comparison of the average calculated rising and falling head hydraulic conductivity results for each monitoring well tested are presented in Table 3-1.

The geometric mean of the calculated hydraulic conductivities for the three rising and falling head slug tests conducted in each monitoring well is summarized in Table 3-2. Geometric mean values ranged from 5.34×10^{-2} to 2.88×10^{-4} centimeters per second (cm/sec). This considerable variability (2 orders of magnitude) in hydraulic conductivity within the same aquifer is a reflection of the wide range of grain sizes (clay to gravel) and interbedding characteristic of the sand-and-gravel aquifer.

Hydraulic conductivities across the site groupings were developed by taking the geometric mean of the calculated hydraulic conductivities associated with all monitoring wells that were slug tested in the grouping.

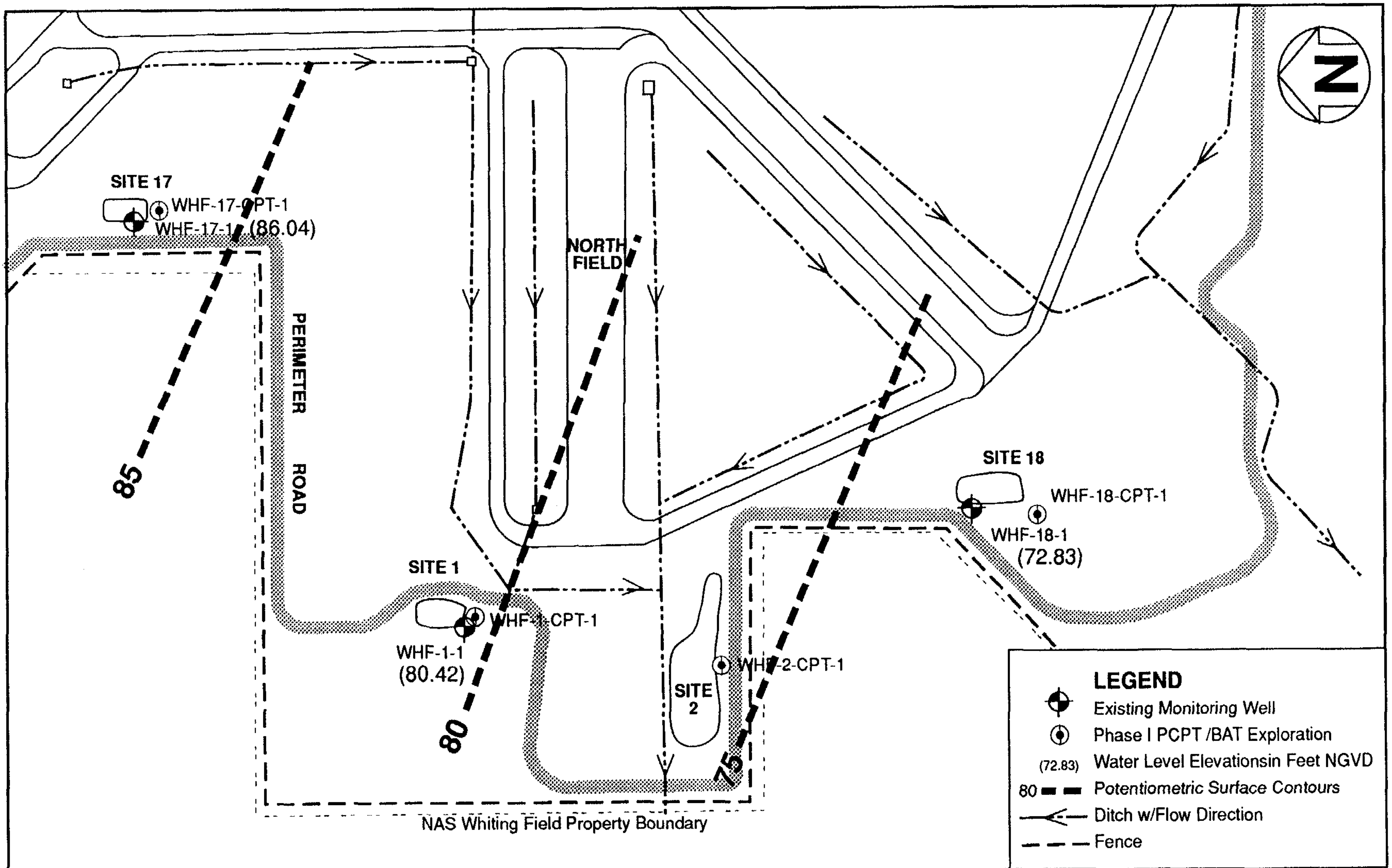


FIGURE 3-2
SITES 1, 17, & 18
GROUNDWATER CONTOUR MAP
JULY 1991
NORTHWEST AREA

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

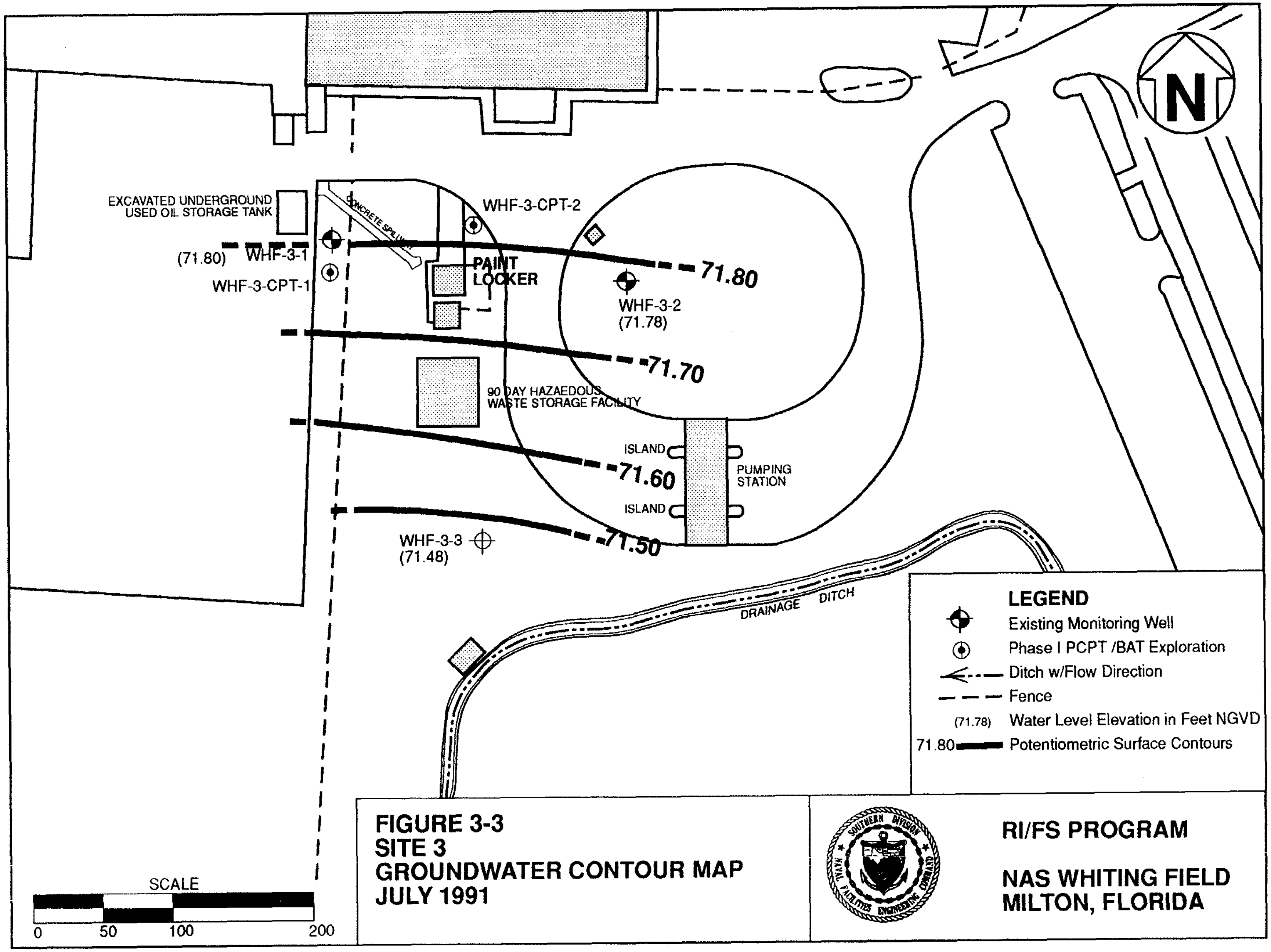


FIGURE 3-3
SITE 3
GROUNDWATER CONTOUR MAP
JULY 1991

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

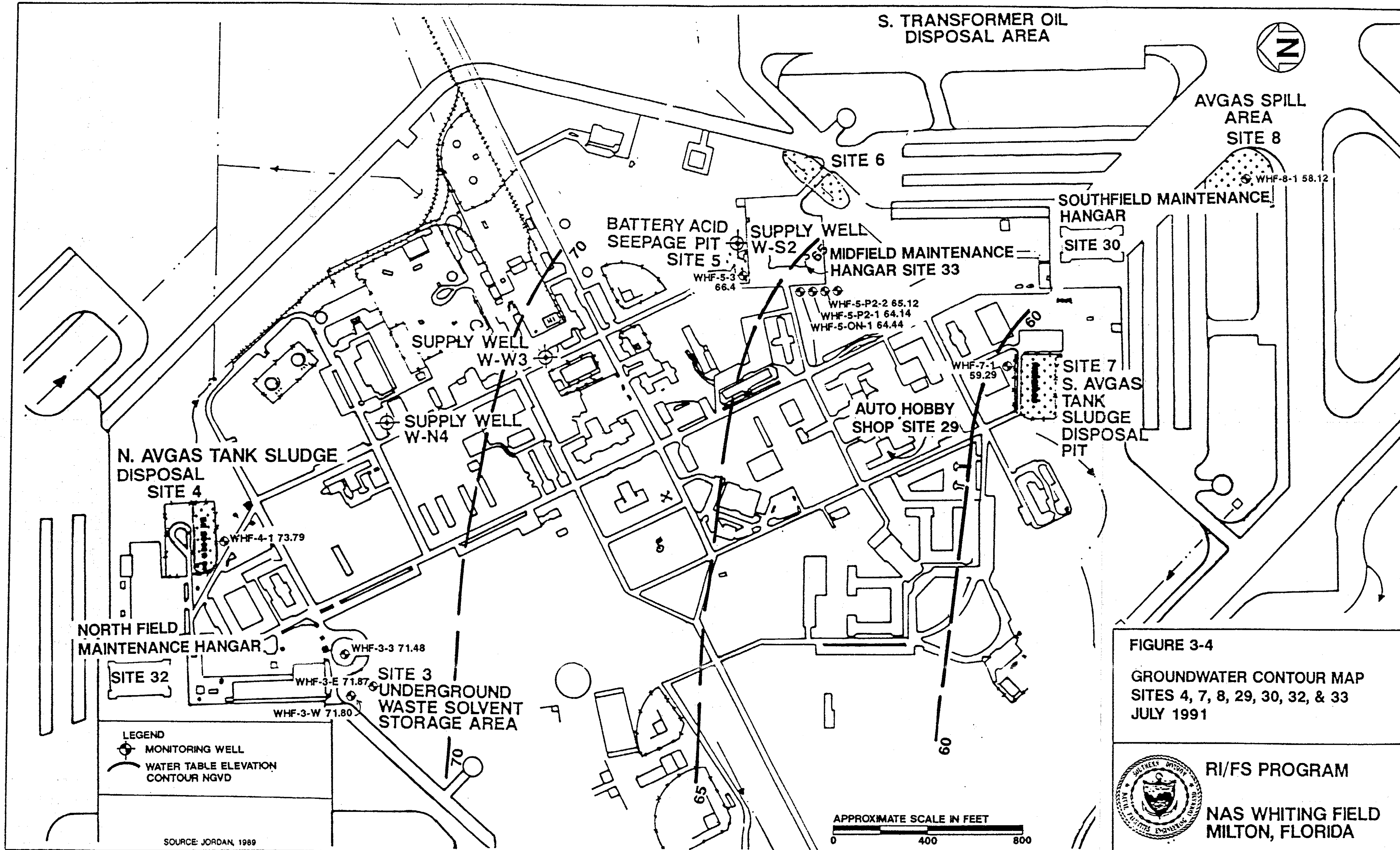


FIGURE 3-4

GROUNDWATER CONTOUR MAP
SITES 4, 7, 8, 29, 30, 32, & 33
JULY 1991

00229I082

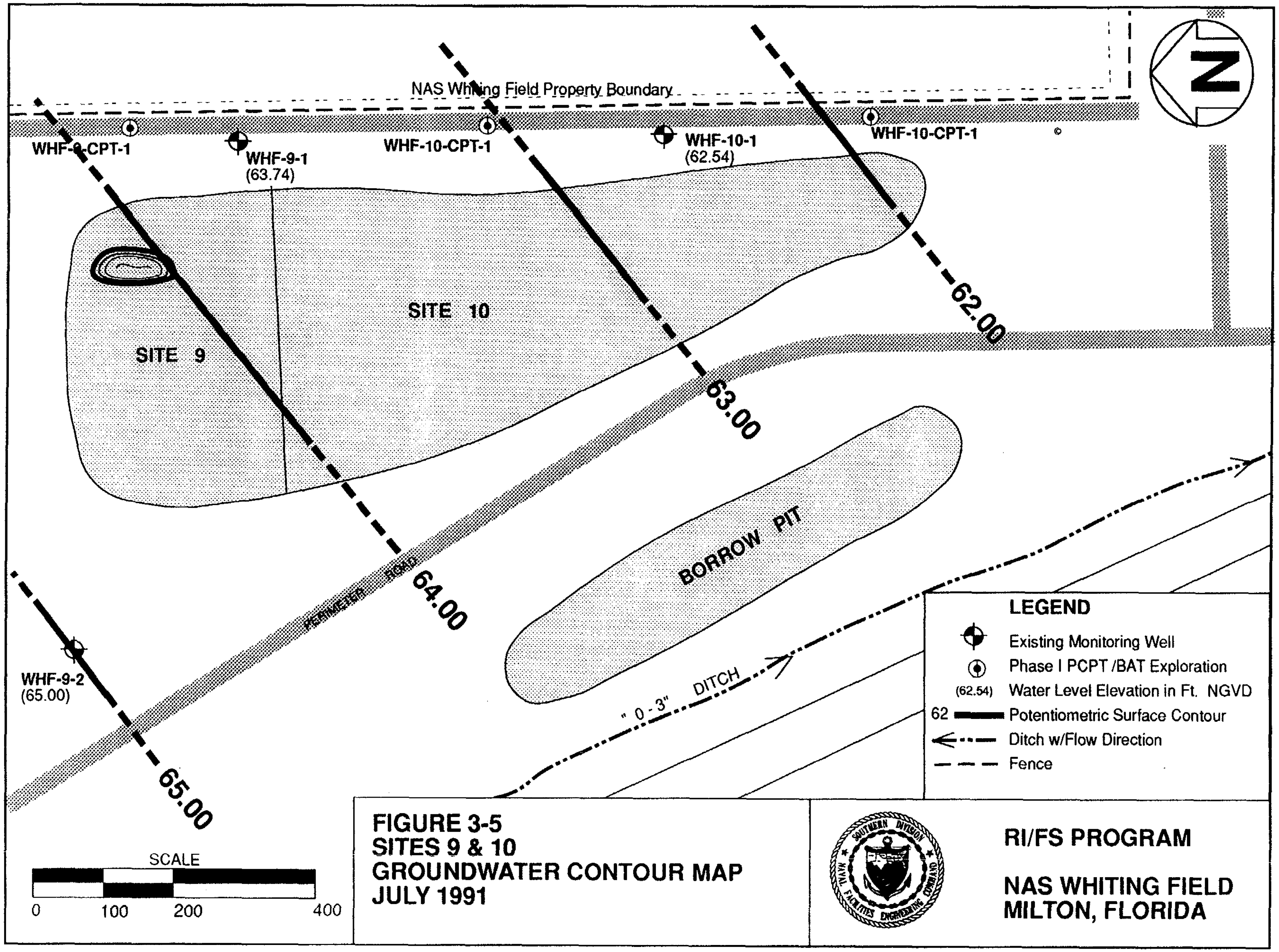


FIGURE 3-5
SITES 9 & 10
GROUNDWATER CONTOUR MAP
JULY 1991

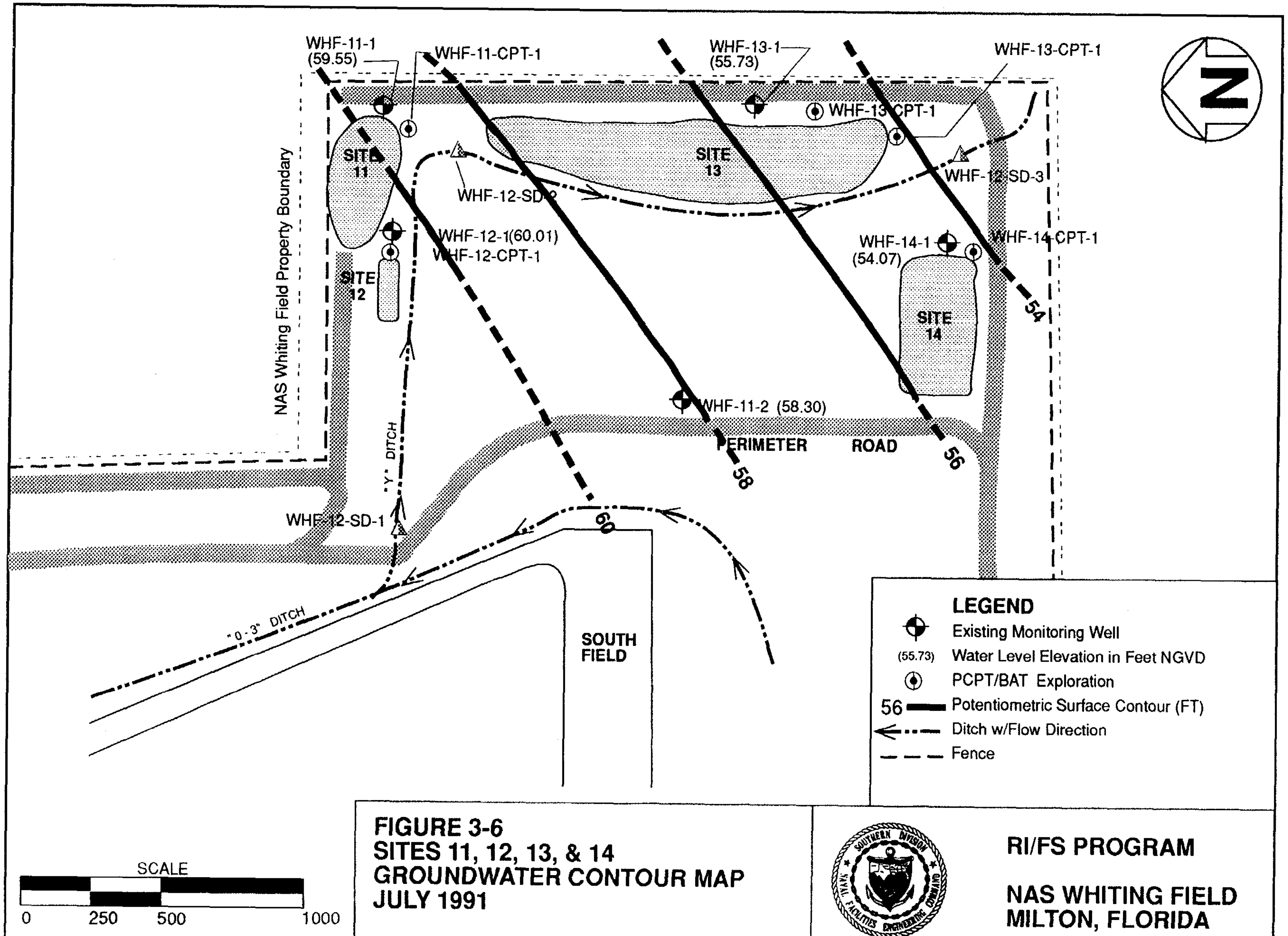


FIGURE 3-6
SITES 11, 12, 13, & 14
GROUNDWATER CONTOUR MAP
JULY 1991

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

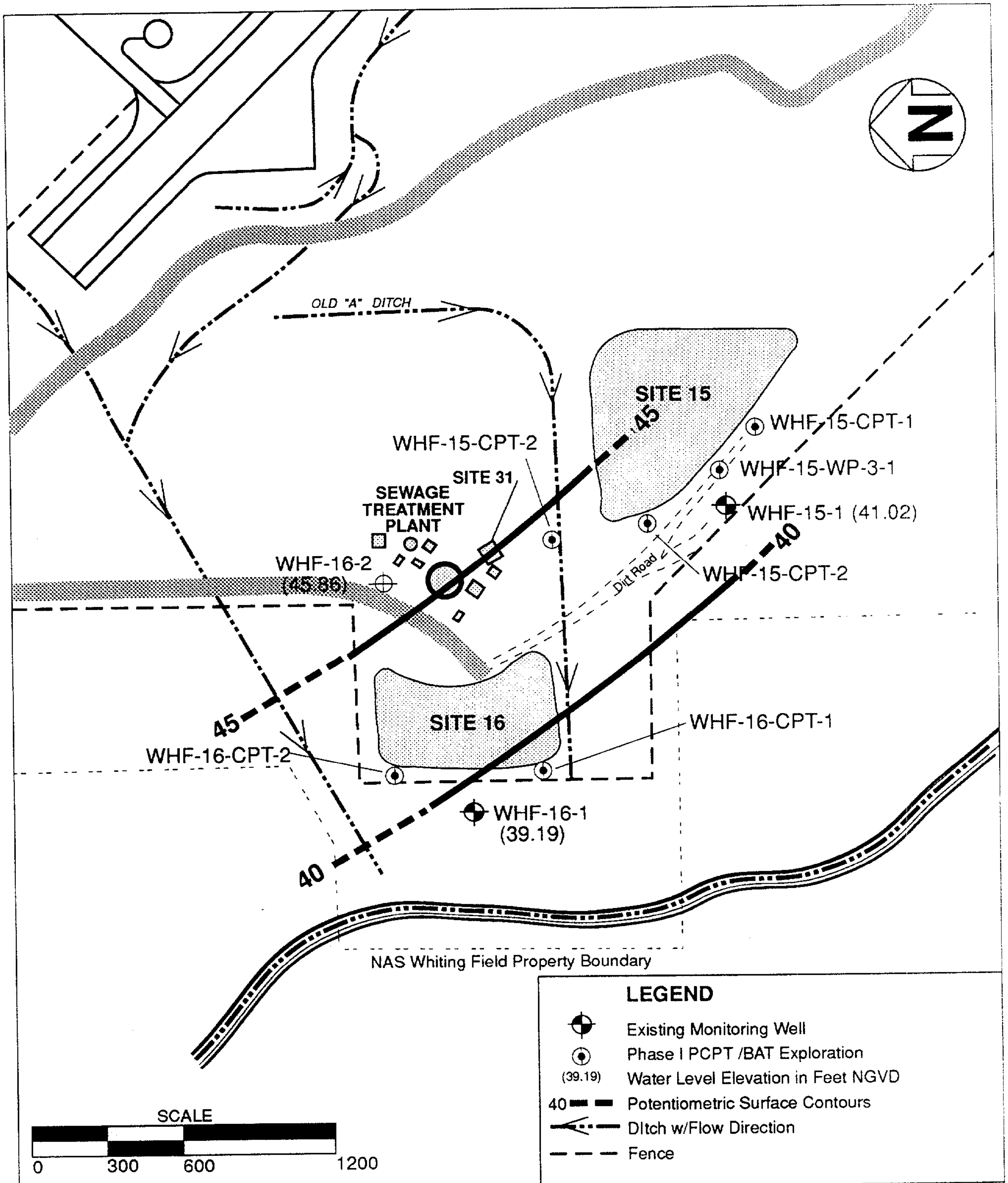


FIGURE 3-7
SITES 15, 16, & 31
GROUNDWATER CONTOUR MAP
JULY 1991

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

Table 3-1
Comparison of Average Falling and Rising Head Slug Tests

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Well	Falling Head K (cm/sec)	Rising Head K (cm/sec)
WHF-1-1	1.03×10^{-3}	1.06×10^{-3}
WHF-3-3	1.29×10^{-3}	5.67×10^{-3}
WHF-5-1	5.13×10^{-4}	2.88×10^{-4}
WHF-8-1	2.71×10^{-3}	2.62×10^{-3}
WHF-9-2	5.48×10^{-3}	4.96×10^{-3}
WHF-10-1	7.00×10^{-3}	9.31×10^{-3}
WHF-11-1	1.78×10^{-2}	2.01×10^{-2}
WHF-12-1	2.35×10^{-2}	1.81×10^{-2}
WHF-13-1	1.40×10^{-2}	1.07×10^{-2}
WHF-14-1	5.34×10^{-2}	1.67×10^{-2}
WHF-15-1	2.98×10^{-2}	1.62×10^{-2}
WHF-16-1	9.72×10^{-3}	5.89×10^{-3}
WHF-16-2	2.40×10^{-3}	2.40×10^{-3}
WHF-17-1	9.46×10^{-3}	9.78×10^{-3}
WHF-18-1	6.80×10^{-3}	4.67×10^{-3}

Notes: Average is the geometric mean.
K = conductivity.
cm/sec = centimeters per second.

Table 3-2
Geometric Mean Hydraulic Conductivity by Site Group

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Grouping	Hydraulic Conductivity (cm/sec)
1, 17, and 18	3.61×10^{-3} (8.96 ft/day)
3	8.17×10^{-3} (23.16 ft/day)
4, 5, 7, and 8	3.87×10^{-3} (9.55 ft/day)
9 and 10	6.53×10^{-3} (18.51 ft/day)
11, 12, 13, and 14	1.91×10^{-2} (54.14 ft/day)
15 and 16	6.80×10^{-3} (19.27 ft/day)

Notes: cm/sec = centimeters per second.
ft/day = feet per day.

Hydraulic conductivities for the following monitoring wells were not calculated due to the various listed conditions.

WHF-3-E	Groundwater contamination, not tested
WHF-3-W	Groundwater contamination, not tested
WHF-7-1	Groundwater contamination, not tested
WHF-11-2	Inconsistent data, not analyzable
WHF-9-1	Inconsistent data, not analyzable
WHF-5-OW-2	Insufficient amount of water in well to test

Seepage Velocity. The average linear pore water velocity or seepage velocity across the site groupings can be calculated by using the following modified version of Darcy's law (accounting for a porous medium):

$$V=\frac{Ki}{n}$$

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

As mentioned in the previous sections, the hydraulic conductivity and hydraulic gradient have been calculated for each site grouping. The effective porosity for silty sands to well sorted sands ranges from 0.18 to 0.27 (Fetter, 1980). An average effective porosity value of 0.23 was selected for the seepage velocity calculations.

Using the above equation, seepage velocities for each site grouping is calculated as follows.

Sites 1, 17, and 18

$$V=\frac{(8.96\ ft/day)(0.0029\ ft/ft)}{0.23}$$

$$V = 0.11\ \text{ft/day}$$

Site 3

$$V=\frac{(23.16\ ft/day)(0.0023\ ft/ft)}{0.23}$$

$$V = 0.21\ \text{ft/day}$$

Sites 4, 5, 7, and 8

$$V=\frac{(9.55\ ft/day)(0.0016\ ft/ft)}{0.23}$$

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

Sites 9 and 10

$$V=\frac{(18.51\ ft/day)(0.0023\ ft/ft)}{0.23}$$

$$V = 0.19\ \text{ft/day}$$

Sites 11, 12, 13, and 14

$$V=\frac{(54.14\ ft/day)(0.0034\ ft/ft)}{0.23}$$

$$V = 0.76\ \text{ft/day}$$

Sites 15 and 16

$$V=\frac{(19.27\ ft/day)\,(0.0076\ ft/ft)}{0.23}$$

0.64 ft/day

These seepage velocities represent the pore velocity at which groundwater is moving horizontally throughout the upper part of the sand-and-gravel aquifer. These velocities may not be representative of the contaminant transport velocity due to the interaction with other physical and chemical variables (i.e., longitudinal and transverse dispersivity).

<u>3.3.1 Aquifer Characteristics</u> Data from the Phase I RI pumping test conducted at NAS Whiting Field from March 14 to 20, 1991, were used to estimate the aquifer characteristics of the sand-and-gravel aquifer.

The data collected during the pumping test were evaluated using the Hantush (1955) leaky aquifer and Boulton (1955) delayed-drainage methods to provide estimates of transmissivity, hydraulic conductivity, and storativity for the sand-and-gravel aquifer. These data and a discussion of the pumping test results are detailed in the pumping test report appended to Technical Memorandum No. 2.

Calculated transmissivity values ranged from 10,000 to 20,000 square feet per day (ft^2/day). This range is not large considering the typical natural variation in aquifer composition. The corresponding range in lateral hydraulic conductivity of the aquifer is approximately 100 to 150 ft/day, which is the range expected for sand with dispersed clay or thin clay lenses under pumping stress. The late-time Boulton storativities (0.045 and 0.08) are also reasonable for unconfined conditions in sand aquifers containing clay.

To summarize the pumping test analysis, the aquifer above and in the production zone contains localized thin lenses of clay sized material that are not really contiguous. These layers function to delay vertical water level response but do not function as true aquitards. Because of this, vertical migration from the water table to the production zone can occur readily. The influence of pumping of the west well and the aquifer behavior does indicate that the system is horizontally stratified; therefore, responses to pumping in a given depth interval may be transmitted rapidly. Detailed quantitative analysis of the system was complex due to the long-term antecedent heavy rainfall, the inability to feasibly control pumping rates closely, and the presence of other pumping wells in the vicinity that could not feasibly be shutdown. Overall, the system appears to behave as an unconfined system. The sand-and-gravel aquifer characteristics calculated from the pumping test are as follows.

transmissivity = 10,000 to 20,000 feet/day,
hydraulic conductivity = 100 to 150 feet/day, and
storativity = 0.045 and 0.08.

As expected, hydraulic conductivities derived from slug test analysis (approximately 9 to 54 ft/day) were lower than the hydraulic conductivity range (100 to 150 ft/day) estimated from the pumping test evaluation. The range of hydraulic conductivities determined from the pumping test analysis is probably more representative of the sand-and-gravel aquifer in the production zone than the range of hydraulic conductivities calculated from the slug test data from the shallower zones. Aquifer test data will likely provide more reliable estimates of the overall conductivity in the production zone than slug test data in the same system for the following reasons:

- the length of the pumping test was several days compared to a few minutes for each slug test, therefore creating a large data base;
- the volume of water displaced during a slug test is small and the results will be influenced by the movement of water through the filter pack of the monitoring well; and
- changes in water levels of several monitoring wells (often screened at various depths) are measured simultaneously during a pumping test rather than one monitoring well (screened at one specific interval) during a slug test.

However, due to the economies of scale and the large distance between monitoring wells at the perimeter sites, pumping tests cannot be conducted at all sites.

3.4 OVERALL HYDROGEOLOGIC INTERPRETATION. The groundwater system at NAS Whiting Field is composed of three aquifers: the sand-and-gravel aquifer, the Upper Floridan aquifer, and the Lower Floridan aquifer.

The groundwater flow direction of the sand-and-gravel aquifer at NAS Whiting Field is in a south-southwesterly direction towards Clear Creek in the western half of the installation and to the southeast towards Big Coldwater Creek in the eastern half.

The gradient of the sand-and-gravel aquifer potentiometric surface ranges from approximately 0.0016 to 0.0075 ft/ft. Hydraulic conductivities calculated from slug test and pumping test data ranged from 9 to 150 ft/day. Seepage velocities across the six site groupings ranged from 0.11 to 1.38 ft/day.

Based on the pumping test analysis, the transmissivity of the sand-and-gravel aquifer ranges from 10,000 to 20,000 ft^2/day.

Due to the depth of the Floridan aquifer production zones and the potential of cross-contamination, no exploration or aquifer characterization was conducted for these deeper systems during the RI field program.

4.0 SUMMARY OF TECHNICAL MEMORANDUM NO. 3, SOILS ASSESSMENT

Technical Memorandum No. 3, Soils Assessment, is the third in a series of six technical memoranda that summarizes the results and transmits data gathered during the Phase I RI. The following sections provide a summary of the soils assessment presented in Technical Memorandum No. 3 and recommend installation wide RI Phase II-A soil sampling and analysis activities. Historical data and information associated with each site are presented in the RI Phase I Workplan (Jordan, 1990).

4.1 OBJECTIVES OF THE SOILS INVESTIGATION. During the Phase I RI, soils sampling was limited to source area sampling at four sites and sampling of soil in two stormwater drainage swales. Specific objectives of the RI Phase I program were as follows.

Site 6, South Transformer Oil Disposal Area: Twelve additional confirmatory samples were collected to evaluate whether PCBs from four dielectric fluid disposals exist in locations not sampled during the verification study including from beneath a concrete flume installed since 1964.

Site 12, Tetraethyl Lead Disposal Area: Six additional samples were collected to further evaluate lead contamination of the waste piles and to evaluate their Resource Conservation and Recovery Act (RCRA) status relative to ignitability, corrosivity, and toxicity using the Toxicity Characteristics Leaching Procedure (TCLP). The latter tests were performed to support an interim removal action if necessary.

Sites 15, Southwest Landfill, and Site 16, Open Disposal and Burning Area: Six surface soil samples were collected to determine whether sandy, erodible surface soils at these locations are contaminated. The objective was to determine the potential for migration toward Clear Creek of soil-bound contaminants. At site 15 an additional objective was to evaluate the surface soil contamination status at an area formerly used as a Boy Scout camping area.

Stormwater Drainage Swales: The old 'A' Ditch is at Site 15. The surface soil of this former drainage ditch has been sampled at three locations to evaluate whether soils from site 15 have migrated to the ditch. "Y" Ditch at site 12 collects all stormwater from the eastern runways and sites 12 and 14. Water and sediment from this ditch are transported off installation toward Big Coldwater Creek. The objective of surface soil sampling in this drainway is to evaluate the potential for particulate transport of contaminates off installation with stormwater.

4.2 RI PHASE I SOIL SAMPLING FIELD PROGRAM SUMMARY. The soil sampling program was conducted on December 3 and 4, 1991. Sampling procedures and locations were described in the Phase I Sampling and Analysis Plan (Volume II of the Workplan). That volume contains the field sampling plan showing planned sampling locations and rationale and the Quality Assurance Project Plan (QAPP) that provides sampling and analysis procedure details and field quality control (QC) requirements. The sampling and analysis program is summarized in this section for each of the sites. With the exception of Site 12, all soil sample analyses were performed in accordance with Naval Energy and Environmental Support Activity (NEESA) Level C QC requirements. Ten percent of the samples, including all field duplicates as well as rinsate blanks, trip blanks, and matrix spike/matrix spike duplicates (MS/MSD), were analyzed at NEESA Level D, which requires full USEPA Contract Laboratory Program (CLP) validation of analytical data. Site 12, sampled primarily to characterize its RCRA status for removal planning, was analyzed in accordance with NEESA Level E QC requirements. Technical Memorandum No. 3 contains summarized analytical results for sites 6, 12, 15, 16, and the two drainage swales.

<u>4.2.1 Site 6, South Transformer Oil Disposal Area</u>. Twelve surface soil samples were collected at the South Transformer Oil Disposal Area at the locations shown in Figure 4-1. Surface to 0.5-foot depth interval soil samples were collected using a stainless-steel spoon and bowl and deeper samples were collected using a stainless-steel hand auger.

<u>4.2.2 Site 12, Tetraethyl Lead Disposal Area</u>. Six soil samples were collected at depths approximately 1 to 2 feet into the waste piles at site 12 as shown in Figure 4-2.

Samples were collected by boring into the piles using a stainless-steel hand auger. Sufficient sample was collected in a stainless-steel bowl and mixed using a stainless-steel spoon to perform corrosivity, flashpoint, TCLP, and total lead analyses in accordance with SW-846 (USEPA, 1986) Methods 9045, 1010, 1311, and 7421, respectively.

<u>4.2.3 Stormwater Drainage Swales</u> Three surface soil samples were collected in each of two stormwater drainage swales ("Y" ditch and "old 'A' ditch"). The general location of these drainages is shown in Figure 4-3. Sample locations are shown in detail for the "old 'A' ditch" in Figure 4-4 and for "Y" ditch in Figure 4-5. Soil samples were collected in the same manner as described in section 2.3 and analyzed for all target compound list (TCL) and target analyte list (TAL) organic and inorganic analytes.

<u>4.2.4 Sites 15 and 16, Southwest Landfill and Open Disposal and Burning Area</u>. Six surface soil samples were collected at these two sites at the locations shown in Figure 4-6. Three samples of surface soil from 0 to 0.5 foot bls were collected at each site. At each location, samples were collected using a stainless-steel spoon. Samples for volatile organic compound (VOC) analysis were collected and placed in containers with minimal mixing and leaving no headspace. Samples for semivolatile organic compounds (SVOCs), pesticides and PCBs, inorganic compounds, TAL metals, and total cyanide were prepared by thoroughly mixing sufficient soil in a stainless-steel bowl to fill all containers. To evaluate the nature of potential soil contaminants, the analytical program consisted of TCL VOCs, SVOCs, pesticides and PCBs, TAL metals, and total cyanide.

<u>4.3 SOIL SAMPLING RESULTS AND INTERPRETATION</u>

<u>4.3.1 Site 6, South Transformer Oil Disposal Area</u>. During the Phase I RI, a set of 12 samples was collected from the ditch and below the paved sections. The reported quantitation limit for PCB in soil was 160 micrograms per kilogram (μg/kg) (0.16 milligrams per kilogram [mg/kg]). Interpretation of the peaks on the chromatograms indicated trace amounts of Aroclor 1260™ in 8 of the 12

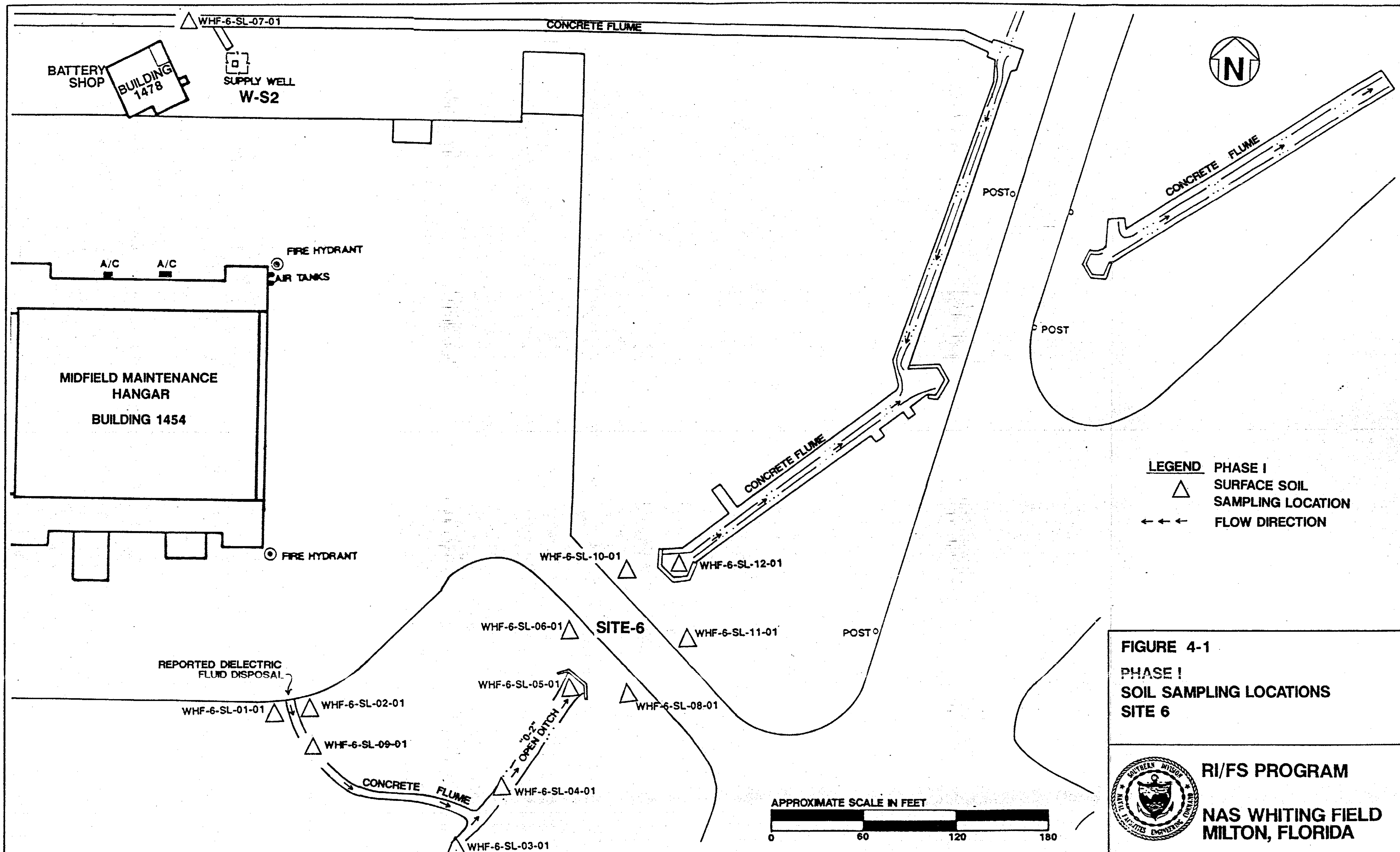


FIGURE 4-1
PHASE I
SOIL SAMPLING LOCATIONS
SITE 6

00229I09Z

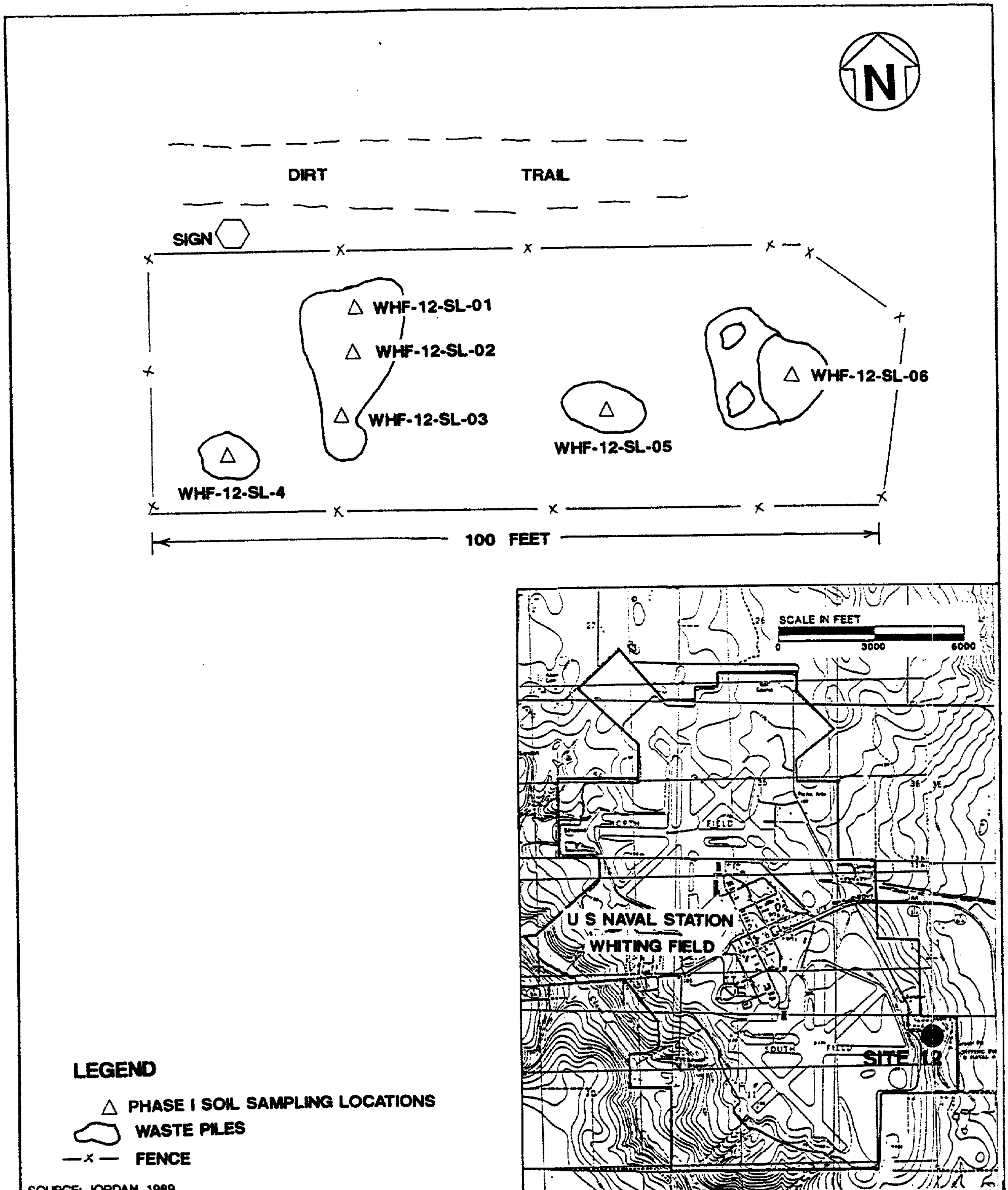
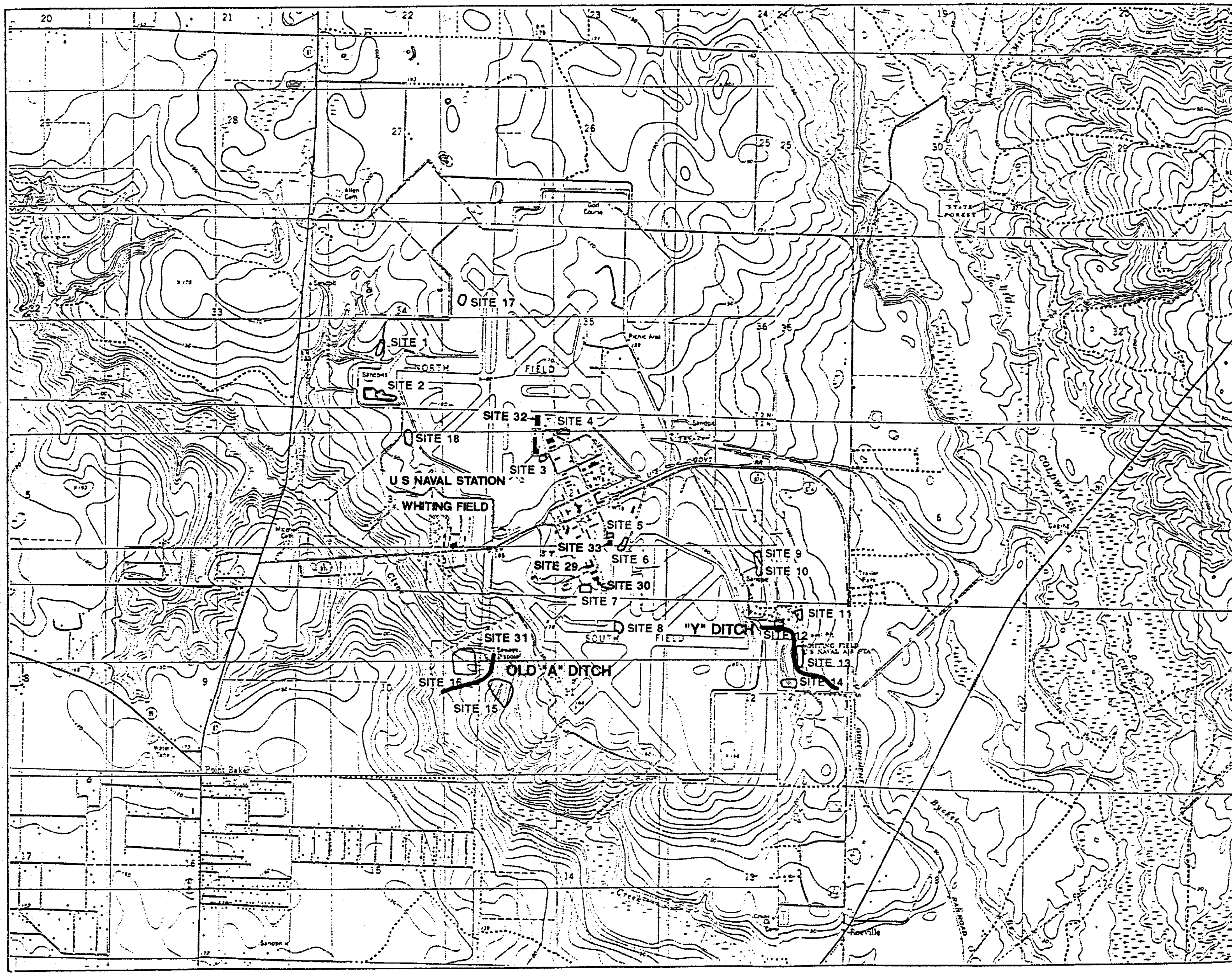


FIGURE 4-2
PHASE I
WASTE PILE SOIL SAMPLING
LOCATIONS SITE 12

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



SCALE IN FEET

0 3000 6000

SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 4-3
LOCATION OF DRAINAGE SWALES

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

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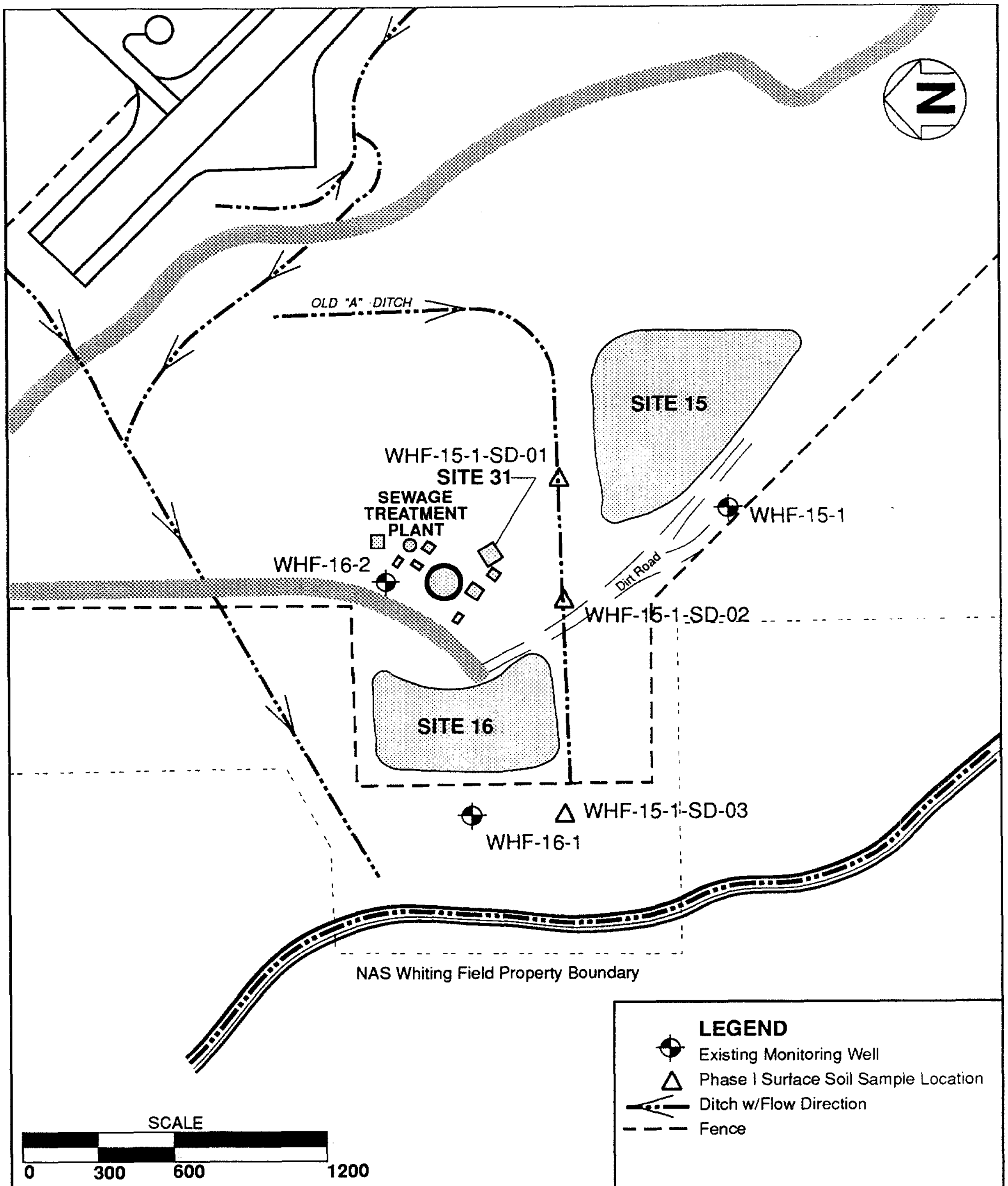


FIGURE 4-4
Site 15, 16, & 31
SURFACE SOIL SAMPLING
LOCATIONS IN "A" DITCH

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

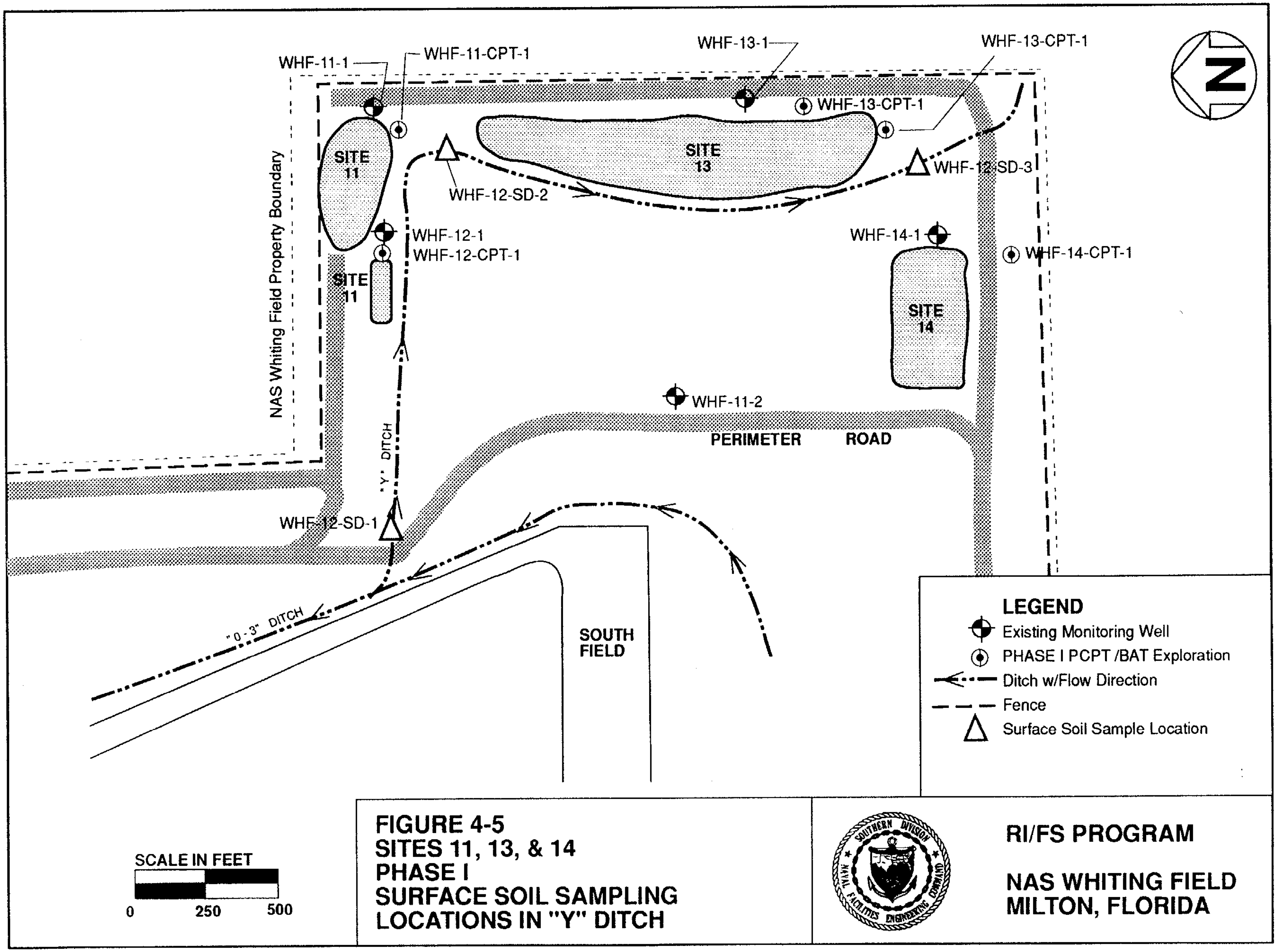


FIGURE 4-5
SITES 11, 13, & 14
PHASE I
SURFACE SOIL SAMPLING
LOCATIONS IN "Y" DITCH

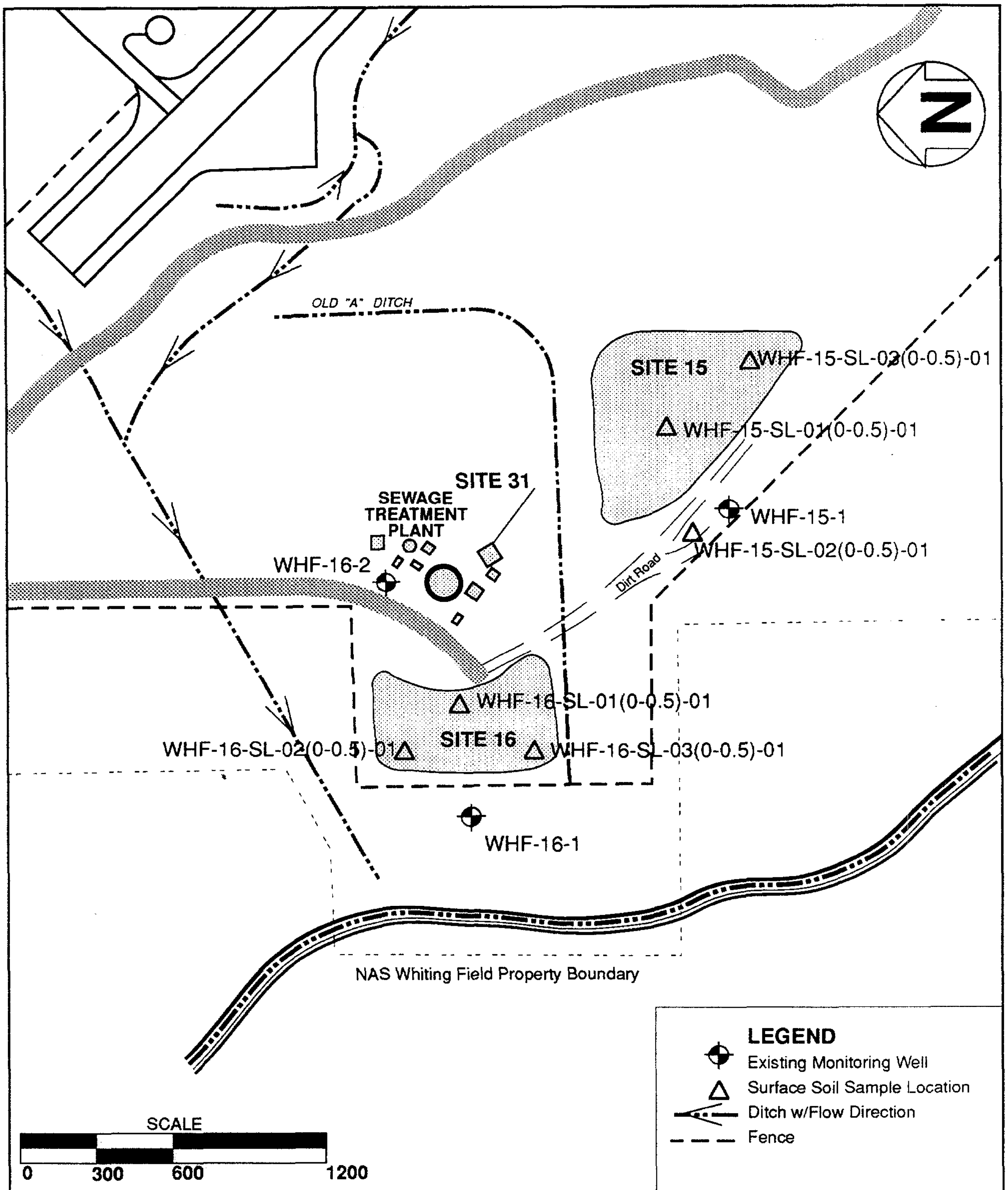


FIGURE 4-6
PHASE I
SITES 15 & 16
SURFACE SOIL SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

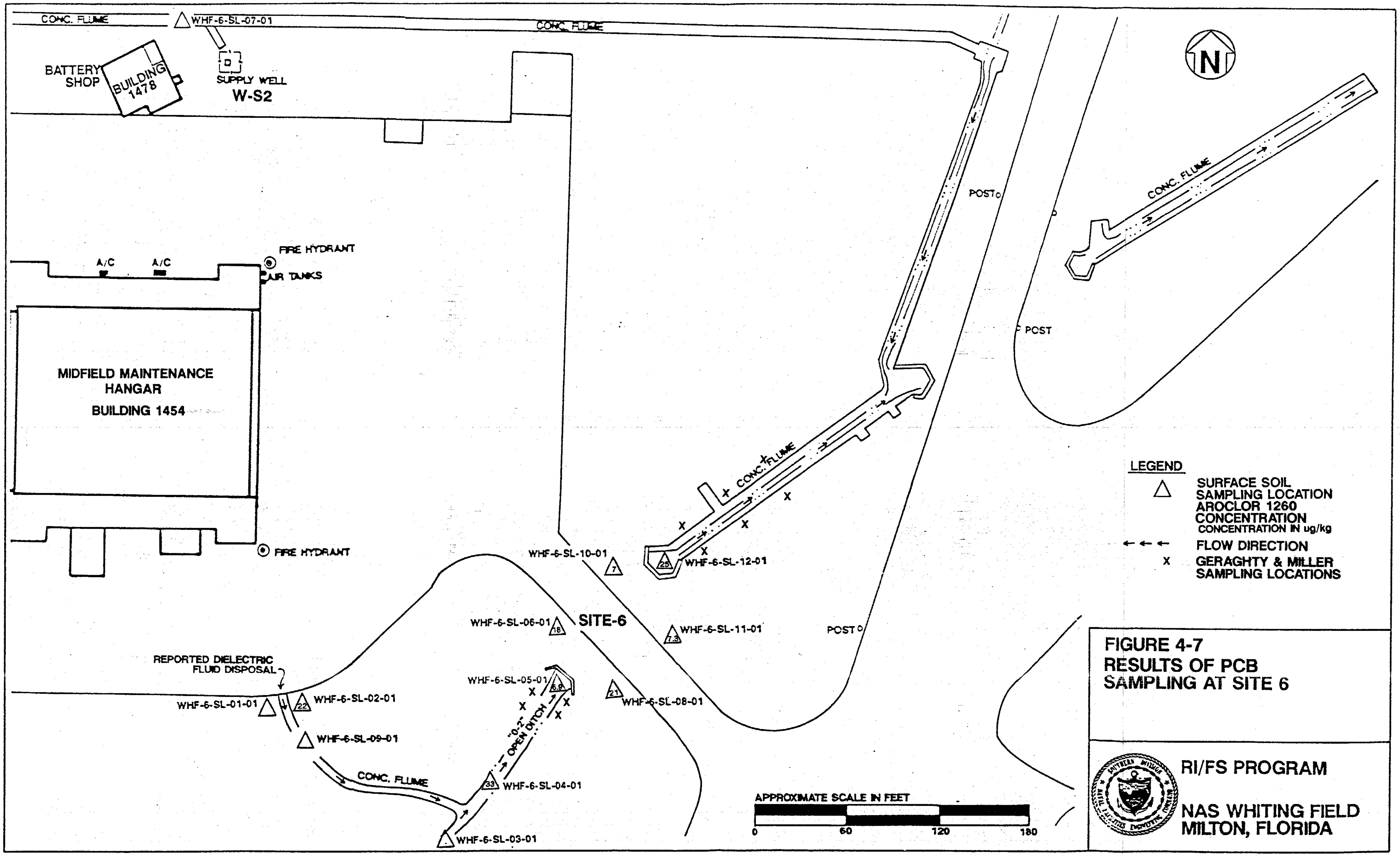
samples. The locations and concentrations observed are shown in Figure 4-7 along with the approximate locations of the Geraghty & Miller explorations.

PCB was not detected in the upstream sample, WHF-6-SL-07-01, nor in the two samples collected under the pavement (WHF-6-SL-09-01 and WHF-6-SL-01-01). Eight samples collected along and in the ditch leading from the disposal area to the culvert and on the shoulders of the culvert/roadway, contained the PCB Aroclor 1260™ at concentrations estimated from 6.9 to 33 μg/kg. This includes sample location WHF-6-SL-12(0-0.5)-01, which was collected under the pavement of the 0-2 ditch at the culvert. The observed concentrations are less than 20 percent of the reported laboratory quantitation limit and is near the reported laboratory limit of resolution of the chromatogram peaks necessary to identify the substance Aroclor 1260™.

These data are interpreted to indicate that transformer oil, at least in limited quantities, was disposed as described. The extremely low concentrations suggest that either only a very small amount of PCB-contaminated material was disposed, or that reworking of the area has removed contamination to an unknown location. PCBs are extremely immobile and would not migrate downward in the soil columns with infiltrating water. Particulate transport downgradient of PCB-contaminated soil could occur. In addition, PCBs are soluble in oils and in chlorinated solvents. Codisposal of these materials or disposal of solvents or oils after the PCBs had been disposed could carry them down the soil column. Reworking of the ditch by grading may also have disturbed the stratigraphy in which the highest concentrations would be found at the top of the soil column. Additional soil sampling deeper in the soil column and further down-ditch are required to completely define the extent of PCB contamination (see Section 7.3).

<u>4.3.2 Site 12, Tetraethyl Lead Disposal Area</u>. During the Phase I RI, six samples from the center of the waste piles were collected and analyzed for total lead and for RCRA corrosivity, ignitability, and toxicity. No evidence of ignitability or corrosivity was present. Samples appeared to be fine- to medium-grained sands with no visible evidence of staining or odor. Soil pH ranged from 6.0 to 6.71, which is typical of soils in the area of NAS Whiting Field. None of the 37 TCLP organic or inorganic chemicals were detected in any of the TCLP extracts tested with the exception of traces of barium (0.14 to 0.41 mg/ℓ). The RCRA regulatory limit for TCLP barium in TCLP extracts is 100 mg/ℓ. No extractable lead was detected in the extract at a detection limit of 0.1 mg/ℓ.

Each of the soil samples contained detectable total lead. Concentrations observed ranged from 9.7 to 30 mg/kg. This concentration range is similar to the Verification Study results and in the range of background lead for soils of the type observed and generally found in the vicinity of NAS Whiting Field. According to Kabata-Pendias and Pendias (1984), lead concentrations in uncontaminated sandy soils and clay soils range from <10 to 70 mg/kg with mean concentrations in the range of 17 and 22 mg/kg, respectively. No site-specific background surface soil was analyzed as a part of the Phase I RI program. Soil lead concentrations for surface soils in the drainage swales and surface soils at sites 15 and 16 ranged from 3.1 to 43.7 mg/kg. These soils were not selected as background locations; however, no substantial evidence of other contamination of these soils was detected. Based on the physical observations and chemical analysis, the mounds at Site 12 are not interpreted to be significantly contaminated by lead and show no evidence of oil or fuel sludge.


CONC. FLUME
WHF-6-SL-07-01
BATTERY SHOP
BUILDING 1478
SUPPLY WELL
W-S2
A/C
A/C
FIRE HYDRANT
AIR TANKS
MIDFIELD MAINTENANCE HANGAR
BUILDING 1454
FIRE HYDRANT
POST
POST
POST
CONC. FLUME
CONC. FLUME
WHF-6-SL-10-01
7
25
WHF-6-SL-12-01
SITE-6
WHF-6-SL-06-01
18
WHF-6-SL-11-01
7.3
REPORTED DIELECTRIC FLUID DISPOSAL
WHF-6-SL-01-01
22
WHF-6-SL-02-01
WHF-6-SL-09-01
WHF-6-SL-05-01
6.9
21
WHF-6-SL-08-01
"0-2" OPEN DITCH
CONC. FLUME
33
WHF-6-SL-04-01
WHF-6-SL-03-01
APPROXIMATE SCALE IN FEET
0
60
120
180
LEGEND
SURFACE SOIL SAMPLING LOCATION AROCLOR 1260 CONCENTRATION
CONCENTRATION IN ug/kg
FLOW DIRECTION
GERAGHTY & MILLER SAMPLING LOCATIONS
N
FIGURE 4-7
RESULTS OF PCB SAMPLING AT SITE 6
RI/FS PROGRAM
NAS WHITING FIELD
MILTON, FLORIDA

00229I112

4.3.3 Stormwater Drainage Swales. No evidence of substantial surface soil contamination by VOCs, SVOCs, pesticides, PCBs, TAL metals, or cyanide was detected. No VOCs were detected in the soil in either swale with the exception of acetone. Acetone detected in soil VOC analysis is interpreted as a sampling artifact in this program and not interpreted as representing environmental contamination. The phthalate ester bis-(2-ethylhexyl)phthalate (BEHP) was the only SVOC observed. The quantitation limit for BEHP in soils is 350 μg/kg. All concentrations observed were below this level and are estimated. BEHP was also the only SVOC detected in all surface soil samples from the landfill sites (Sites 15 and 16).

Presence of BEHP in soil samples remote from any sources is not readily attributable to environmental contamination, although that cannot be absolutely ruled out.

Table 4-1 summarizes the concentration of inorganic compounds in soils of the drainage swales. Levels of metals are within the range of typical background for soils of the type found at NAS Whiting Field as reported in the literature. Data for soils of the Eastern United States, the Gulf Coast of Alabama and Florida, and for clays, sands, or alluvial soils in the United States has been summarized in Technical Memorandum No. 5 for comparison.

Based on the sampling performed in the Phase I RI, no evidence of residual surface soil contamination exists in the soils of the "Old 'A' Ditch" adjacent to former disposal Sites 15 and 16, or in the eastern storm drainage swale ("Y" ditch).

The "Y" ditch receives the drainage from the south field runways and Sites 12 and 14. No evidence of contamination exists in the drainage.

4.3.4 Sites 15 and 16, Southwest Landfill and Open Disposal and Burning Area. The soil sampling field program confirmed the observations relative to the sandy nature of the surface soils at Sites 15 and 16. No exposed wastes were observed. Evidence of former camping activity was prevalent at Site 15. During the exploratory groundwater sampling program described in Technical Memorandum No. 5, solid waste and garbage were detected in one borehole at this site confirming that buried waste is present at Site 15.

With the exception of acetone and BEHP, which are apparent artifacts of the sampling program, no organic contaminants were detected in surface soils at either Site 15 or Site 16. No VOCs, SVOCs, pesticides, or PCBs indicative of environmental contamination were detected in the soil cover of these two disposal areas.

Inorganic analyses results are tabulated for Sites 15 and 16 in Table 4-1. With the exception of sampling location WHF-16-SL-03(0-0.5)-01, the inorganics results are consistent with the other soils and sediments at NAS Whiting Field and are at or below concentrations in background soil. WHF-16-SL-03(0-0.5)-01 metals concentrations are approximately two times the other sample concentrations. In spite of this, only lead and mercury slightly exceeded mean values for any background soil types and these were less than a fraction of two times above background. It is possible that the metals concentrations observed at this location are affected by past disposal. However, no NAS Whiting Field specific

Table 4-1
Inorganic Compounds in Surface Soils at NAS Whiting Field

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Parameter	Drainage Swales Sample Location						Landfills Soil Sample Location					
	12-01	12-02	12-03	15-01	15-02	15-03	15-01	15-02	15-03	16-01	16-02	16-03
Aluminum	5,990	10,500	4,240	10,400	4,590	11,170	7,660	9,000	8,220	9,900	10,400	16,100
Antimony	<11.1	<9.1	<9.3	<7.9	<8.4	<8.9	<8.4	<9.1	<10.1	<10	<9.5	<8.8
Arsenic	<2.2	<1.7	<1.8	3.2J	<1.7	2.1	<1.7	<1.9	<1.9	<2	3	5
Barium	8.6J	10J	7.8J	13.8J	5.2J	14.9J	5.3J	4.5J	8.8J	14.8J	19.2J	26.2J
Beryllium	<1.1	<0.92	<0.93	<0.79	<0.84	<0.89	<0.84	<0.92	<1	<1	<0.95	<0.88
Cadmium	<1.1	<0.92	<0.93	<0.79	<0.84	<0.89	<0.84	<0.92	<1	<1	<0.95	<0.88
Calcium	3,750	92.2	137J	2,240	<83.5	<88.5	<83.9	<92.4	<102	300J	233J	355J
Chromium	6.7	7	2.7	8.6	3.4	6.9	4.8	9.5	4.7	7.5	8.6	12.1
Cobalt	<2.2	<1.8	<1.9	<1.6	<1.7	<1.8	<1.7	<1.8	<2	<2	<1.9	<1.8
Copper	<5.5	<4.5	4.8	7.9	4.4	<4.4	<4.2	<4.5	<5	<5.3	7.2	10.8
Cyanide	<0.31	<0.27	<0.28	<0.62	<0.29	<0.48	<0.32	<0.35	<0.39	<0.29	<0.29	<0.29
Iron	3,140	5,340	2,790	4,910	2,770	6,340	3,810	4,870	4,110	4,800	4,840	7,440
Lead	<5.5	8.6	23.1	23.3	<12.9	<6.5	<2.4	<6	<3.1	<14	46.5J	43.7
Magnesium	864J	149J	<93.2	365J	19.5	166J	92.2J	92.4J	138J	147J	169J	272
Manganese	52.2	92.7	51.1	72	19.5	144	32.4	19.3	20.2	76.2	83.8	141J
Mercury	<0.01	0.01	0.01	0.04	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.02	<0.08
Nickel	<8.9	<7.4	<7.5	<158	<6.7	<7	<6.7	<7.4	<8.1	<8.0	<7.5	<7
Selenium	<1.1	<0.87	<0.89	<0.89	<0.84	<0.95	<0.83	<0.93	<0.93	<1	<0.89	<0.95
Silver	<2.2	<1.8	<1.9	<1.6	<1.7	<1.8	<1.7	<1.8	<2	<2	<1.9	<1.8
Sodium	<111	<92.2	<93.2	<79	<83.5	<88.5	<83.9	<92.4	<102	<99.5	<94.7	<88
Vanadium	9.8J	13.6	5.2J	15	6J	15.6	10.1	12.8	10.6	13.9	14.6	22.7
Zinc	4.4	6.4	14.8	15.5	10.8	7.2	<3.4	3.7	4.7	16.3	29.4	35.6

Note: All concentrations are in micrograms per kilogram (μg/kg).
J = estimated value.

background data has been collected and the number of samples is not sufficient to interpret the concentration observed at WHF-16-SL-03(0.5-1.0)-01 as differing from background.

Based on the results of the Phase I surface soil sampling, no firm evidence exists for surface soil contamination at either Site 15 or Site 16. Further it is highly unlikely based on three samples from the camping areas that past camping activities resulted in human exposure. Data is sufficient to conclude that the camping areas do not contain surface soil contamination. Subsurface soil and groundwater sampling are required to evaluate the nature and extent of contamination from these sites. The exploratory screening groundwater program indicates that VOC contamination of groundwater is present at these sites. Based on the collection of two sets of three surface soil samples over several acres of potential sources, inadequate data are available to unequivocally conclude that no surface soil contamination exists. Surface samples collected in conjunction with soil borings should be collected in Phase II-A to confirm the tentative conclusion that no surface soil contamination is present.

5.0 SUMMARY OF TECHNICAL MEMORANDUM NO. 4, SURFACE WATER AND SEDIMENTS ASSESSMENT

Technical Memorandum No. 4, Surface Water and Sediments Assessment, is the fourth in a series of six technical memoranda that summarize the results and transmits data gathered during the Phase I RI. The following sections provide a summary of the surface water and sediment investigation of Clear Creek and Big Coldwater Creek presented in Technical Memorandum No. 4 and recommended RI Phase II-A surface water sediment sampling and analysis activities and ecological characterization along Clear Creek. Background and historical information associated with Clear Creek and Big Coldwater Creek are presented in the RI Workplan (Jordan, 1990).

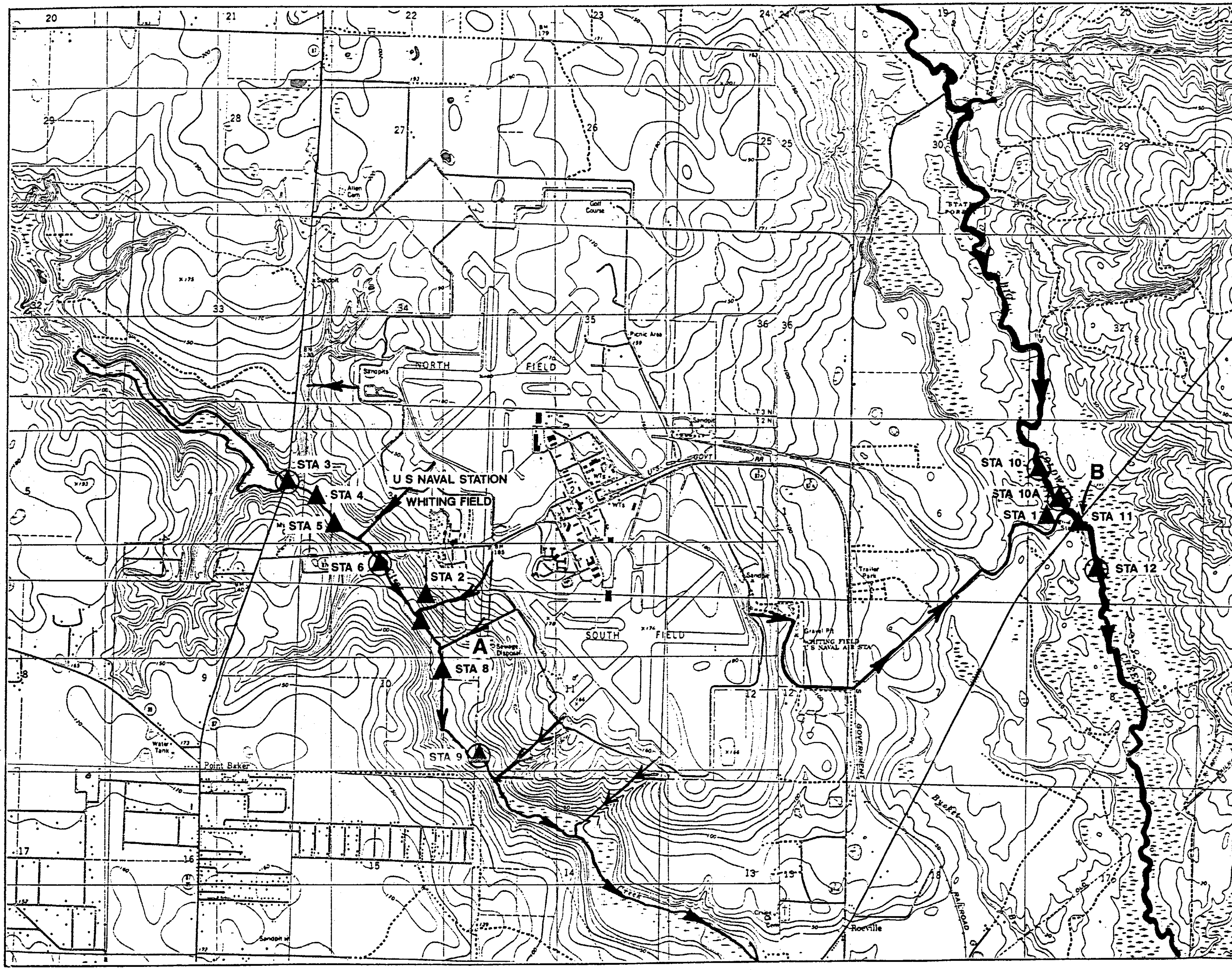
5.1 OBJECTIVES OF THE SURFACE WATER AND SEDIMENT ASSESSMENT. The objective of the Phase I RI surface water and sediment program was to evaluate whether evidence of contamination exists in either stream as a result of past or current operations at NAS Whiting Field. Data derived from the program will be used in the Public Health Evaluation and Environmental Risk Assessment to be performed during the Phase II-A RI.

5.2 FIELD PROGRAM SUMMARY. The Phase I surface water and sediment program at NAS Whiting Field consisted of three components:

- collection of surface water and sediment samples at 12 sampling locations,
- measurement of general water quality parameters (pH and specific conductance) and physical description of each location, and
- instantaneous stream flow measurements and channel cross-section measurements at three locations in Clear Creek and two in Big Coldwater Creek.

5.2.1 Sampling and Analysis Surface water and sediment samples were collected from 12 locations along Clear Creek and Big Coldwater Creek, as shown in Figure 5-1. Sampling stations were situated both upstream and downstream of major drainage ditch discharge points that may have received runoff from the identified disposal sites at NAS Whiting Field. The intent has been to determine the impact of discharge from NAS Whiting field on creek water and sediment quality. All samples were sent to Savannah Laboratories and Environmental Services, Tallahassee, Florida, for analyses of the constituents as listed in Section 3.9 of Volume II of the RI Phase I Workplan (the Sampling and Analysis Plan).

All samples were collected in accordance with procedures discussed in Sections 6.7.3 and 6.6.5 of the RI Phase I Workplan and QAPP, Volume II, Appendix B. Surface water samples were collected by dipping the sample container directly into the water. Sediment samples were collected using a stainless-steel scoop, mixed in a stainless-steel pan, and placed into the sample container. VOC analysis samples were collected from the stream and placed directly into sample containers without mixing.



LEGEND

- ▲ SURFACE WATER/SEDIMENT SAMPLING LOCATION
- Ⓐ SAMPLING AND STREAMFLOW MEASUREMENT STATION
- ← FLOW DIRECTION
- **A** LOCATION OF WWTP DISCHARGE OUTFALL
- **B** USGS GAUGING STATION NO. 02370500

SCALE IN FEET

0 3000 6000

SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 5-1
PHASE I
SURFACE WATER, SEDIMENT, AND STREAMFLOW SAMPLING STATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I12Z

All surface water and sediment samples were analyzed for VOCs, PCBs, and CERCLA TAL inorganics. The latter consists of total cyanide and the following 23 metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, total chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. Specific conductance, pH, and water temperature were measured at each station location.

Water and sediment chemical analyses were performed in accordance with NEESA QC Level C with 10 percent (including all field quality control samples) analyzed at NEESA QC Level D. Data review and validation were carried out by ABB-ES. Review of monthly quality control reports and data were carried out by Martin Marietta, Oak Ridge, Tennessee.

Surface water and sediment sampling was conducted during the period December 5 through 7, 1990. Analytical results are tabulated and presented in Appendix B, Technical Memorandum No. 4, and Appendix C, Technical Memorandum No. 4, for surface water data and sediments, respectively.

<u>5.3 RESULTS AND INTERPRETATION OF SURFACE WATER AND SEDIMENT INVESTIGATION</u>. The purpose of this section is to present the results of the Phase I RI surface water and sediment program. Prior to this episode only a single water quality sample and no sediment data had been collected in Clear Creek or in the potential area of NAS Whiting Field impact in Big Coldwater Creek. Section 5.3.1 of Technical Memorandum No. 4 presents a summary discussion of the surface water hydrology of the two creeks draining NAS Whiting Field. Sections 5.3.2 and 5.3.3 of Technical Memorandum No. 4 describe and interpret water quality and sediment status of Clear Creek and Big Coldwater Creek, respectively.

<u>5.3.1 Surface Hydrology</u> NAS Whiting Field is located on a plateau that is bounded in the west and southwest by Clear Creek and to the northeast by Big Coldwater Creek. These streams are tributaries of the Blackwater River. The Blackwater River is classified as an Outstanding Florida Water. Figure 5-2 shows the location and Water Quality Classification of these streams. Clear Creek is classified as Class III by FDER. Florida Class III water is suitable for propagation of fish and aquatic life and for body-contact recreation. Big Coldwater Creek is classified as Class III except that within the Blackwater River State Forest it is classified an Outstanding Florida Water. No drinking water intakes exist downstream of NAS Whiting Field on either stream or in the Blackwater River. Because of the flat open nature of the airfield and the installation facilities, NAS Whiting Field is drained by an extensive storm drainage system. Surface drainage is shown in Figure 5-3. As a consequence of the drainage, none of the 18 disposal sites has an upstream drainage area of greater than 50 acres, the minimum area scored in HRS II pathway consideration. Figure 5-4 shows the outline of the 100- and 500-year floodplains adjacent to NAS Whiting Field. None of the identified disposal sites lies within the 100- or 500-year floodplain.

Distance to the nearest surface water for each of the 18 sites and instantaneous discharge and current velocity in Clear Creek and Big Coldwater Creek are tabulated in Tables 3-1 and 3-2 of Technical Memorandum No. 4.

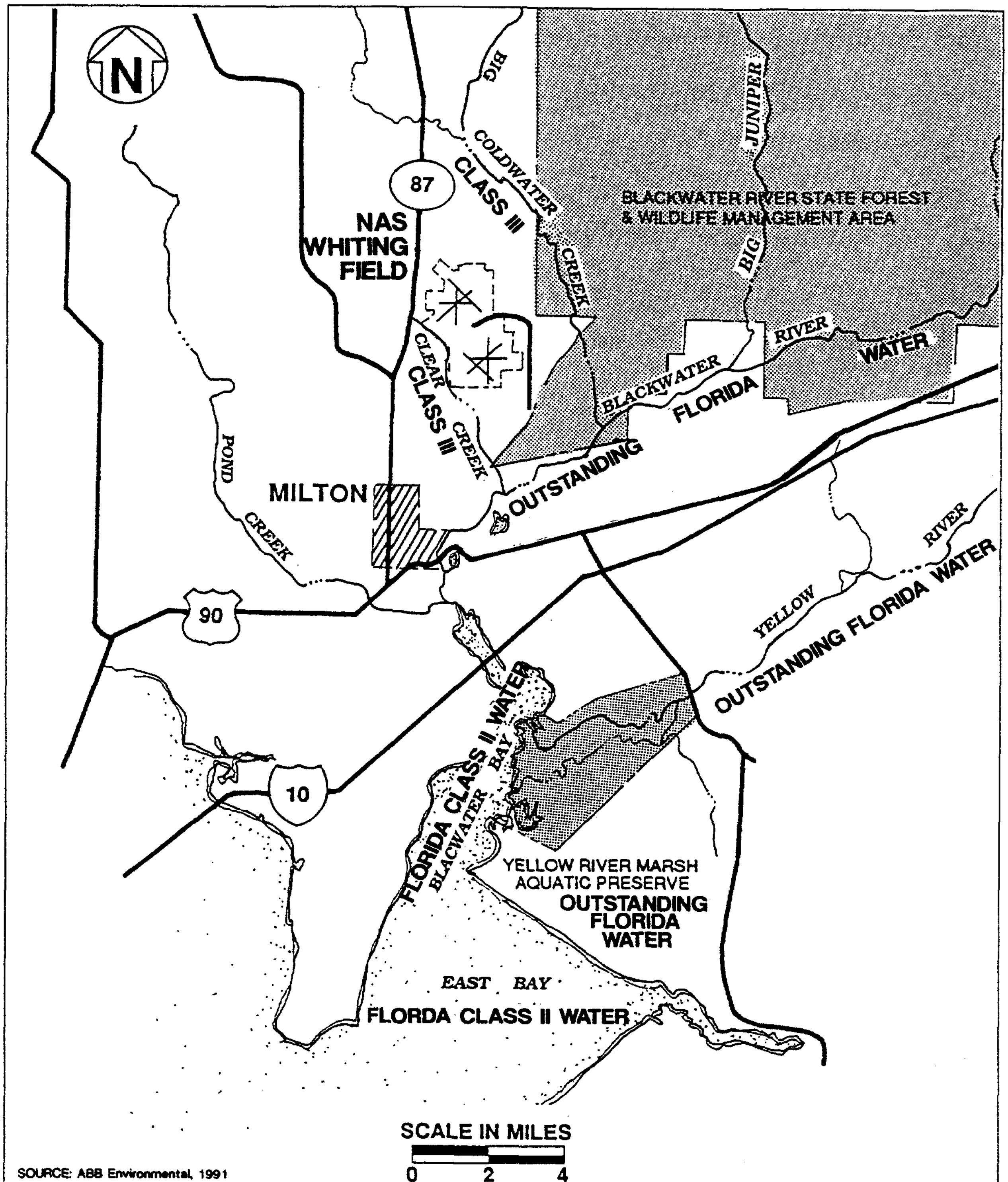


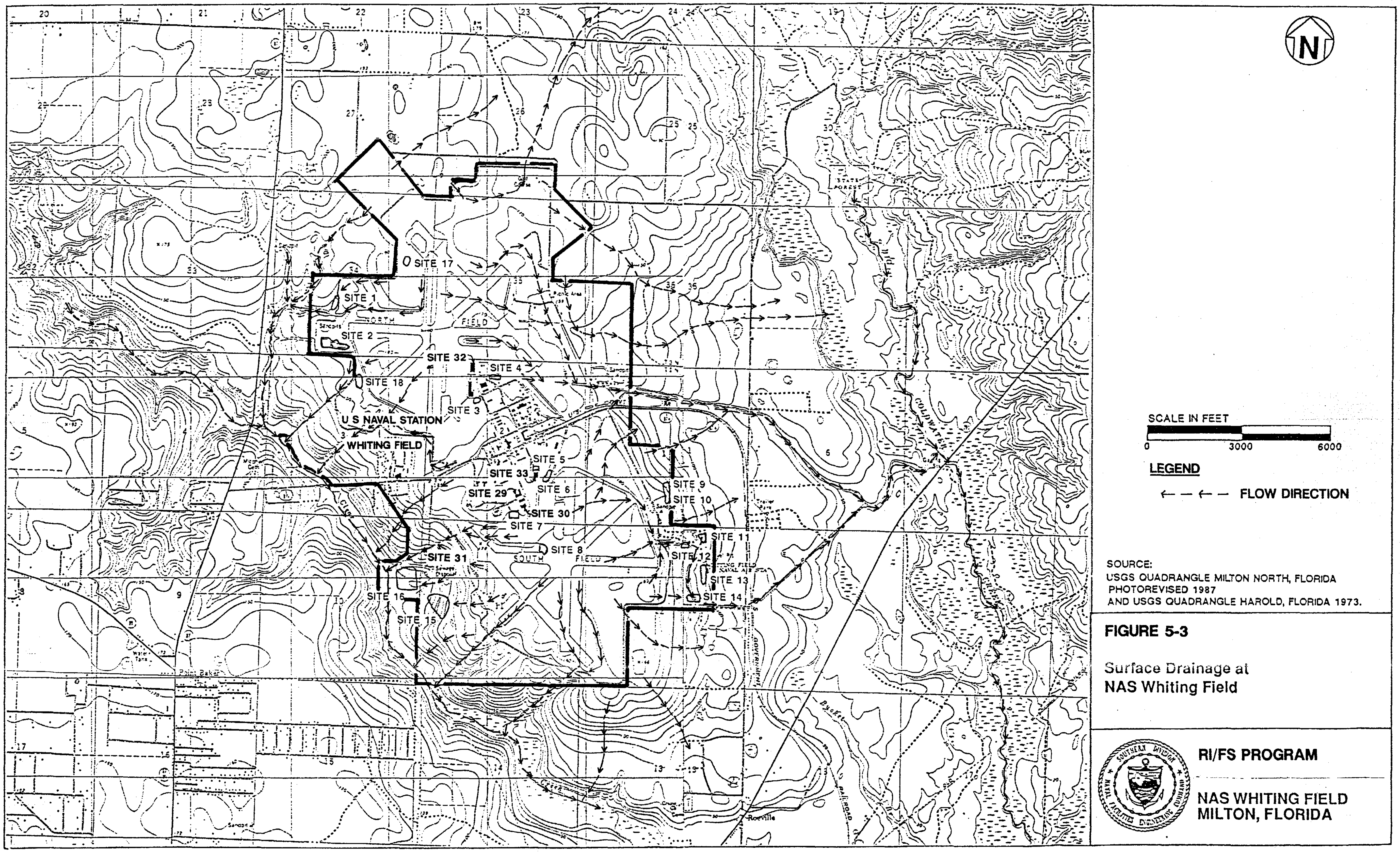
FIGURE 5-2

Surface Water Classification in the Vicinity of NAS Whiting Field

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 5-3

Surface Drainage at
NAS Whiting Field

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

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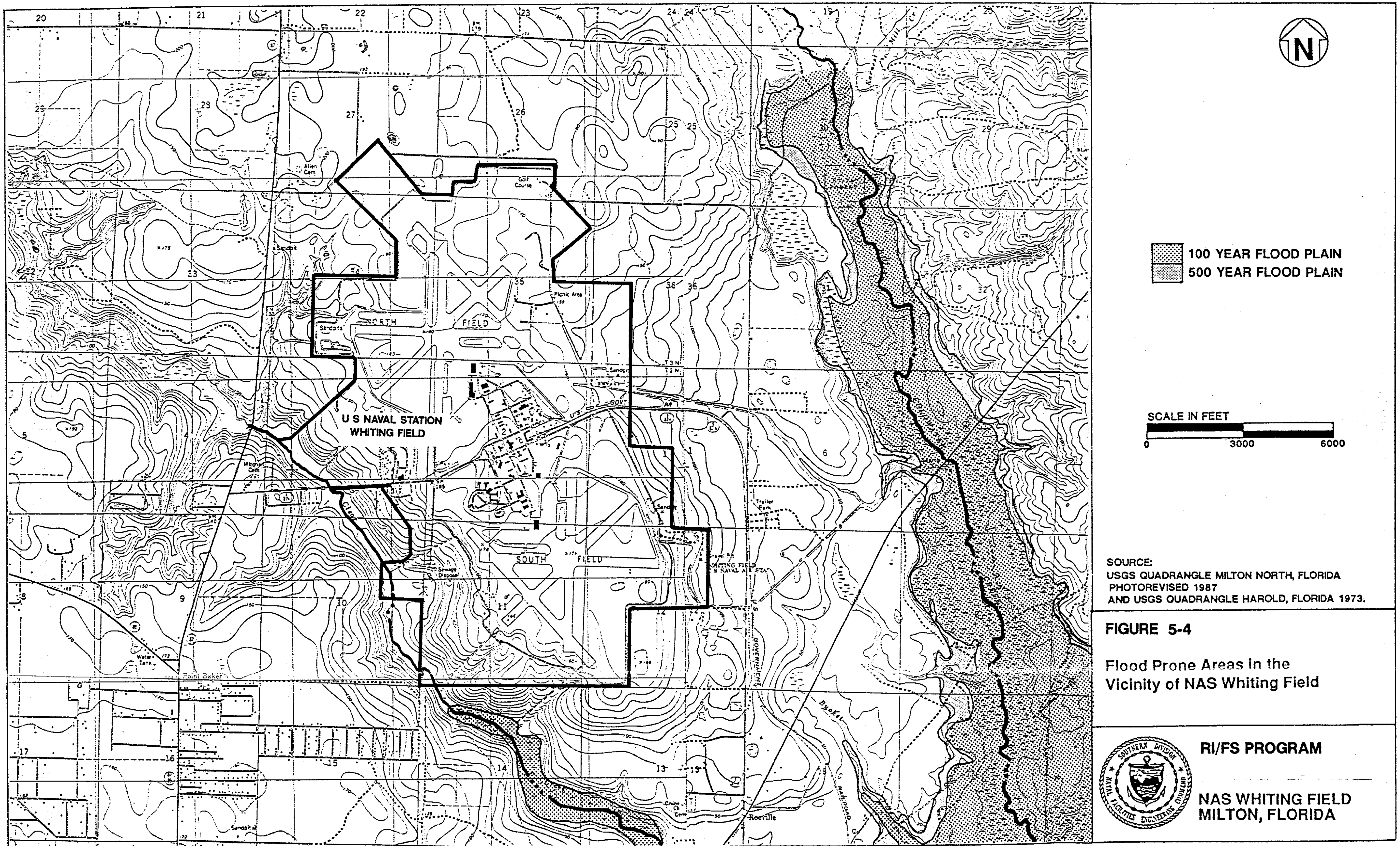


SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 5-4

Flood Prone Areas in the Vicinity of NAS Whiting Field

RI/FS PROGRAM

**NAS WHITING FIELD
MILTON, FLORIDA**

5.3.2 Surface Water Quality

Clear Creek. At the time of the sampling episode, flow conditions in Clear Creek were highly favorable for detection of any contaminants migrating either from the wetlands lining the creek or from groundwater discharge to the creek or wetlands. Only traces of rainfall had occurred during the previous 24 hours prior to sampling. No contaminants attributable to NAS Whiting Field were detected in the surface waters of Clear Creek. At Station 9, an estimated 0.7 micrograms per liter ($\mu g/\ell$) of methylene chloride was detected in one replicate of the field duplicate sample. The associated trip blank also contained 0.7 $\mu g/\ell$ (estimated) methylene chloride. The quantitation limit for methylene chloride is 10 $\mu g/\ell$. No other VOCs, SVOCs, pesticides, or PCBs were detected in any of the Clear Creek surface water samples or in the floodplain surface water samples (Station 7). Sediments at Station 2, however, were contaminated by organic and inorganic chemicals. No SVOC chemicals or tentatively identified compounds were observed even below the quantitation limit. SVOC detection limits are qualified because of the sample size taken for extraction. The impact of the reduced sample size on data quality is that estimated concentration identification limits may be slightly higher than for a larger sample size. In the case of NAS Whiting Field samples, the reduced sample size would not compromise detecting any of the SVOCs at levels in excess of either human health or aquatic life criteria, or Florida or Federal maximum contaminant limits (MCL).

Results of inorganic chemical analysis and field measurements in Clear Creek are tabulated in Table 5-1. None of the TAL inorganic analytes except the major cations calcium, magnesium, sodium, and traces of barium were detected. Trace levels of each of these were detected in laboratory reagent blanks. Calcium, magnesium, and sodium are cations, naturally occurring in all surface waters. The concentrations observed are consistent with an extremely "soft" water. The specific conductance of Clear Creek of 10 to 22 micromhos per centimeter (μmhos/cm) is indicative of a water occurring in a non-calcareous sandy watershed. Barium is also a naturally occurring element. The barium concentrations observed were greater than five times those observed in method blanks, which suggests that barium is present; however, at concentrations near the detection limit of 10 mg/ℓ the presence of barium in the samples may also be a laboratory artifact. The presence of barium at the levels observed has no public health or environmental significance.

In general, the sediments of Clear Creek itself were free from toxic or hazardous chemicals attributable to NAS Whiting Field activities. No pesticides or PCBs were detected at any of the sampling locations. Traces of the polynuclear aromatic hydrocarbon (PAH) pyrene and the phthalate ester BEHP were detected at Station 5 in Clear Creek. These chemicals were also detected in Big Coldwater Creek, far from NAS Whiting Field. BEHP is a common plasticizer and is one of the most frequently occurring artifacts of sampling and analysis. Its presence at a concentration estimated as 360 $\mu g/kg$, which is below the quantitation limit (flagged "J"), and finding it in the samples remote from any manufacturing operation or landfill from which it may be released, indicates that BEHP is a probable artifact of sample handling. Pyrene, a non-carcinogenic PAH, may be attributed to either weathered petroleum products such as kerosene or heavier oils but is also a common by-product of the combustion of fossil fuels and vegetative material. Appreciable background concentrations of PAH are frequently observed in soil where either frequent wild fires occur or in controlled burning

Table 5-1
Surface Water Inorganic Chemicals, Clear Creek

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Parameter	Station Number (Downstream Order)							
	3	4	5	6	7	8	[1]9	Flood-plain at 7
Aluminum	<200	<200	<200	<200	<200	<200	<200	<200
Antimony	<50	<50	<50	<50	<50	<50	<50	<50
Barium	16.8J	16.8J	16.5J	16.5J	15.1J	15.1J	15.1J/15.1J	10.5J
Arsenic	<10	<10	<10	<10	<10	<10	<10	<10
Beryllium	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	<5	<5	<5	<5	<5	<5	<5	<5
Calcium	777	789	742	759	680J	727	744J/727J	500J
Chromium	<10	<10	<10	<10	<10	<10	<10	<10
Cobalt	<10	<10	<10	<10	<10	<10	<10	<10
Copper	<25	<25	<25	<25	<25	<25	<25	<25
Iron	614	626	584	607	568	591	706/737	1,050
Lead	<3							
Magnesium	707J	707J	681J	683J	612J	619J	631J/604J	569J
Manganese	17.3	18.6	16.3	16.3	16.3	16.3	18.6/16.3	11.1J
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	<40	<40	<40	<40	<40	<40	<40	<40
Selenium	<5	<5	<5	<5	<5	<5	<5	<5
Silver	<10	<10	<10	<10	<10	<10	<10	<10
Sodium	2,130J	2,110J	2050J	1990J	1970J	2400J	2500J/2340J	2430J
Titanium	<10	<10	<10	<10	<10	<10	<10	<10
Vanadium	<10	<10	<10	<10	<10	<10	<10	<10
Zinc	<20	<20	<20	<20	<20	<20	<20	<20
Cyanide	<10	<10	<10	<10	<10	<10	<10	<10
Potassium	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
pH (standard unit)	4.5	4.3	4.5	4.5	4.5	4.7	4.4	4.5
Specific conductance (μmhos/cm)	18	20	20	20	10	20	22	20
Temperature (°C)	12.5	13	13	12	16	15	14	16

[1]Second value of sample results for Station 9 represent replicate field duplicate.

Notes: All concentrations are in micrograms per liter (μg/ℓ) unless otherwise indicated.
J = estimated value.
umhos/cm = micromhos per centimeter.
°C = degrees Celsius.

areas. Pyrene was detected in both Clear Creek and Big Coldwater Creek. All pyrene concentrations were estimated because they were below the quantitation limit. The presence of pyrene at 36 μg/kg (estimated) has no public health or environmental significance and may be a component of background conditions. Station 2, located in the floodplain downstream of a major stormwater drainage, was contaminated by VOCs and metals.

Sediment and soil samples contained sporadic instances of relatively high concentrations of acetone. This VOC appears to be transformed from pesticide grade isopropanol after being transferred into non-colored glass or Teflon™ containers. Because of this factor, the sporadic nature of its presence, and the lack of a major contaminant source to account for the findings, acetone has been interpreted as an artifact of the decontamination procedure for soils and sediment. Acetone was detected in samples collected at sampling Stations 1, 3, 8, and 9 at concentrations ranging from 140 to 2,600 μg/kg. Methylene chloride was detected in sediment samples from Station 5 at 20 μg/kg. (This is estimated because it is below the quantitation limit.) This single finding is probably attributable to sample handling because of the reasons previously stated relative to its common presence as an artifact. It was not, however, detected in the associated method, rinsate, or trip blanks. Its presence or absence at Station 5 should be confirmed by a second sample. Benzene was detected in samples from Station 7 in samples from 25 μg/kg. Station 7 is located immediately downstream of the location where discharge of a major storm drainage enters Clear Creek. In addition, sediment samples at Station 2, the floodplain station located in this stormwater flow path, were contaminated by the halogenated VOCs, cis-1,2-dichloroethylene (DCE), trans-1,2-DCE, and 1,1-dichloroethane. Metals at concentrations greater than those found in the remaining sediments were also observed at Station 2. Cis-1,2-DCE was detected at 290 μg/kg, trans-1,2-DCE at 83 μg/kg, and 1,1-dichloroethane at 24 μg/kg. The latter concentration is below the quantitation limit and is, therefore, estimated. No aromatics were detected at Station 2. Although the data are not totally consistent, the pattern indicates that sediment contamination exists in the floodplain at this location and it is possible that migration into the creek is ongoing. Station 2 is located in the part of the floodplain that receives discharge from Sites 15 and 16. As described in Technical Memorandum No. 5, groundwater at Sites 15 and 16 is contaminated by aromatic VOCs and by chlorinated solvent transformation products.

Sediment metals concentrations were not in excess of uncontaminated sandy soils with the exception of Station 2. Soils background metal concentrations taken from the published literature are presented in Technical Memorandum No. 3. At Station 2, seven metals were substantially greater than either expected soils background or the remaining Clear Creek samples. The sediments of the floodplain are highly organic in gross constituency and would be expected to trap metals as well as organic chemicals to a much greater degree than sands. These chemicals are listed below along with background ranges in organic soils.

Metal	Concentration at station 2 (μg/kg)	Expected background (μg/kg)	
		Mean	Range
Chromium	36.9	7	1.8 to 10
Copper	37.5	15	1 to 100
Lead	327	24	10 to 50
Manganese	24	260	7 to 1,500
Mercury	0.15	0.28	0.01 to 4.60
Vanadium	55.7	--	19 to 22
Zinc	58	34	25 to 108

The source of expected background concentrations is Kabata-Pendias and Pendias (1984). With the exception of manganese, the metals observed may be associated with military industrial and maintenance operations.

Big Coldwater Creek. Inorganic chemical results and field measurements in Big Coldwater Creek and the drainage ditch leading from NAS Whiting Field are tabulated in Table 5-2. No evidence of organic or inorganic toxic or hazardous chemicals was detected in the surface waters of this system. Big Coldwater Creek also exhibits similar water quality characteristics to Clear Creek as described previously. Big Coldwater Creek is low in mineral content (specific conductance ≤20 μmhos/cm) and slightly acidic.

No significant sediment contamination was observed in Big Coldwater Creek. The presence of traces of BEHP and pyrene was previously discussed in reference to Clear Creek. Interpretation of these chemicals as artifacts and naturally present, respectively, follows similar rationale presented in the previous section. No inorganic chemicals in excess of expected backgrounds were detected nor were pesticides or PCBs. Toluene was detected at an estimated 24 μg/kg at Station 10. This location is upstream of potential impact from Santa Rosa County Route 197 or the drainage ditch. Toluene at the concentrations estimated is below the reported quantitation limit. Toluene is a common laboratory solvent as well as a constituent of motor fuels and is interpreted as being an artifact in Station 10 sediment due to the undeveloped nature of the watershed upstream (Blackwater River State Forest). Based on its upstream location, toluene, if truly present, is not attributable to NAS Whiting Field. Big Coldwater Creek is navigable by small motor-powered boats; however, no immediate explanation for the presence of toluene is apparent.

5.4 SURFACE WATER AND SEDIMENT ASSESSMENT. Surface water and sediment sampling locations in Clear Creek and Big Coldwater Creek appear to be located appropriately to detect any contaminant migration to receiving waters that may be attributable to NAS Whiting Field. Both streams may be characterized as slightly acidic waters with extremely low concentrations of cations and anions. This is typical of streams in a sandy undeveloped watershed.

Table 5-2
Surface Water Inorganic Chemicals, Big Coldwater Creek

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Parameter/Units	Station Number (Downstream Order)			
	Stormwater Ditch	10	11	Downstream Order 12
Aluminum	<200	<200	<200	<200
Antimony	<50	<50	<50	<50
Barium	14.1J	31.8J	31.8J	31.5J/31.5J
Arsenic	<10	<10	<10	<10
Beryllium	<5	<5	<5	<5
Cadmium	<5	<5	<5	<5
Calcium	918J	1,180J	1,170J	1,180J/1,180J
Chromium	<10	<10	<10	<10
Cobalt	<10	<10	<10	<10
Copper	<25	<25	<25	<25
Iron	131	214	209	230/219
Lead	<3	<3	<3	<3
Magnesium	569J	<3	<3	<3/<3
Manganese	11.1J	15.1	14.0J	14.0J/14.0J
Mercury	<0.2	<0.2	<0.2	<0.2
Nickel	<40	<40	<40	<40
Selenium	<5	<5	<5	<5
Silver	<10	<10	<10	<10
Sodium	2,130J	1,450J	1,450J	1960J/1990J
Titanium	<10	<10	<10	<10
Vanadium	<10	<10	<10	<10
Zinc	<20	<20	<20	<20
Cyanide	<10	<10	<10	<10
Potassium	<1,000	<1,000	<1,000	<1,000
pH (standard units)	ND	5.2	5.1	5.2
Specific Conductance (µmhos/cm)	18	20	18	18
Temperature (°C)	15	12.5	12.5	12.5

Note: J = estimated value.
ND = data not available.
umhos/cm = micromhos per centimeter.
°C = degrees Celsius.

No significant environmental contamination was detected migrating in Clear Creek or Big Coldwater Creek surface waters. No environmental contamination was detected in the sediments of either stream.

The sediments of the Clear Creek floodplain at Station 2, however, contain halogenated VOCs, and also metals concentrations in excess of background. The VOCs, and likely some if not all of the metals (especially lead), are likely due to release of chemicals attributable to NAS Whiting Field. The halogenated VOCs observed, cis-1,2-DCE, trans-1,2-DCE, and 1,1-dichloroethane, are frequently observed as transformation products or solvents in military and industrial use. Detection of these chemicals, but not tri-chlorinated or tetra-chlorinated solvents, suggests that the release occurred fairly long ago. Further exploration to evaluate the nature and extent of contamination in the floodplain and its potential to cause migration in Clear Creek is required (see section 4.4). Such data are necessary also to estimate risks to human or environmental receptors.

6.0 SUMMARY OF TECHNICAL MEMORANDUM NO. 5, GROUNDWATER QUALITY ASSESSMENT

Technical Memorandum No. 5, Groundwater Quality Assessment, is the fifth in a series of six technical memoranda that summarize the results and transmits data gathered during the Phase I RI. The following sections provide a summary of the groundwater quality assessment presented in Technical Memorandum No. 5 and recommend installation wide RI Phase II-A activities associated with groundwater quality determination. Groundwater quality historical data and information for each of the sites and the overall installation are detailed in Volume I RI Phase Workplan (Jordan, 1990).

6.1 OBJECTIVES OF THE GROUNDWATER SCREENING PROGRAM. A groundwater quality screening program was carried out as a component of the Phase I RI subsurface exploration program at NAS Whiting Field. The other components of the subsurface exploration program were geophysical logging, monitoring well installation and aquifer testing, groundwater elevation measurement, and PCPT testing. The physical measurements taken and the interpretation of the subsurface geology and hydrogeology are presented in Technical Memoranda Number 1 and Number 2. The overall purpose of the subsurface exploration was to more completely characterize the hydrogeological setting in the vicinity of the identified sites of potential groundwater contamination as well as the hydrogeological setting of the industrial area in the capture zone of the installation water supply wells. These studies focused especially on delineating the lateral and vertical extent of a semiconfining to confining clay layer that potentially underlies NAS Whiting Field. Boring logs generated during the Verification Study (Geraghty & Miller, 1986) suggest that a laterally extensive clay layer exists at a depth of 90 to 110 feet bls throughout most of NAS Whiting Field and that the layer may be more than 10 feet thick over much of its extent. An additional focus of the Phase I RI was more precise delineation of groundwater flow direction. At a number of sites, verification study well placement did not appear to be truly downgradient of identified disposal sites. Verification Study wells also were screened below clay layers encountered during drilling. Because of that, the piezometric surface as well as the contamination status of the water table component of the aquifer was largely unexplored. The Phase I groundwater quality investigation was conducted as an *in-situ* screening program in conjunction with PCPT soundings to cost effectively screen the overall installation in order to limit the number of required monitoring wells and to maximize the effectiveness of their placement in the upper and/or lower aquifer zones. As described more fully in the Workplan (Volume I) and Sampling and Analysis Plan (Volume II) (Jordan, 1990), groundwater sampling for VOCs and metals was accomplished by *in-situ* placement of a Bengt-Arne-Torstensson (BAT) sampling system based on results of PCPT logs. VOCs and metals were selected for *in-situ* screening because these analytes tend to be mobile in groundwater and because of the finding of VOCs and metals during the Verification Study and in sampling of the installation production wells. Specific objectives were as follows:

- evaluate the upper water table contamination status and further delineate the production zone VOC contamination status at Site 3, Underground Waste Solvent Storage Area release;

- confirm the absence of contamination in the water table aquifer component at Site 2, Northwest Open Disposal Area rubble dump;

- screen the upper and lower components of the aquifer downgradient of the following sites to determine if any release has occurred,

  Site 1, Northwest Disposal Area (former landfill),
  Site 9, Waste Fuel Disposal Pit,
  Site 10, Southeast Open Disposal Area (A),
  Site 11, Southeast Open Disposal Area (B),
  Site 12, Tetraethyl Lead Disposal Area,
  Site 13, Sanitary Landfill, 1979-1984, and
  Site 14, Short-Term Sanitary Landfill, 1978-1979;

- evaluate the effect of any confining layers on contaminant migration and the extent of releases from the Southwest Landfill (Site 15) and adjoining Open Disposal and Burning Area (Site 16);

- evaluate whether surface clay layers prevent groundwater contamination resulting from firefighting training exercises at the Crash Crew Training Areas, Sites 17 and 18; and

- determine the probable direction of unidentified sources of VOC contamination from the production wells W-S2 and W-W3 (South and West wells) and overall contamination status of the upper and lower zones of the aquifer in the Industrial Area of NAS Whiting Field.

To accomplish these objectives, 40 shallow and 28 deep BAT samples were collected and analyzed during the period February 1991 to May 1991. Shallow BAT samples were collected at the surface or near the surface of the water table. Deep samples were collected in the production zone of the sand-and-gravel aquifer. These data are interpreted by site or site group in Section 3.0 of Technical Memorandum No. 5.

6.2 FIELD PROGRAM SUMMARY

6.2.1 BAT Sampling Technique The BAT groundwater sampling program was conducted in conjunction with the PCPT subsurface exploration program to verify the contamination of groundwater downgradient of each site. Based on subsurface exploration data (lithology and pore pressure) collected from the PCPT soundings, the depth of the *in-situ* BAT groundwater sample was determined.

The groundwater samples were shipped to the laboratory for volatile organic and metals analysis. Three 40-milliliter (mℓ) vials were collected for each VOC sample and four 130-mℓ volumes of groundwater were collected for each metals sample.

6.2.2 Exploration Locations A total of 68 groundwater samples were collected by Williams and Associates (Clearwater, Florida) from Sites 1, 2, 3, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and production well areas W-S2 and W-W3. Groundwater samples identification and sampling depths are summarized in Table 6-1. *In situ* BAT sampling locations are shown in Figures 6-1 through 6-8. Of the 68 samples collected, 6 were duplicate samples and 7 were optional samples. The seven optional *in-situ* BAT groundwater samples were collected from Sites S2 (production well W-S2) and 15. Samples at Site S2 were collected from 180 feet bls to ascertain the vertical extent of contamination in the production zone of the

Table 6-1
***In-Situ* Groundwater Samples and Depths**

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Number	Sample Number	Sampling Depth (feet bls)
1	WHF-01-WP-01-01	[1]88.0
1	WHF-01-WP-01-01	[1]98.0
1	WHF-01-WP-01-01	[1]109.0
1	WHF-01-WP-01-01	130.0
2	WHF-02-WP-01-01	99.0
3	WHF-03-WP-01-01	118.0
	WHF-03-WP-01-01A	118.0
	WHF-03-WP-01-02	183.0
	WHF-03-WP-01-02A	183.0
	WHF-03-WP-02-01	117.0
	WHF-03-WP-02-02	180.0
9	WHF-09-WP-01-01	100.0
10	WHF-10-WP-01-01	102.0
10	WHF-10-WP-02-01	102.0
10	WHF-10-WP-02-02	152.0
10	WHF-10-WP-01-01	102.0
11	WHF-11-WP-01-01	92.0
11	WHF-11-WP-01-02	132.0
12	WHF-12-WP-01-01	102.0
12	WHF-12-WP-01-02	162.0
13	WHF-13-WP-01-01	82.0
13	WHF-13-WP-01-01	82.5
13	WHF-13-WP-02-01	132.0
14	WHF-14-WP-01-01	107.0
14	WHF-14-WP-01-02	160.0
15	WHF-15-WP-01-01	55.0
15	WHF-15-WP-02-01	33.0
15	WHF-15-WP-02-02	72.0
15	WHF-15-WP-03-01	50.0
15	WHF-15-WP-04-01	40.0
16	WHF-16-CPT-01-01	28.0
16	WHF-16-CPT-01-02	82.5
16	WHF-16-WP-02-01	40.0
16	WHF-16-WP-02-02	100.0
17	WHF-17-WP-01-01	128.0

See notes at end of table.

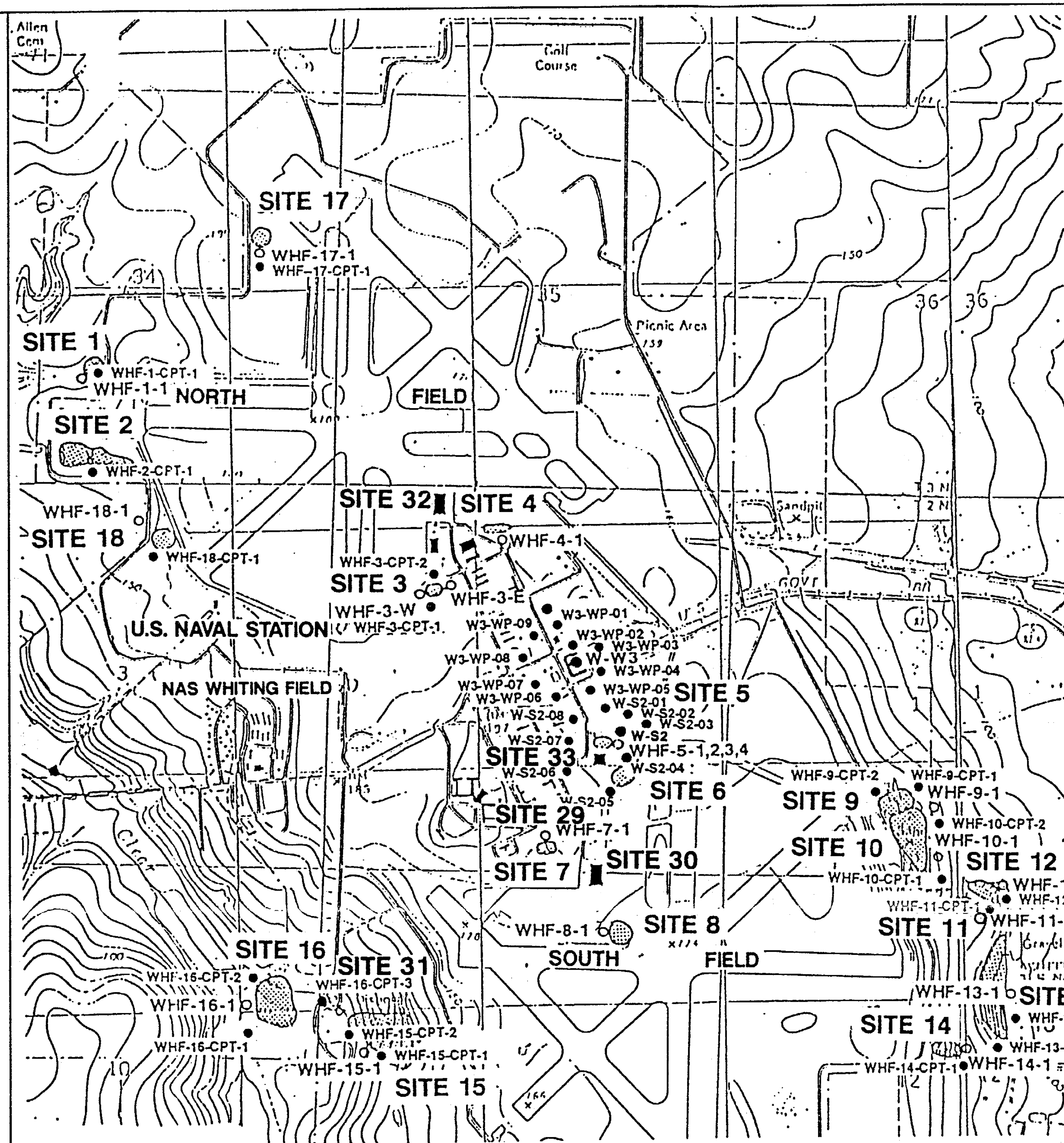
Table 6-1 (Continued)
In-Situ Groundwater Samples and Depths

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Number	Sample Number	Sampling Depth (feet bls)
18	WHF-18-WP-01-01	95.0
18	WHF-18-WP-01-01A	95.0
18	WHF-18-WP-01-02	183.0
18	WHF-18-WP-01-02A	183.0
S2	WHF-S2-WP-01-01	114.0
S2	WHF-S2-WP-01-02	180.0
S2	WHF-S2-WP-02-01	118.0
S2	WHF-S2-WP-03-01	133.0
S2	WHF-S2-WP-04-01	121.0
S2	WHF-S2-WP-04-02	180.0
S2	WHF-S2-WP-05-01	130.5
S2	WHF-S2-WP-05-02	180.0
S2	WHF-S2-WP-06-01	126.0
S2	WHF-S2-WP-06-02	180.0
S2	WHF-S2-WP-07-01	127.5
S2	WHF-S2-WP-08-01	122.0
S2	WHF-S2-WP-08-02	180.0
W3	WHF-W3-WP-01-01	117.0
W3	WHF-W3-WP-01-02	182.0
W3	WHF-W3-WP-02-01	125.0
W3	WHF-W3-WP-02-02	182.0
W3	WHF-W3-WP-03-01	126.0
W3	WHF-W3-WP-03-02	182.0
W3	WHF-W3-WP-04-01	127.0
W3	WHF-W3-WP-04-02	182.0
W3	WHF-W3-WP-05-01	132.0
W3	WHF-W3-WP-05-02	182.0
W3	WHF-W3-WP-06-01	[1]115.0
W3	WHF-W3-WP-06-01	[1]149.0
W3	WHF-W3-WP-06-02	180.0
W3	WHF-W3-WP-07-01	132.0
W3	WHF-W3-WP-07-02	182.0
W3	WHF-W3-WP-08-01	132.0
W3	WHF-W3-WP-08-02	182.0
W3	WHF-W3-WP-09-01	133.0
W3	WHF-W3-WP-09-02	183.0

[1]No water.

Note: bls = below land surface.



N

LEGEND

○ Existing Monitoring Well

● PCPT/BAT Exploration

APPROXIMATE SCALE

0 2000 4000 8000

FIGURE 6-1

LOCATION OF EXISTING MONITORING WELLS & PHASE I PCPT/BAT EXPLORATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I142

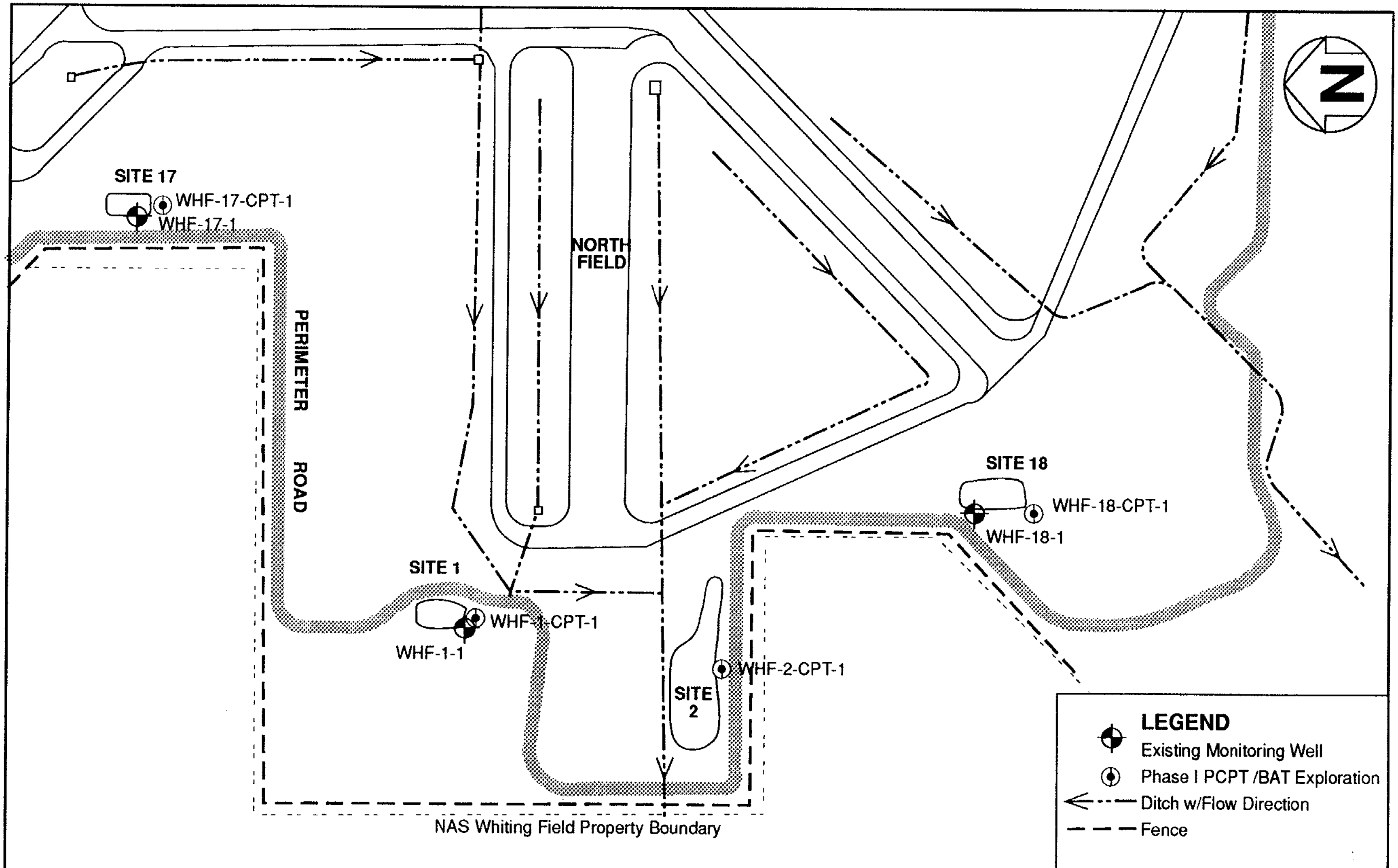


FIGURE 6-2
SITES 1, 2, 17, & 18
PHASE I
BAT GROUNDWATER
SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

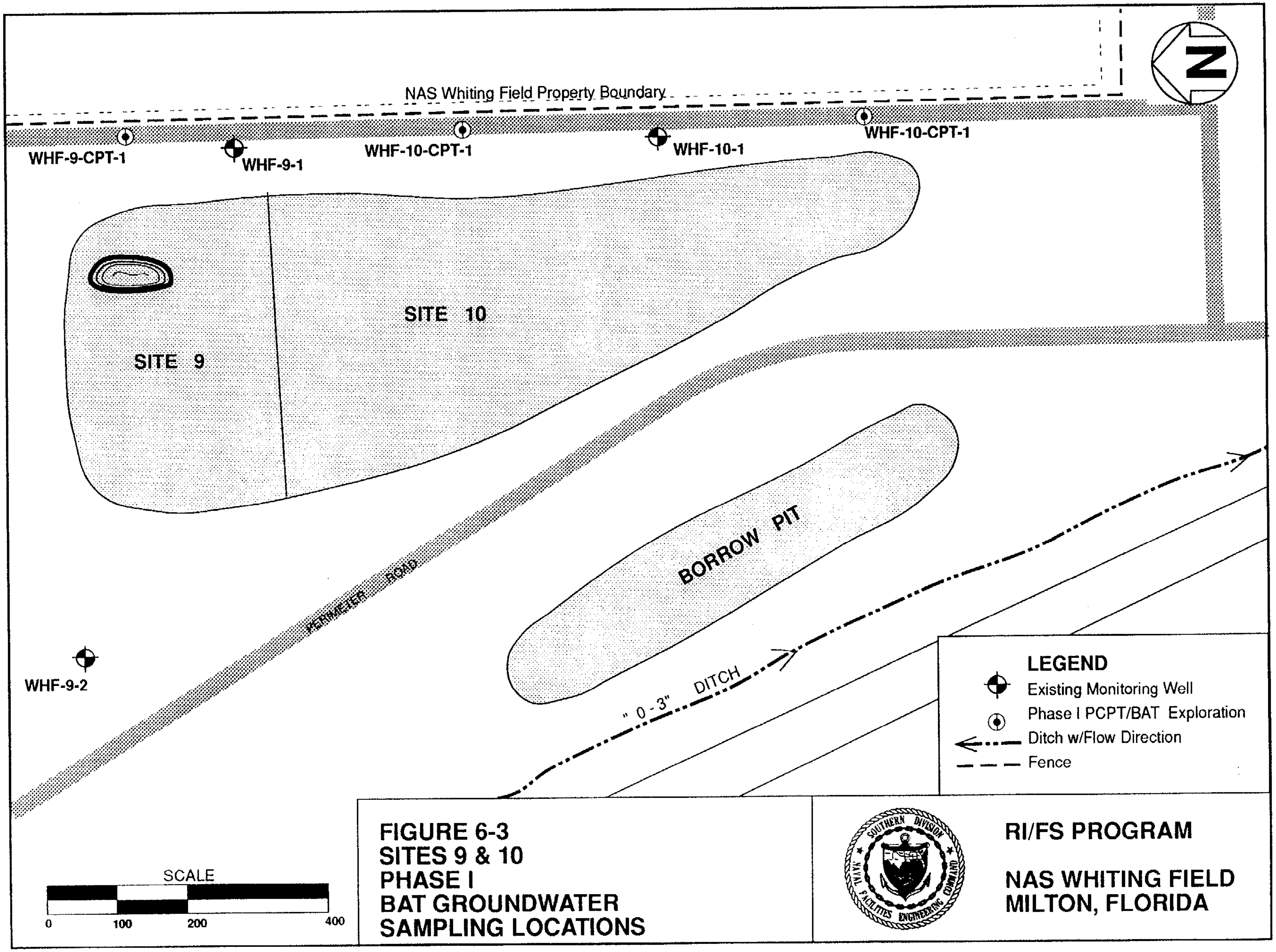


FIGURE 6-3
SITES 9 & 10
PHASE I
BAT GROUNDWATER
SAMPLING LOCATIONS

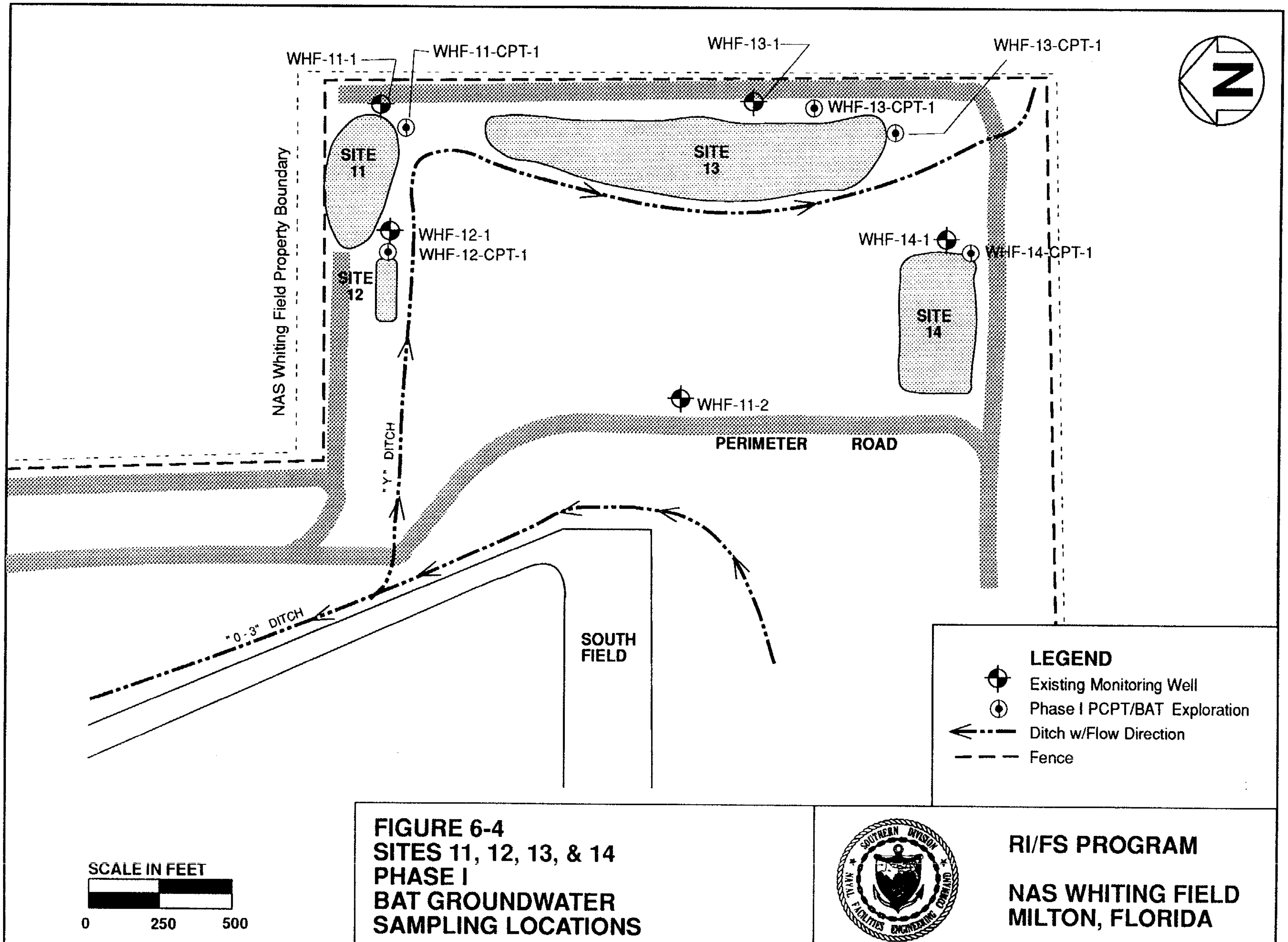


FIGURE 6-4
SITES 11, 12, 13, & 14
PHASE I
BAT GROUNDWATER
SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

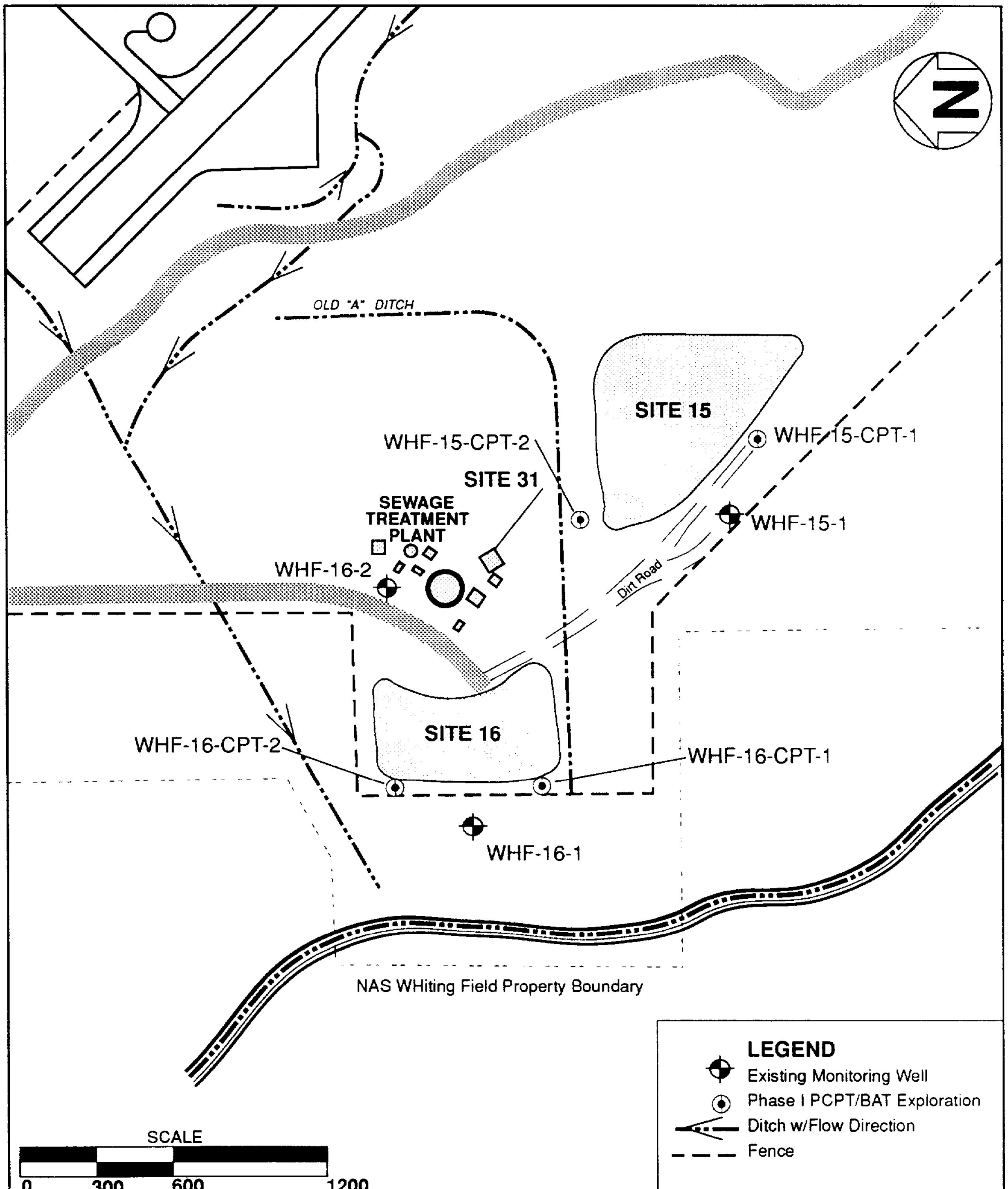


FIGURE 6-5
SITE 15, 16, & 31
BAT GROUNDWATER
SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

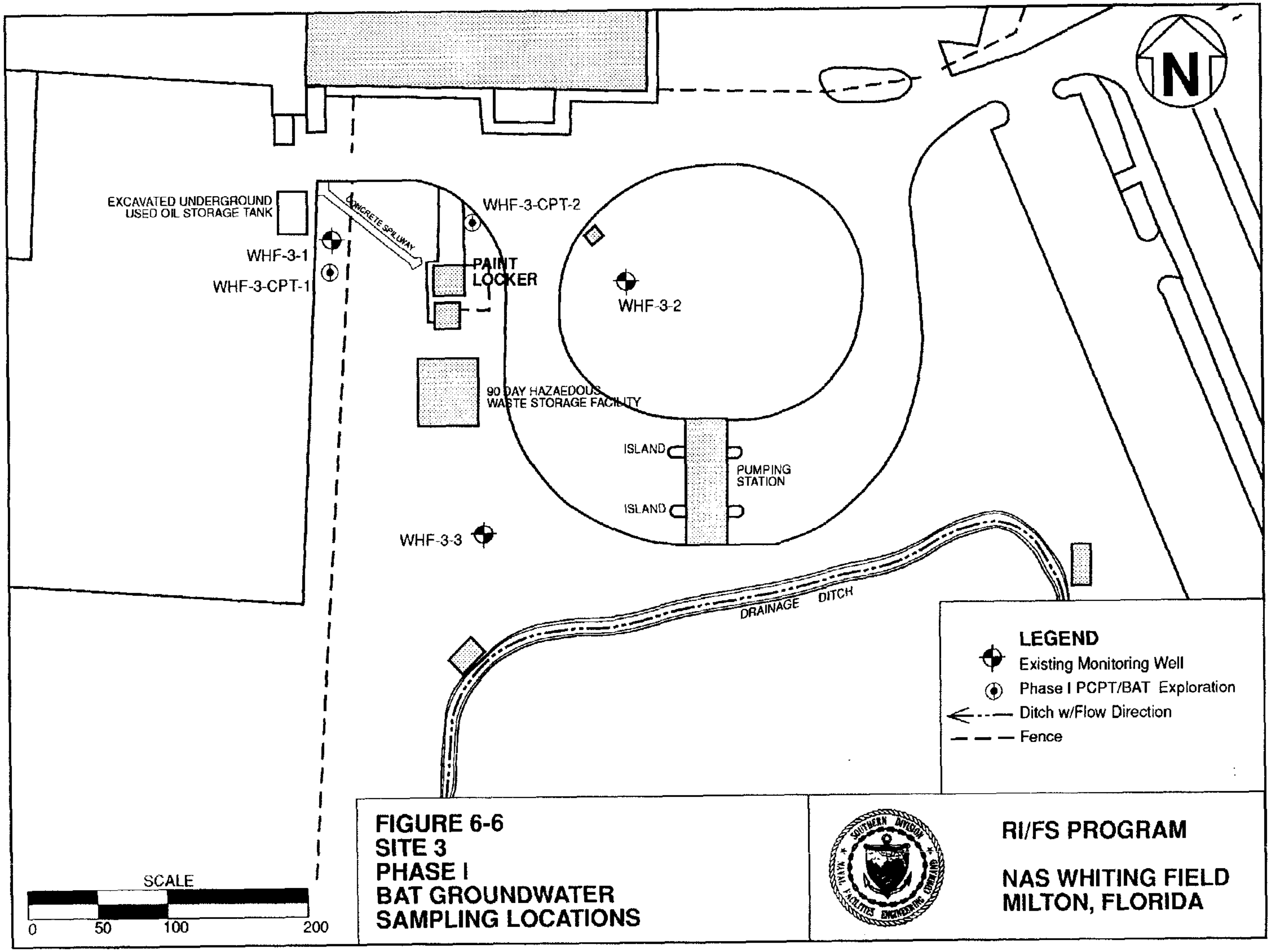


FIGURE 6-6
SITE 3
PHASE I
BAT GROUNDWATER
SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

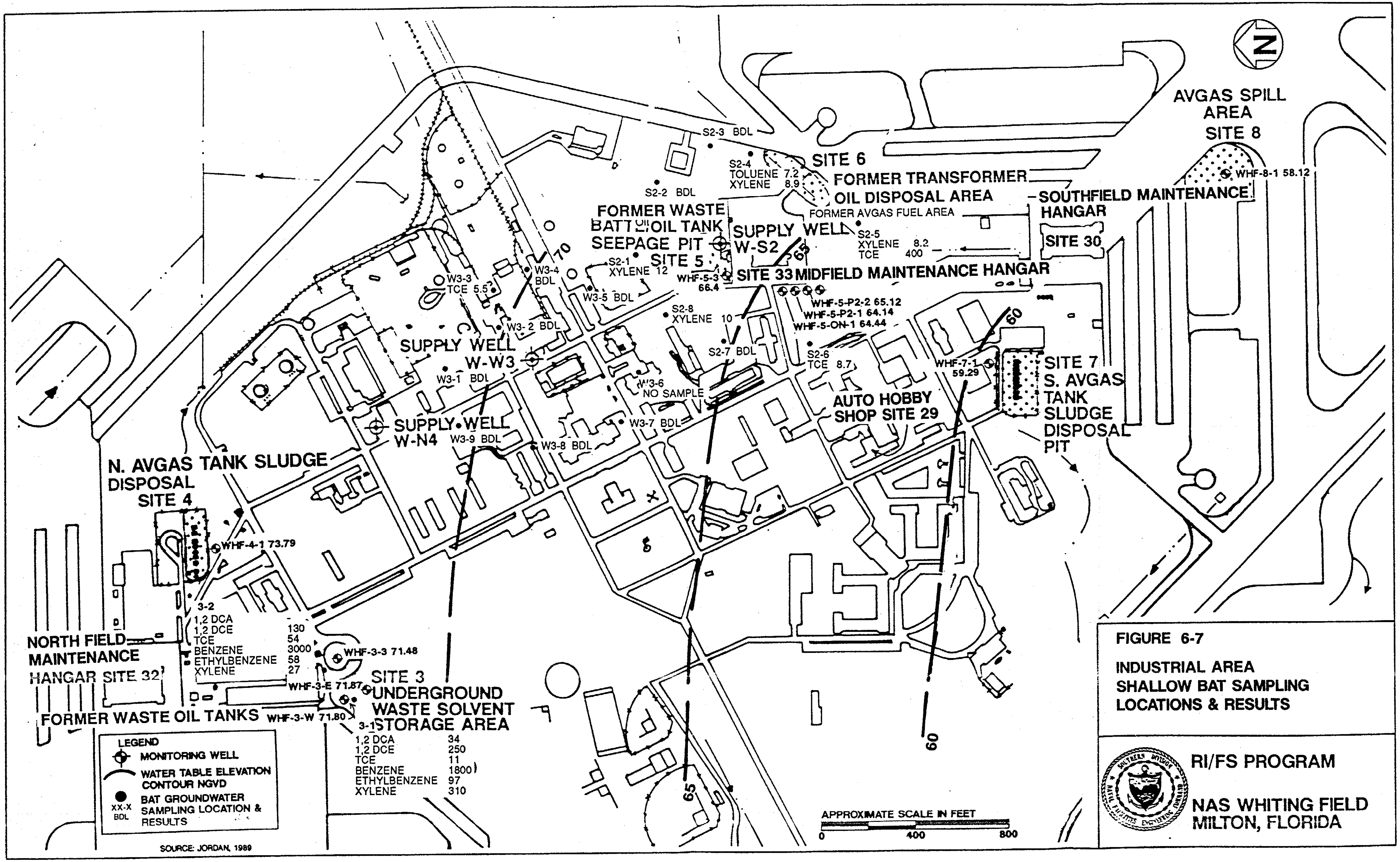


FIGURE 6-7

INDUSTRIAL AREA SHALLOW BAT SAMPLING LOCATIONS & RESULTS

00229IB152

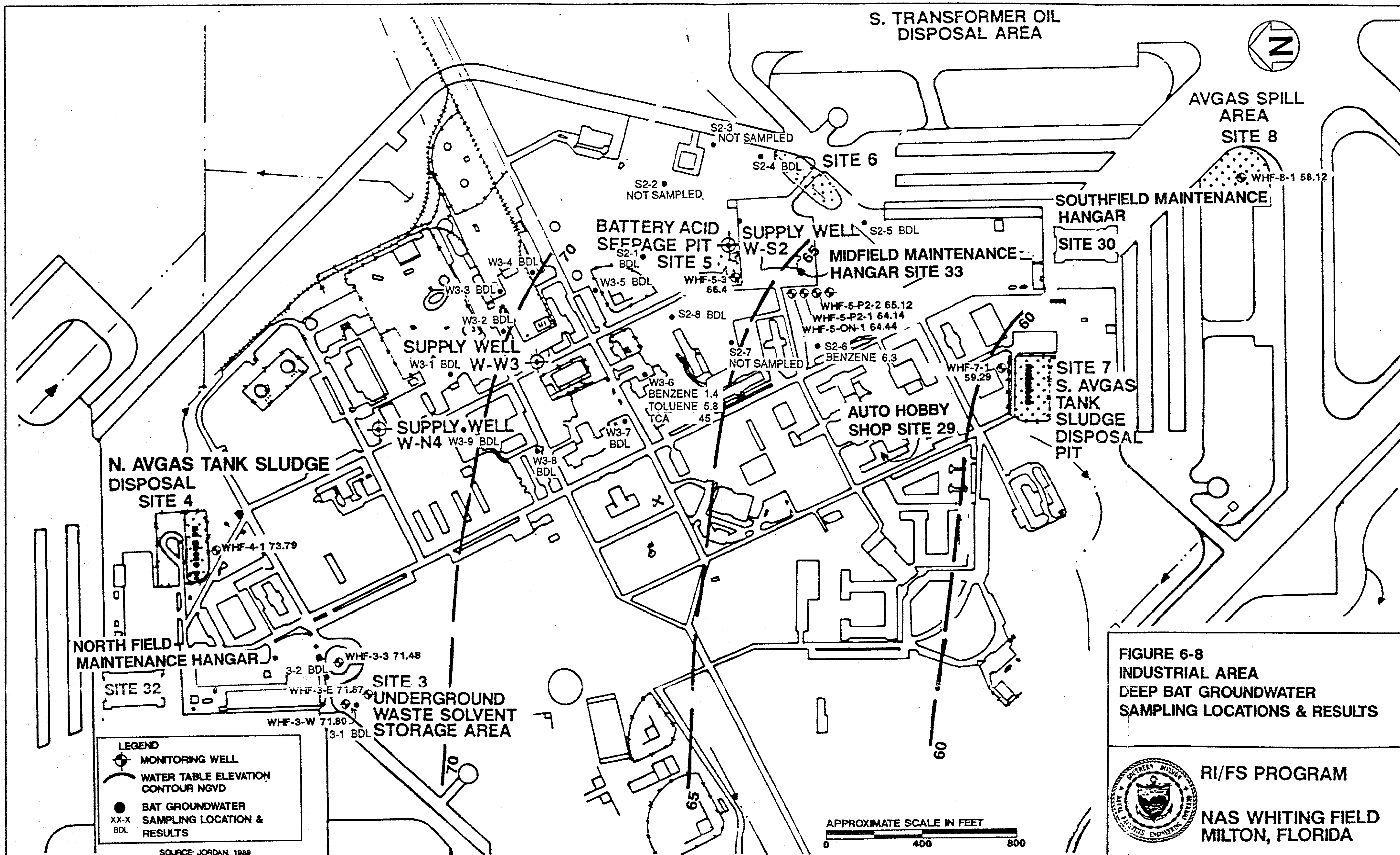


FIGURE 6-8
INDUSTRIAL AREA
DEEP BAT GROUNDWATER
SAMPLING LOCATIONS & RESULTS

sand-and-gravel aquifer that may have resulted from vertical migration of contaminants detected in shallow groundwater samples at Site S2 locations S2-01, S2-04, S2-05, S2-06, and S2-08, previously. The remaining two optional BAT groundwater samples were collected from the shallow groundwater zone at Site 15.

6.3 DATA QUALITY ASSESSMENT. The purpose of this section is to present and interpret the site-specific results of the *in-situ* groundwater program conducted as a component of the Phase I RI. This section is organized to present and interpret the data for sites grouped according to spatial and hydrogeological relationships. As such, the subsections describe results for the industrial area in the vicinity of the base water supply production wells and Site 3 (the northern industrial area); Sites 15 and 16, the southwestern part of NAS Whiting Field; Sites 1, 2, 17, and 18, the northwestern part of NAS Whiting Field; and Sites 9, 10, 11, 12, 13, and 14, the eastern part of NAS Whiting Field. This organization and order of presentation also addresses the site groups in order of highest priority relative to extent of groundwater contamination.

6.4 INTERPRETATION OF RESULTS. Because the *in-situ* water quality samples have not been collected from developed monitoring wells, the data are appropriate for preliminary screening but would not support risk assessment conclusions or decision making relative to response actions. In addition, comparison of analyte concentrations to Florida or Federal MCLs cannot be done directly because the *in-situ* sampling procedure does not provide samples that can be used to identify a verified violation of standards.

6.4.1 Industrial Area The BAT sampling program also confirmed that the upper part of the aquifer is heavily contaminated by VOCs in the vicinity of Site 3 at the northern end of the industrial area (see Figures 6-7 and 6-8). At site 3, deeper BAT samples (in the production zone) showed no contamination (Figure 6-8). Because Sites 4, 7, and 8 are to be investigated under the underground storage tank (UST) program no *in-situ* sampling was conducted at these sites.

Because of the effects of production well pumping at different wells in a complex pattern, temporal changes in localized groundwater flow directions and gradient are probably complex. In addition, the geologic explorations indicated that a definable clay aquiclude does not appear to exist; however, complex interbedded clay and silt layers exist as well as clay (at Sites 3 and 4) that restrict vertical migration, except where induced by pumpage. The results of the aquifer test (Technical Memorandum No. 2) indicated that, although the response of the aquifer above the production zone was slower than would be expected for a unconfined system, the system behaved as one overall flow system. These factors complicate the interpretation of groundwater flow and contaminant movement in the sand-and-gravel aquifer.

Groundwater VOC contamination distribution and movement of contaminated groundwater can be interpreted in a general way; however, based on the pattern of contamination, hydrogeologic properties of the aquifer (described in Technical Memoranda No. 1 and No. 2), and historical operations in the industrial area, additional confirming data are necessary to map the full vertical and horizontal extent of contamination, the complete spectrum of chemicals of concern, location of past sources, and the strength and exact location of residual sources. Based on the screening data and the history of industrial operations, VOCs (both fuel-derived VOCs and cleaners, solvents, thinners, and degreasers) represent major groundwater contamination problems at NAS Whiting Field.

Contamination released to the upper component of the aquifer to the north of production wells W-W3 and W-S2 appears to be drawn downward to the production zone of the aquifer in the vicinity of the three production wells. The North Well appears to be upgradient of this contamination. Migration to the south in the production zone has apparently occurred as shown in Figure 6-7. Benzene, toluene, and 1,1,1-trichloroethane (1,1,1-TCA) have been observed south of well W-W3. The 1,1,1-TCA concentration detected was 45 $\mu g/\ell$. This indicates potential that the zone of deeper contaminated groundwater extends a substantial distance to the south. Based on the monitoring well data, the flow path from the production well area curves westerly toward Clear Creek. There are approximately 6,000 feet of flow distance from the production well area to the point where the land surface slopes off rapidly to Clear Creek. Using the hydraulic conductivity of the aquifer of 100 ft/day calculated from the pumping test and the estimated hydraulic gradients, time of travel to the creek could be approximately 13 to 26 years.

Examination of the BAT VOC results from the shallower zone sampling indicates three areas of groundwater contamination. One of these is located to the immediate northeast of Production Well W-W3. This source appears to be in the Public Works Transportation Department area behind Building 1429. The ground vehicle maintenance activities have been performed at this location by NAS Whiting Field from the 1940's until the present. Currently a contractor performs maintenance for NAS Whiting Field Public Works Vehicles.

Shallow groundwater downgradient of this area contains trace (<20 $\mu g/\ell$) concentrations of trichloroethene (TCE) and xylene. Sample WHF-W3-WP-03-01, collected in the transportation area, contained 5.5 $\mu g/\ell$ TCE. No VOCs were detected in samples collected to the north of this sample area. The pattern of positive VOC results suggest that the Base Exchange (BX) service station petroleum tanks and activities and the current JP-5 storage and pumping facility do not contribute substantially to groundwater contamination. The BX service station is located between Well W-W3 and W-N4 but is upgradient of Building 1429.

Another source of groundwater VOC contamination exists in the shallow parts of the aquifer near Site 3 as shown in Figure 6-7. In the Verification Study (Geraghty & Miller, 1986), soil contamination attributed to two 500-gallon waste solvent tanks was detected to the south of Building 1429. These tanks were reportedly removed in 1984. Table 6-2 shows the maximum concentration of soil contaminants. Although the tanks were reportedly used for paint and metals preparation, and wastes including thinners and solvents, no VOCs were detected in soil. VOCs, including 1,1,1-TCA, 1,1,2-TCA, TCE, 1,2-dichloroethane (DCA), 1,2-DCE, benzene, ethyl benzene, and xylene were detected in the shallow zone of the aquifer, but not in the production zone at 180 feet bls, as shown in the Verification Study samples from Wells WHF-3-1 and WHF-3-2 and the shallow zone BAT samples.

Examination of the historical industrial operations indicate that Building 2941, located just north of Site 3, has been used since the 1960's for aircraft intermediate maintenance activities. Prior to 1968, all AIMD activities were done in hangars; since that time airframe, power plant, and painting activities have

Table 6-2
Summary of Available Data on Contamination in the Industrial Area

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Number	Site Name	Materials Disposed	Soil Chemical	Frequency of Detection[1]	Maximum Conc. (mg/kg)	Groundwater Chemical	Frequency of Detection[1]	Maximum Conc. (µg/ℓ)
3	Underground Waste Solvent Storage Area	Waste solvents, paint stripping residue, 120 gallon spill.	Cadmium	1/2	0.28	1,1,1-TCA	1/2	13
			Chromium	2/2	43	1,1,2-TCA	1/2	111
			Mercury	2/2	0.20	TCE	1/2	18
			Silver	2/2	1.85	Lead	2/2	12
			Zinc	2/2	586	Arsenic	1/2	1
			Phenols	1/2	0.61			
4	North AVGAS Tank Sludge Disposal Area	Tank bottom sludge with tetraethyl lead.	Lead	2/2	27	Benzene	1/1	17
						Toluene	1/1	10
						Lead	1/1	5
5	Battery Acid Seepage Pit	Waste electrolyte solution with heavy metals, waste battery acid.	Arsenic	21/26	1.4	Benzene	6/8	26
			Cadmium	12/26	0.55	Aldrin	1/8	0.13
			Lead	19/26	24	g-BHC (lindane)	1/8	0.02
			Mercury	24/26	0.212	Heptachlor	2/8	0.04
						Antimony	4/8	170
						Cadmium	2/8	3
						Chromium	4/8	20
						Copper	4/8	33
						Lead	4/8	37
						Zinc	7/8	360
6	South Transformer Oil Disposal Area	PCB-contaminated dielectric fluid.	PCB	0/10	ND	NT		
7	South AVGAS Tank Sludge Disposal Area	AVGAS with tetraethyl lead.	Lead	2/2	575	Toluene	1/1	43,000
						Benzene	1/1	8,800
						EDB	1/1	23.56
						Lead	1/1	862
						Xylene	1/1	1,000

See notes at end of table.

Table 6-2 (Continued)
Summary of Available Data on Contamination in the Industrial Area

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site Number	Site Name	Materials Disposed	Soil Chemical	Frequency of Detection[1]	Maximum Conc. (mg/kg)	Groundwater Chemical	Frequency of Detection[1]	Maximum Conc. (μg/ℓ)
8	AVGAS Fuel Spill Area	AVGAS with tetra-ethyl lead.	Lead	12/12	27	Benzene	1/1	2
						Toluene	1/1	26
						Lead	1/1	7
9	Waste Fuel Disposal Pit	AVGAS with tetra-ethyl lead.	Lead	12/12	14	Lead	1/1	7

Notes: [1] = (12/12) number of samples with detectable levels of contaminant per total number of samples analyzed.

Conc. = concentration
mg/kg = milligrams per kilogram.
μg/ℓ = micrograms per liter.
TCA = trichloroethane.
TCE = trichloroethene.
BEHP = bis(2-ethylhexyl)phthalate.
PCB = polychlorinated biphenyls.
ND = Not detected.
NT = Not tested.
AVGAS = aviation gasoline.
EDB = ethylene dibromide.

been conducted in Building 2941. Prior to that time such activities were conducted at Hangar 1424, immediately north of Building 2941. The IAS indicates that an additional underground liquid waste tank existed at the south and southwest corner of Building 2941. The location of this tank is shown in Figure 6-7. This tank was used for storage of airframe, power plant, and ground support equipment waste since at least 1968. Prior to AIMD activities, aircraft maintenance wastes from Hangar 1424 reportedly were sent to base landfills. However, spills and uncontrolled disposals of solvents at or near the sites of generation were common practice in the 1940's and 1950's. Additional record search and source exploration in the vicinity of Buildings 1424 and 2941 are required to evaluate the status of the former waste oil tank and to locate any areas of residual soil contamination. The waste oil tank at Building 2941 was reportedly removed (NAS Whiting Field Public Works Department, 1991) in 1987 during expansion of the hard stand at Building 2941.

Based on the interpreted groundwater flow direction and the velocity interpreted from the pumping test, VOCs from the Site 3 North Hangar Area could have migrated to Clear Creek. VOCs deep in the aquifer were observed at Site 16, in the southwest corner of the installation. These were not interpreted to be from Site 16 due to the depth at which they were encountered and the absence of any contamination at shallow depths. Interpretation is made that these VOCs (including benzene at 410 $\mu g/\ell$) may have migrated from the North Hangar Area or North Fuel Farm area (Site 4). This interpretation must be confirmed by further data gathering.

Shallow aquifer zone VOC contamination was also detected south and southeast of Hangar Building 1451 in the vicinity of, but downgradient of, Production Well W-S2, and near Sites 5 and 6. Production zone groundwater at this location was not contaminated. Xylene was detected upgradient of Well W-S2 as discussed previously. According to the IAS and interviews with NAS Whiting Field Public Works Department personnel, a waste oil tank (now removed) existed from the 1940's until the 1980's at the northwest corner of the hardstand at the Middle Hangar (Building 1451). The location of this tank and a former AVGAS Fueling Point at the north side of the hardstand is shown in Figures 6-7 and 6-8. According to the IAS, oily wastes from the electrical shop were discharged to the storm drainage ditch at the south side of the hardstand. It is possible that aircraft maintenance wastes were also discharged. The upper zone of the aquifer downgradient of the former waste oil tanks and storm drain disposal area was observed to contain 400 $\mu g/\ell$ TCE and 8.2 $\mu g/\ell$ xylene. To the southeast of the waste oil tank, traces of toluene and xylene were detected. These are shown on Figure 6-7. These findings indicate past or residual sources of contamination in the vicinity of Building 1451 that must be located and evaluated. Further exploration of groundwater must be conducted downgradient of the waste oil tanks to determine the full nature and extent of migration from this and/or other sources in the area of the hangar.

In addition to the above identified potential sources, not previously identified as sites in either the IAS or Verification Study program, additional sources or potential sources of groundwater contamination exist in the industrial area. The North and South Fuel Farms, Site 4 and 7, are to be investigated under the Navy UST Program. At the South Fuel Farm, Verification Study data from 10 feet below the water table surface indicated 43,000 $\mu g/\ell$ toluene, 8,800 $\mu g/\ell$ benzene, 1,000 $\mu g/\ell$ xylene, and 24 $\mu g/\ell$ ethylene dibromide (see Table 6-2) in groundwater.

Because of the placement of the well screen below the water table surface no evaluation of floating fuel could be made. At the North Fuel Farm, groundwater contamination was relatively low compared to the South Fuel Farm (see Table 6-2). However, Well WHF-4-1 was installed below a clay layer. A perched water table may exist above this layer. The contamination status of this perched zone is unknown.

In addition to the UST program issues discussed above, two other former or current underground waste oil tanks exist at NAS Whiting Field. From 1972 to 1984, helicopter maintenance waste oils, solvents, thinners, etc., were stored in three underground waste oil tanks located at Building 1406 as shown in Figure 6-9. No explorations of this area have been conducted. Figure 6-9 shows the orientation of Building 1406 and the waste oil tanks to the South Fuel Farm and AVGAS Sludge Disposal Area. A fourth waste oil tank was located at the Auto Hobby Shop, Building 1404. This tank stored waste oils, solvents, and thinners from 1970 to 1984. The status of this tank also is unexplored. This tank location is also indicated on Figure 6-9.

<u>6.4.2 Sites 15 and 16; Southwestern Disposal Areas</u> Figures 6-10 and 6-11 show the VOC results from the *in-situ* BAT sampling program at Sites 15 and 16.

VOC results indicate groundwater contamination by VOCs. Shallow groundwater downgradient of Site 15 contains aromatic VOCs (benzene, toluene, and xylenes). At site 16, the shallower part of the aquifer is not apparently contaminated. The deeper zone contains both aromatic and halogenated compounds.

VOCs were detected at substantial concentrations as shown in Figure 6-10. The distribution pattern for VOC results at these two sites is somewhat complicated to interpret. Further groundwater and subsurface soils investigation is required to develop a complete understanding of the location of residual contamination, vertical and horizontal flow patterns, interaction with the creek, the nature of chemicals capable of migrating, and the extent of migration.

Samples collected for analysis of TAL metals at these same locations showed no concentrations suggesting a metals release at either site. The only anomalous metals result was aluminum, which was detected at WHF-15-CPT-2-1 at 3,330 $\mu g/\ell$.

<u>6.4.3 Sites 1, 2, 17, and 18; Northwestern Disposal Areas and Fire Fighting Training Areas</u> Figures 6-12 and 6-13 show the results of VOC analysis of BAT samples from the water table and below the clay layer, respectively, at each of the four sites. No evidence of VOC contamination was detected at the water table. Because of the absence of contamination above the clay layer, BAT samples below the layer were not collected at Site 2 and Site 17.

TAL metals analysis from the BAT sampling program showed no evidence of elevated groundwater metals at Sites 1 and 2. At Site 17 and 18, evidence of elevated aluminum, barium, chromium, copper, lead, mercury, nickel, vanadium, and zinc were observed in the shallow part of the aquifer. The distribution of these metals is shown in Figure 6-12. No evidence for elevated metals was detected in the deeper zone where it was sampled. Because of the screening nature of the sampling program, firm conclusions relative to metals release cannot be made for the reasons discussed in Section 3.1.2, Technical Memorandum No. 5. The metals detected, however, may be due to the combination of waste oils or the release of

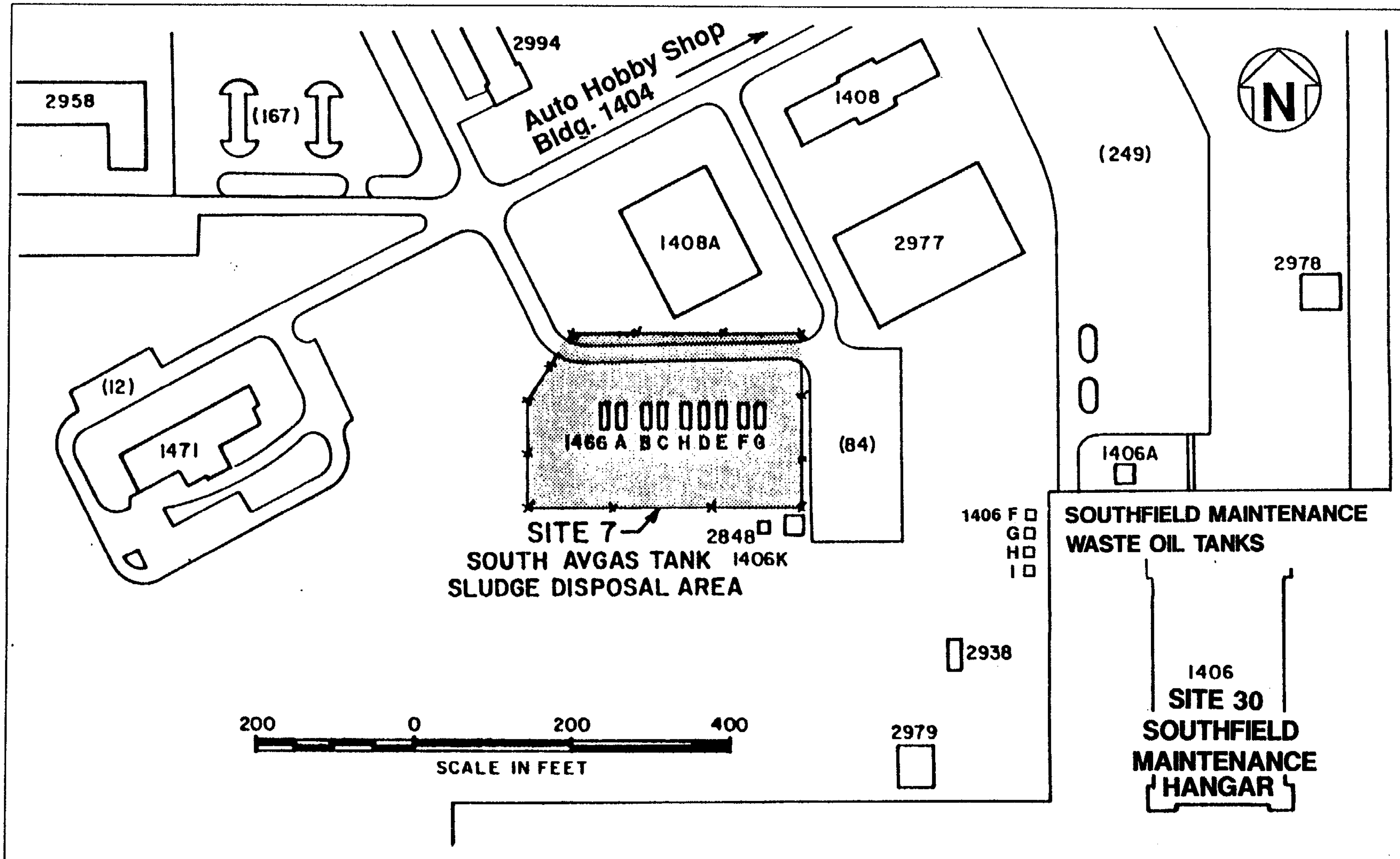


FIGURE 6-9
SITES 7 AND 30
SOUTH AVGAS TANK FARM AND SOUTHFIELD MAINTENANCE AREA

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

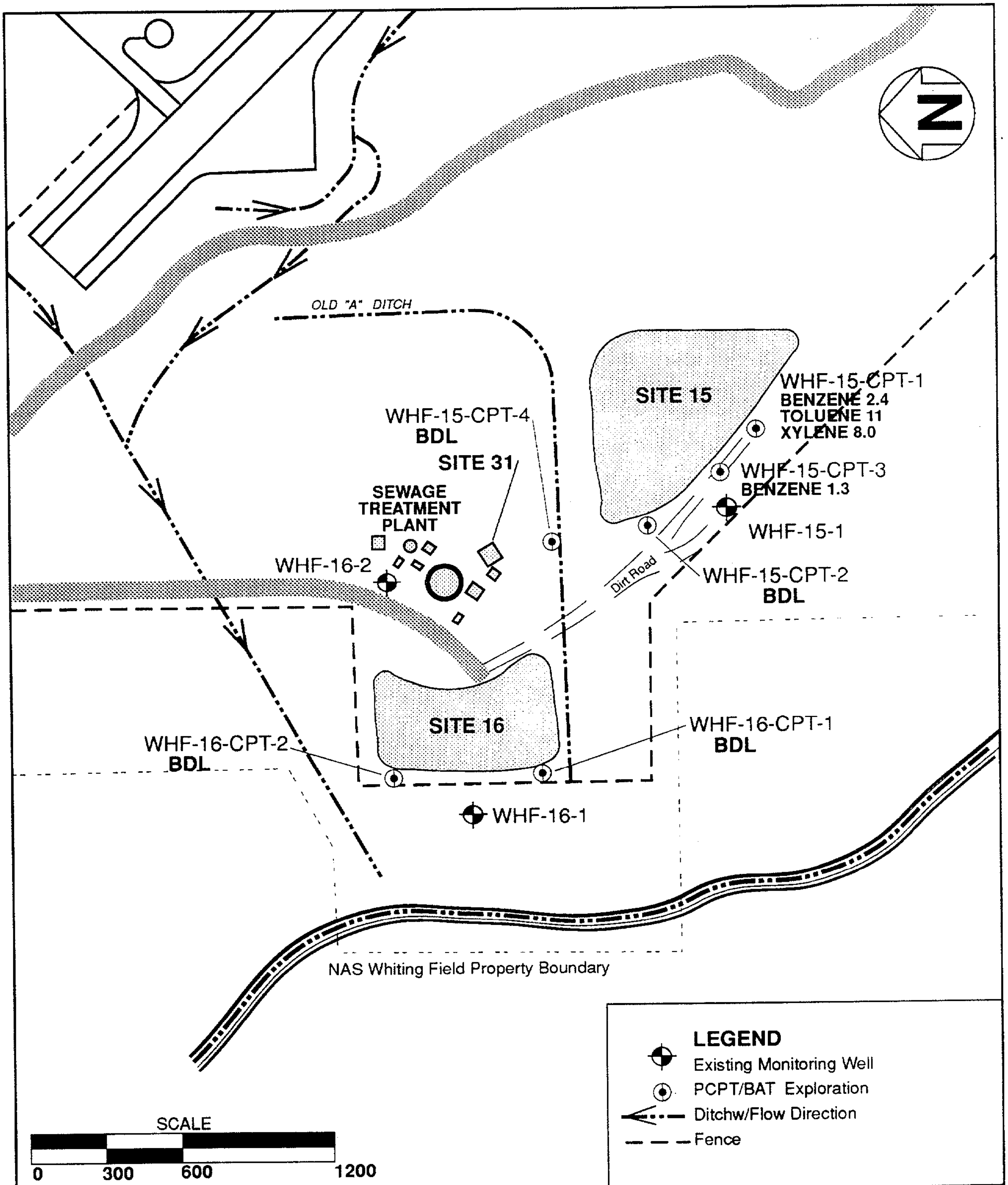


FIGURE 6-10
SITES 15 & 16
PHASE I
SHALLOW BAT GROUNDWATER
VOC RESULTS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

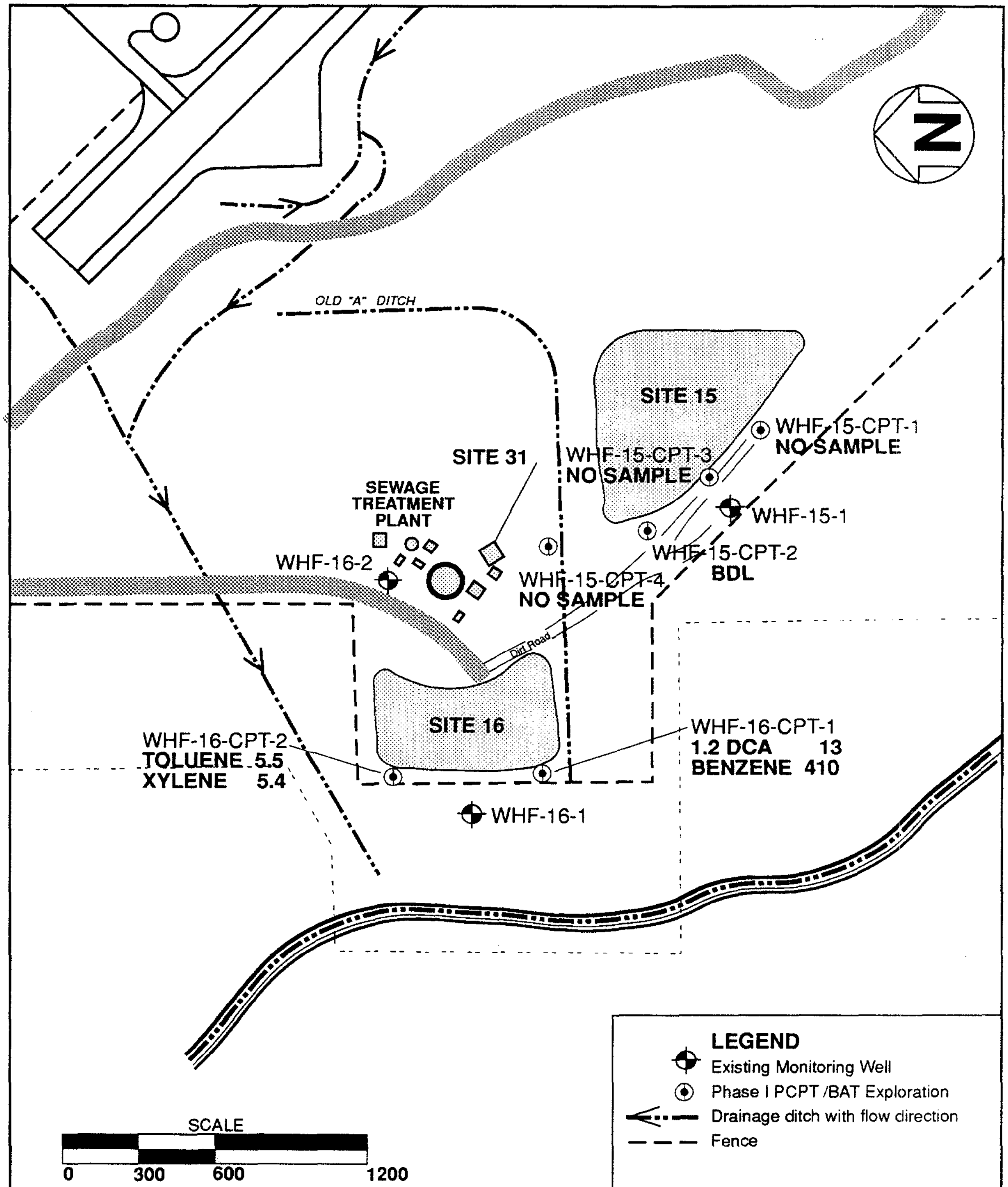
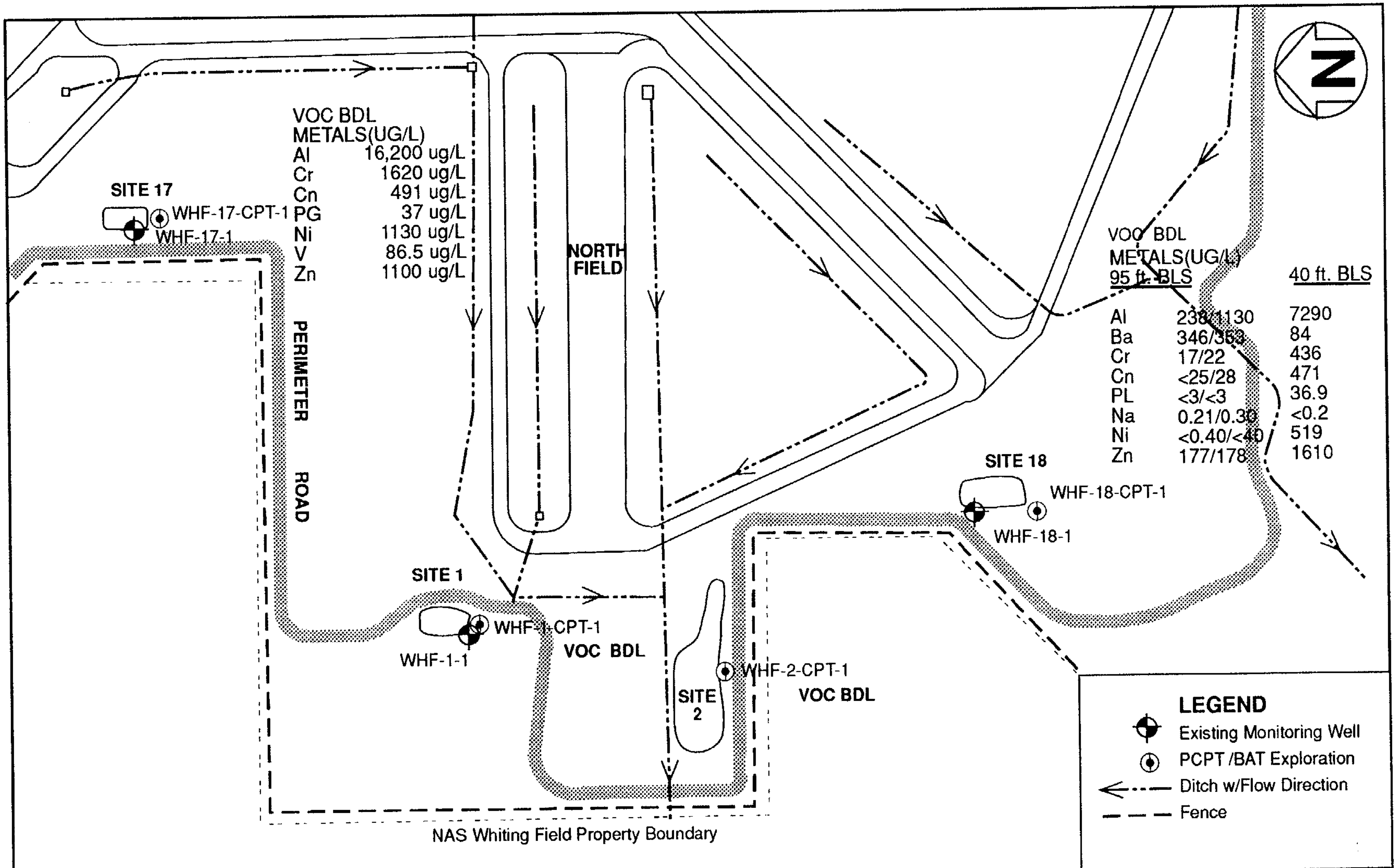


FIGURE 6-11
SITES 15 & 16
PHASE I
DEEP BAT GROUNDWATER
VOC RESULTS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA



SCALE IN FEET

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FIGURE 6-12
SITES 1, 2, 17, & 18
PHASE I
SHALLOW BAT GROUNDWATER
VOC & METALS RESULTS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

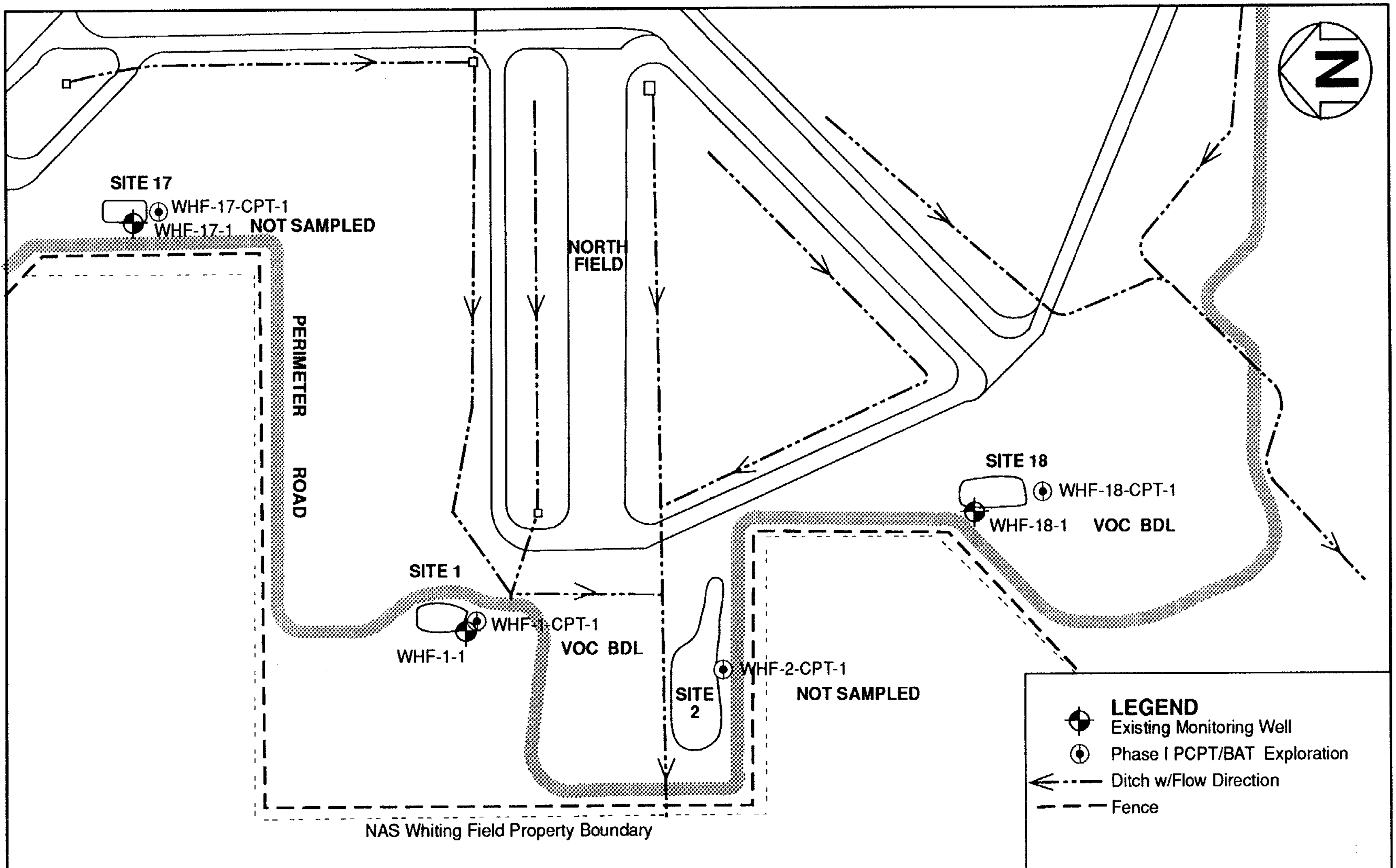


FIGURE 6-13
SITES 1, 2, 17, & 18
PHASE I
DEEP BAT GROUNDWATER
VOC RESULTS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

cations from the geologic matrix as residual fuel product is biologically transformed and causes changes in the geochemical environment. No evidence of fuels related VOCs were detected in groundwater, however. Further confirmation of the metals concentrations and/or the geochemical processes responsible for elevating metals concentrations in groundwater at these two sites are required. Chromium as reported exceeds Federal and Florida MCLs. Lead exceeds the newly promulgated Federal standards.

__6.4.4 Sites 9, 10, 11, 12, 13, and 14; Eastern Disposal Areas__ Phase I RI BAT samples were collected above and below the localized clay layer for VOC and metals analysis. No evidence of VOC release was detected in either zone. Samples collected above the clay layer ranged in depth from 82 to 107 feet bls. Samples collected below the clay layer ranged in depth from 132 to 162 feet bls.

Based on the screening assessment of metals, the only metals concentrations that suggest potential impact are the replicated chromium results at WHF-09-WP-01 and WHF-09-WP-01A. Sample WHF-WP-01 contained chromium at 88.5 $\mu g/\ell$. The duplicate contained 42.2 $\mu g/\ell$. Excluding two extreme values, the chromium mean was 23 $\mu g/\ell$ overall at NAS Whiting Field. At sites 9 through 14, chromium ranged from 410 $\mu g/\ell$ to 88.5 $\mu g/\ell$. Zinc was detected in all the BAT groundwater samples at concentrations ranging from 52.4 $\mu g/\ell$ to 281 $\mu g/\ell$. Overall mean zinc concentration installation wide was 123 $\mu g/\ell$. The highest zinc also occurred in one replicate of WHF-09-WP-01. These data do not indicate firm evidence of groundwater impact due to metals releases at any of the six sites.

Based on the above screening data, no evidence of current releases of VOCs or metals exists at Sites 9, 10, 11, 12, 13, and 14. The maximum chromium concentration (at Site 9) exceeds the Florida MCL for chromium. To complete a groundwater evaluation at these sites, confirmatory upgradient samples should be collected from a water table monitoring well and from a well placed in the water table immediately downgradient of sites 9, 10, 11, 13, and 14. These should be sampled for TCL organics and the TAL inorganics. No further groundwater explorations are necessary for Site 12.

__6.5 GROUNDWATER QUALITY STATUS SUMMARY AND CONCLUSIONS__. This section is a summary of the significant findings resulting from the screening groundwater quality program conducted as a component of the NAS Whiting Field Phase I RI and assessment of past investigations. Overall, groundwater contamination resulting from past releases, primarily in the industrial area of the installation, directly or indirectly represents the most significant problem identified at NAS Whiting Field. Based on the Verification Study, the Battery Shop Investigation, and the metals screening program conducted in this RI phase, VOCs appear to be the major contaminants of concern. Additional data are required to confirm this tentative conclusion based on existing identified sources of contamination.

At Site 16, VOC contamination was detected in groundwater 50 feet below the water table surface. At this location, contamination was interpreted to result from a release that had migrated from the northern part of the industrial area in the vicinity of the Site 3 area (Building 2941) or the North Fuel Farm. Benzene was detected at 410 $\mu g/\ell$ and 1,2-DCE at 13 $\mu g/\ell$. Because this location is within 200 feet of the installation boundary, off-installation contaminant migration at benzene concentrations above Florida groundwater standards is likely to occur. Because of the depth of the contamination, underflow of Clear Creek is likely.

On the other hand, floodplain sediment contamination detected in the surface water/sediment program may be due to contaminated groundwater discharge in this flow path. At Site 16, the relationship of the site contamination to the groundwater contamination detected deep within the aquifer must be evaluated. Further environmental investigation of Site 16 is recommended and the potential impact to off-installation potable water supplies downgradient of Site 16 should be investigated.

In the industrial area, additional probable sources of groundwater contamination not highlighted in the IAS or Verification Study may account for the observed pattern of VOC contamination of the upper zone of the sand-and-gravel aquifer. This contamination appears to be drawn downward into the contaminated production wells W-W3 and W-S2 from sources in the Public Works Transportation Area.

Additional potential sources and their significance in the groundwater contamination problem at NAS Whiting Field require source identification, verification, and confirmation to evaluate the full nature and extent of groundwater contamination associated with these potential source areas. The additional potential sources of groundwater contamination requiring further investigation are as follows.

1. The former waste oil tank south of Building 2941 (former AIMD Shop Area) and the Hangar 1424 Aircraft Maintenance Area may be responsible for shallow zone VOC contamination near Site 3 and may possibly be causing groundwater contamination detected 6,500 feet downgradient at Site 16. Further investigation is required to determine the nature and extent of contamination that may be associated with the former waste oil tank and the aircraft maintenance area.

2. At the North Fuel Farm Area, it is unknown whether contamination is due to fuels leaking from the tank farm. This possibility is to be investigated under the UST Program.

3. At the Public Works Department Transportation Area, east of Building 1429, pre-1984 maintenance activities appear to be responsible for groundwater contamination detected in the two production wells (W-W3 and W-S2) and in the production zone of the aquifer downgradient. The full nature and extent of groundwater contamination and verification and identification of residual source locations in the ground vehicle maintenance area are required.

4. Confirmation of the lack of contamination from the BX Service Station and current JP-5 fuel handling facility will be addressed under the UST program.

5. Residual soils contamination at the edges of Building 1451 hardstand, the drainage ditch, and the former waste oil storage tank require investigation. The shallow groundwater zone downgradient of the former tank and storm drainage ditch contains 410 $\mu g/\ell$ TCE. The full nature and extent of contaminated groundwater due to this site should be confirmed.

6. At the South Fuel Farm, high levels of aromatic VOC contamination exist in the aquifer. The flow direction and the nature and extent of contamination at this site will be addressed under the UST program.

7. The contamination status of soils and groundwater due to the underground waste oil tank at Building 1406, Helicopter Maintenance Shop, has not been investigated. The contamination status of soil and groundwater should be evaluated at this location.

8. The contamination status of soils and groundwater due to the underground waste oil tanks at Building 1404, Auto Hobby Shop, has not been investigated. The contamination status of soil and groundwater should be evaluated at this location.

A limited investigation should be conducted at the open disposal sites and landfills at the sites located along the eastern boundary of NAS Whiting Field (Sites 9, 10, 11, 12, 13, and 14) and the Northwest (Sites 1, 2, 17, and 18) to support no-action or monitoring-only decisions. A minimum number of soil borings and monitoring wells are recommended to rule out the presence of groundwater contamination associated with these sites.

7.0 SITE-SPECIFIC PHASE II-A RI ACTIVITIES

The following sections present descriptions of the RI Phase II-A field investigations and sampling and analysis plans scheduled for Sites 1, 3, 5, 6, 9, 10, 11, 13, 14, 15, 16, 17, 18, 29, 30, 31, 32, and 33. Sites 29 through 33 were identified after the completion of the Phase I field investigation and subsequently added to the Phase II-A program for assessment of contamination. No further action is proposed for Sites 2 and 12; therefore, no field activities are scheduled at these two sites during the Phase II-A field investigation. ABB-ES will prepare 'No Action Decision Documents' for Sites 2 and 12 at a future date. The documents will provide the rationale to support the no further action decision based on results of previous investigations at both sites.

Based on the results of the RI Phase I field investigations, recommendations for additional investigation were made in Technical Memoranda No. 3, 4, and 5 to adequately characterize the nature and extent of contamination at the sites listed above.

The RI Phase II-A exploration program activities include: terrain conductivity electromagnetic (EM) and ground penetrating radar (GPR) geophysical surveys; soil gas surveys; monitoring well installation; soil borings; test pits; sampling of subsurface and surface soil, surface water, sediment and groundwater; location surveys; and ecological and public health surveys. A summary of the RI Phase II-A activities is presented in Table 7-1. Procedures for proposed RI Phase II-A field explorations, including sampling and analysis, are found in Volumes I and II of the RI Phase I Workplan (Jordan, 1990).

Five of these activities, EM and GPR geophysical surveys, soil gas surveys, test pitting, ecological characterization, and public health survey were not conducted during the Phase I RI field program and details of the specific procedures for each of these activities are presented in the following paragraphs. In addition, modifications to the monitoring well installation program and investigation derived waste disposal have been made and are also addressed in this section.

<u>EM and GPR Geophysical Program</u>. Geophysical investigations at Whiting Field may include terrain conductivity (EM) and GPR surveys. In addition, a metal detector will be used before drilling at selected sites to screen for possible underground utility lines, fuel distribution lines, or other obstructions that could interfere with the completion of subsurface explorations and to prevent damage to underground equipment. Geophysical investigations will be conducted in accordance with Level I DQOs.

Terrain conductivity refers to the relative ability of the earth to conduct electricity. Terrain conductivity can be measured using electromagnetic ground conductivity meters. As some types of leachate can alter the electrical properties of soil pore waters and groundwater, this technique can be useful in tracing ionic fractions of leachate plumes. In addition (by measuring the in-phase response) the instruments can detect buried metallic objects and can profile some changes in soil composition. These features can provide data for determining the limits of waste disposal areas or landfills. Both the magnetometry and terrain conductivity instruments are sensitive to metal objects; therefore, onsite fences, pipes, and power lines may cause interference. For

Table 7-1
Remedial Investigation (RI) Phase II-A Exploration Program

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	EM/GPR (acres)	Soil Gas (points)	Monitoring Wells	Soil Borings	Test Pits	Subsurface Soil Samples	Surface Soil Samples	Surface Water and Sediment Samples	Groundwater Samples
Background soil	--	--	--	--	--	--	10	--	--
Background groundwater	--	--	3	--	--	--	--	--	3
Clear Creek (surface water and sediment)	--	--	--	--	--	--	--	11	--
PCPT/BAT	--	--	--	--	--	--	--	--	14
1	5	--	1	--	3	5	3	--	2
3 and 32	--	120	17	20	--	100	--	--	20
5, 6, and 33	--	50	16	8	--	45	--	--	17
9	--	--	1	--	--	--	--	--	3
10	4	--	1	--	5	3	5	--	2
11	3	--	1	--	3	3	5	--	3
13	4	--	1	--	5	5	5	--	2
14	3	--	1	--	--	--	5	--	2
15	15	--	10	--	10	5	3	--	11
16	10	--	9	--	10	5	3	--	11
17	--	--	1	10	--	34	36	--	2
18	--	--	1	12	--	42	52	--	2

See notes at end of table.

Table 7-1 (Continued)
Remedial Investigation (RI) Phase II-A Exploration Program

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	EM/GPR (acres)	Soil Gas (points)	Monitoring Wells	Soil Borings	Test Pits	Subsurface Soil Samples	Surface Soil Samples	Surface Water and Sediment Samples	Groundwater Samples
29 and 30	--	50	10	8	--	46	--	--	10
31	--	--	--	--	--	8	16	--	--
Total Installation	44	220	73	58	36	301	143	11	104

Notes: EM/GPR = electromagnetic/ground penetrating radar.
-- = sample collection not scheduled.
PCPT/BAT = piezocone penetrometer test/Bengt-Arne-Torstensson.

areas where interferences may occur, GPR may be used to define potential waste disposal areas and buried objects.

Typical applications for GPR include delineating the boundaries of buried hazardous waste materials and the perimeters of abandoned landfills, finding steel reinforcement bars and voids in concrete structures, recording the depth of geological interfaces and bedrock, and locating and mapping buried utilities. Applications at NAS Whiting Field will be mainly delineation of landfill perimeters.

The GPR technique uses high frequency radio waves to determine the presence of subsurface objects and structures. Energy is radiated downward into the subsurface from an antenna that is pulled slowly across the ground at speeds varying from about 0.25 to 5 miles per hour (mph), depending upon the amount of detail desired and the nature of the target. The radio wave energy is reflected from surfaces where there is a contrast in the electrical properties of subsurface materials. These surfaces may also be naturally occurring geologic horizons (soil layers, changes in moisture content, voids and fractures in bedrock) or manmade (buried utilities, tanks, drums, etc.). The reflected energy is processed and displayed as a continuous strip chart recording distance versus time (where time can be thought of as proportional to depth). The depth of penetration of a GPR system is highly site specific, and depends, among other factors, on (1) the soil types at the site (clean sands are best), (2) moisture conditions (dry is best), and (3) the frequency of the antenna (the lower the frequency, the deeper the penetration, and the less the resolution capability).

The radar system consists of a control unit, an antenna assembly (transmitter and receiver), and a recording device for analog field recordings. A tape recording unit may also be present for further data processing after field activities are completed. The antenna transmits electromagnetic pulses of short duration into the ground. The pulses are reflected from geologic or man-made surfaces and are picked up by the receiver, which transmits the signals to the control unit for processing and analog display. Shallow objects appear near the top of the strip chart recording (less time elapsed between the outgoing pulse and the return of reflected energy), whereas deeper objects appear further down the recording (more time elapsed).

<u>Soil Gas Survey</u>. Soil gas surveys can be used to identify the areal extent of waste deposition and to define areas of subsurface exploration and sample collection. Sample gas analysis can be performed using different methodologies, each with unique DQOs. The method that will be used during the RI will be the Petrex™ passive soil gas technique. With this technique carbon coated Nichrome wire collectors are left in place for 7 to 12 days (depending on soil gas flux). The collectors are retrieved and absorbed chemicals are analyzed by gas chromatograph/mass spectroscopy (GC/MS) (Level III DQOs). Standard operating procedures for the Petrex passive soil gas technique are presented in Appendix A.

<u>Test Pits</u>. Test pits or trenches may be excavated at sites selected after geophysical screening to locate potentially hazardous objects (i.e., buried drums), to examine subsurface conditions, and to assess the vertical and horizontal distribution of shallow soil contamination (i.e., at depths of approximately 0 to 12 feet). A backhoe will be used to excavate the test pits and trenches.

Soils, stratigraphy, perched groundwater conditions, and evidence of contamination will be logged by ABB-ES personnel. Excavated soil will be backfilled in the excavation area. Analytical soil samples will be selected based on field monitoring results (i.e., elevated photoionization detector [PID] readings) and visual indications of contamination.

Ecological Survey. The ecological survey will consist of an informal visual identification of terrestrial vegetation cover types (e.g., herbaceous plants, emergents, shrubs, and trees) and terrestrial wildlife (e.g., mammals, reptiles, amphibians, and birds). Local wildlife officials may also be contacted to determine terrestrial species reported to be in the area or reported to inhabit the types of vegetative cover identified. Additional information may be collected for use in wetlands and floodplains assessments, including identification of soil types and wetland vegetation. Data will be compiled in a species list of representative flora and fauna, separated by community type found on each site.

According to the preamble of the NCP (40 CFR, Part 300), CERCLA actions will consider Federal environmental standards such as the Floodplains Management Executive Order (EO) 11990; the Clean Water Act (CWA) Section 404(b)(1) Guidelines; and the Office of Emergency and Remedial Response *Policy on Floodplains and Wetlands Assessments for Superfund Sites* (USEPA, 1985). To evaluate the impact of remedial alternatives on wetlands and floodplains, it may be necessary to first identify the location of floodplains and wetlands and then determine wetland functional attributes.

Wetlands and floodplains may be identified using information collected during the ecological survey and a review of available wetland and floodplain mapping of the area. Floodplain Insurance Rate Maps (FIRMs) prepared by the Federal Emergency Management Agency (FEMA) will be used to evaluate the 100-year floodplain boundaries. If available, wetlands will be identified using U.S. Fish and Wildlife Survey wetland inventory maps and onsite inspection. Wetland functional attributes may be identified based on a qualitative evaluation of the ecological survey information and hydrogeology of the area.

Public Health Survey. A public health survey consisting of an area reconnaissance, interviews, and records search will be conducted by an ABB-ES Public Health Risk Assessment specialist. The survey will be conducted to examine on-base and off-base communities, activities, and drinking water sources.

A survey of water-supply wells in the vicinity of NAS Whiting Field will be conducted to identify wells within a 4-mile radius of the installation to list their uses (domestic, public water supply, industrial-commercial, or other), and to state available information from well completion records, utility companies, or similar sources. These data, along with available data concerning the location of the water supply wells, the construction details of these wells, and the approximate production rate for each well, will be completed.

In addition, data concerning land use and land cover on and adjacent to NAS Whiting Field will be collected and presented in a area map. Information gathered will be used to develop potential exposure pathways to be evaluated in the Baseline Risk Assessment and the transport and fate analysis.

Monitoring Well Installation. Groundwater monitoring wells will be installed to provide groundwater samples in accordance with Level III (10 percent Level IV) DQOs for laboratory analysis to monitor groundwater elevations, evaluate horizontal and vertical gradients, and determine aquifer characteristics. The monitoring well depths and screened intervals will depend on site-specific data objectives.

Monitoring wells will be constructed of 2-inch inside-diameter (ID), Schedule 40, flush-threaded, PVC screen and riser. Five-, 10-, and 15-foot well screens with 0.01-inch slotting will be used to construct all wells. Monitoring wells will be constructed and installed in accordance with SOUTHNAVFACENGCOM *Guidelines For Groundwater Monitoring Well Installation*. The annulus or annular space around all well screens will be backfilled with a 20/30 grade clean silica sand from a minimum of 2 feet below the bottom of the well screen to 3 feet above the top of the screen. A minimum 2-foot bentonite pellet or slurry seal will be installed above the sandpack. A cement-bentonite grout will be tremie grouted from the bentonite seal to within 2 feet of the ground surface. The well will be developed prior to sampling (after a minimum of 24 hours grout set time) to remove fines, improve the hydraulic connection with natural soils, and to obtain a representative sample.

Double-cased wells will be installed at sites underlain by a confining to semi-confining clay unit unless the well is designated an upgradient background well. The installation of a double-cased well shall require the placement of a 6-inch ID, flush-threaded, Schedule 40 PVC outer casing at least 2 feet into the confining unit. Under no circumstance will the outer casing breach the confining unit. The annular space surrounding the casing shall be tremie grouted to the surface. Additional well construction details with associated diagrams can be found in Volume II of the Phase I RI Workplan (Jordan, 1990).

Monitoring wells will be developed using a gasoline-powered centrifugal pump, a submersible pump, or both. No air or water will be injected into the wells during development. Wells will generally be purged of at least three well volumes, until the water is clear and free of silts, and/or until field measurements of pH, temperature, and conductivity have stabilized.

Monitoring wells will either be flush-mounted with a protective steel casing installed at the ground surface or will be constructed with aboveground protective casings to protect the well riser. Aboveground wells in high traffic areas will be surrounded by four protective steel posts. Protective steel casings will be equipped with locking covers. A cement seal and cement pad will be placed from the top of the grout to the ground surface around each protective casing to secure the casing, and to direct runoff away from the casing. The aboveground parts of both the well riser and protective casing will be vented. Two weep holes will be drilled into the bottom of the protective casing near ground level to allow water to drain from inside the casing. Wells will be permanently and properly identified as specified in SOUTHNAVFACENGCOM guidance.

Control and Disposal of Investigation-Derived Wastes. Disposal of investigation-derived wastes (IDW) will follow the procedures outlined in Volume I and II of the Phase I RI Workplan (Jordan, 1990). Modifications to the Phase I waste management plan to be followed during the Phase II-A field program are described in the following paragraphs.

Purge and development water will be pumped from the wells into 55-gallon drums. The drums will be transported and emptied into a second 10,000-gallon tanker truck (to be used for purge and development water only). Once the tanker is full, a water sample will be collected by the activity and analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL inorganics, and total cyanides (Level V DQOs). If the laboratory results indicate contaminants are below the RCRA hazardous waste criteria, the wastewater will be transported to the NAS Whiting Field wastewater treatment plant for disposal. If contaminants in the purge and development water exceeds RCRA criteria, the water will be classified as a hazardous waste and the activity (NAS Whiting Field) will be responsible for appropriate disposal.

Soil cuttings from soil borings will be piled into two separate piles (one for unsaturated soils and one for saturated soils) on plastic sheeting at a designated area and covered. At the end of the drilling program, one sample will be collected by the activity from each soil pile and analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL inorganics, and total cyanides (Level V DQOs). If the laboratory results indicate contaminants are below the RCRA hazardous waste criteria, the soils will be spread onsite. If the laboratory analytical results indicate contaminants exceed RCRA hazardous waste criteria, the soils will be classified as a hazardous waste and the activity will be responsible for appropriate disposal.

Any drummed materials left by field personnel at the site will become the property of NAS Whiting Field. ABB-ES will maintain a log of the drums and will clearly identify the containers using weather-resistant labels. The labels will indicate the drum contents, site and sample location number, date filled, and corresponding log entry number. NAS Whiting Field will take responsibility for the drums and their contents.

The materials will be handled, transported, and disposed according to Applicable or Relevant and Appropriate Requirements (ARARs) for IDW. The ARARs may include RCRA, the CWA, the Toxic Substances Control Act (TSCA), and/or any other existing State regulations. Non-hazardous (non-contaminated) materials will be returned to the site from which they originated and disposed onsite or in a Whiting Field dumpster, as appropriate.

The following sections describe the site-specific field investigation activities that will be performed at each of the individual sites and AOCs. Tables summarizing the field investigation activities and a site map are included in each discussion.

7.1 PROPOSED INSTALLATION-WIDE PHASE II-A RI ACTIVITIES. This section presents field explorations that will be conducted during Phase II-A RI and are not associated with any identified site or AOC. The explorations include: background surface soil sample collection, surface water and sediment sampling of Clear Creek, background upgradient monitoring well installation, and PCPT explorations and BAT groundwater sampling.

Background Surface Soil Sample Collection. A total of 10 background surface soil samples will be collected (0 to 2 feet bls) to provide background concentrations of inorganics, PAHs, and pesticides and PCBs in surface soils at NAS Whiting Field. The samples will be collected from each of the three primary soil groups

(Lakeland sand, Orangeburg sandy loam, and Tifton loamy sand) to characterize background concentrations for each of the soil groups in which sites are located. Three samples will be collected from the Lakeland sand (characteristic of sites 16 and 18), three samples will be collected from the Orangeburg sandy loam (characteristic of site 17), and four samples from the Tifton loamy sand (characteristic of sites 1, 9, 10, 11, 12, 13, 15, and 16). These should be located in areas remote from the past activities. Figure 7-1 presents the proposed background surface soil sampling locations.

Background surface soil samples will be analyzed for TCL pesticides and PCBs, PAHs, and TAL inorganics in accordance with USEPA Level III with 10 percent Level IV DQOs. All samples will be collected following procedures outlined in Section 6.6.4 of the QAPP, Volume II of the Phase I RI Workplan (Jordan, 1990). Site-specific surface and subsurface soil sampling is discussed in the following sections.

Surface Water and Sediment Sampling of Clear Creek. To evaluate the nature and extent of contamination in the floodplain and its potential for migration to Clear Creek, 11 surface water and sediment samples will be collected along Clear Creek. Sample locations are shown in Figure 7-2. Because no environmental contamination was detected in Big Coldwater Creek, no surface water or sediment samples will be collected during the Phase II-A RI investigation. All samples collected along Clear Creek will be analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL metals, and total cyanide (Level III DQOs with 10 percent Level IV DQOs). Samples will be collected in accordance with procedures discussed in Sections 6.7.3 and 6.6.5 of the QAPP, Volume II of the Jordan Workplan. A discussion concerning the specific rationale for each proposed sample location is presented in Table 7-2.

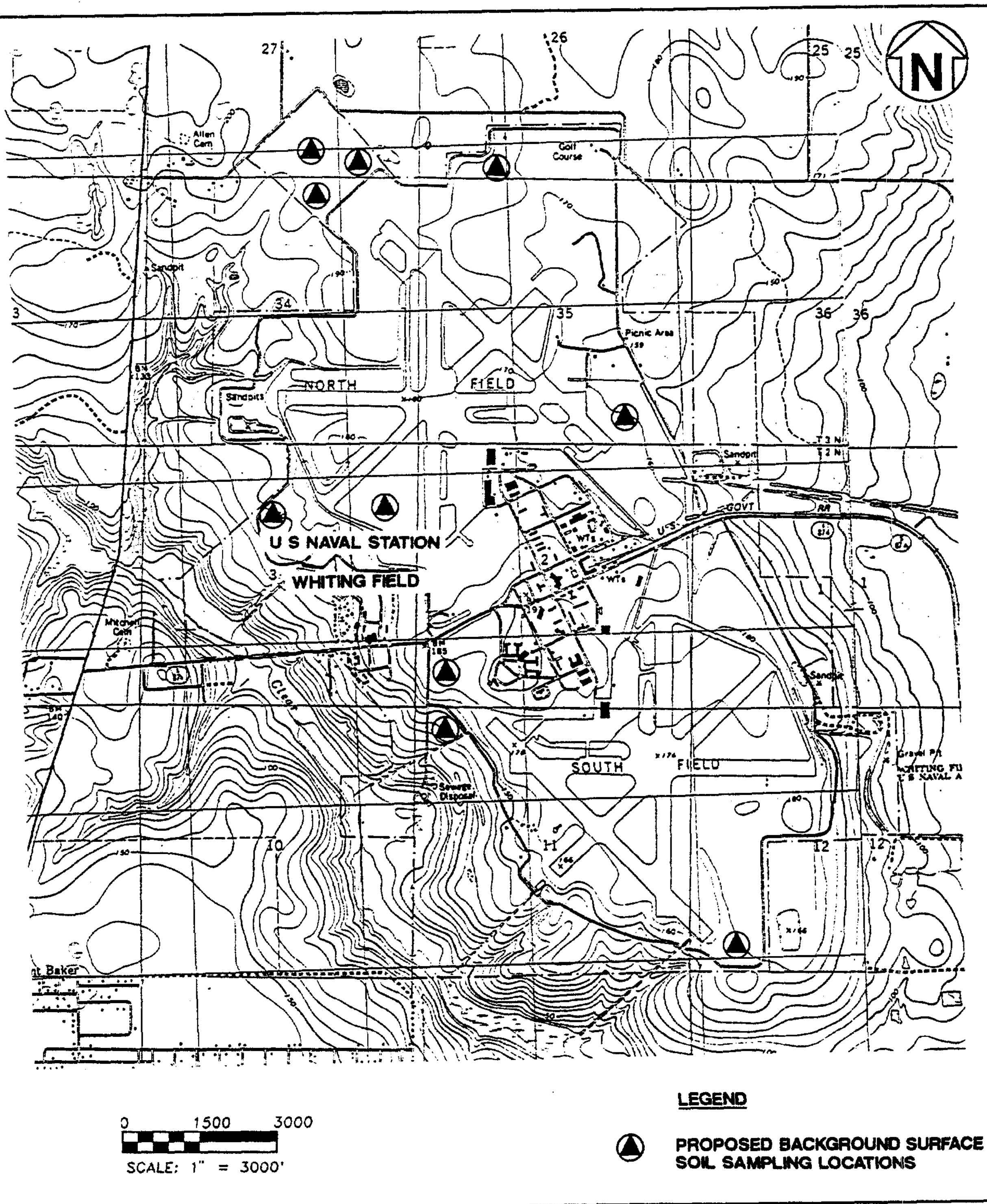
Background Monitoring Wells. Three monitoring wells will be installed upgradient of all the sites in the northern part of NAS Whiting Field to provide upgradient background groundwater quality data for comparison to source area groundwater quality. Proposed locations of the background monitoring wells are shown in Figure 7-3.

Groundwater samples will be collected from the three wells and analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL metals and total cyanide (Level III and Level IV DQOs). Samples will be collected in accordance with procedures discussed in Section 6.7.2 of the QAPP, Volume II of the Phase I RI Workplan (Jordan, 1990).

PCPT Explorations and BAT Groundwater Sampling. Seven PCPT explorations will be conducted between the industrial area and Sites 15 and 16 to define the stratigraphy and determine shallow and deep BAT groundwater sampling depths at each location. PCPT and BAT locations are also presented in Figure 7-3.

A total of 14 groundwater samples will be collected and analyzed for TCL VOCs (Level II DQO) to determine whether observed contamination is migrating from the industrial area toward Clear Creek and Sites 15 and 16.

PCPT and BAT exploration and sampling procedures are detailed in Section 5.3.1.3 of Volume I of the RI Workplan (Jordan, 1990). Site-specific groundwater investigations are discussed in Section 7.0 of this memorandum.



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▲ PROPOSED BACKGROUND SURFACE SOIL SAMPLING LOCATIONS

FIGURE 7-1
PROPOSED PHASE II-A BACKGROUND SURFACE SOIL SAMPLING LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

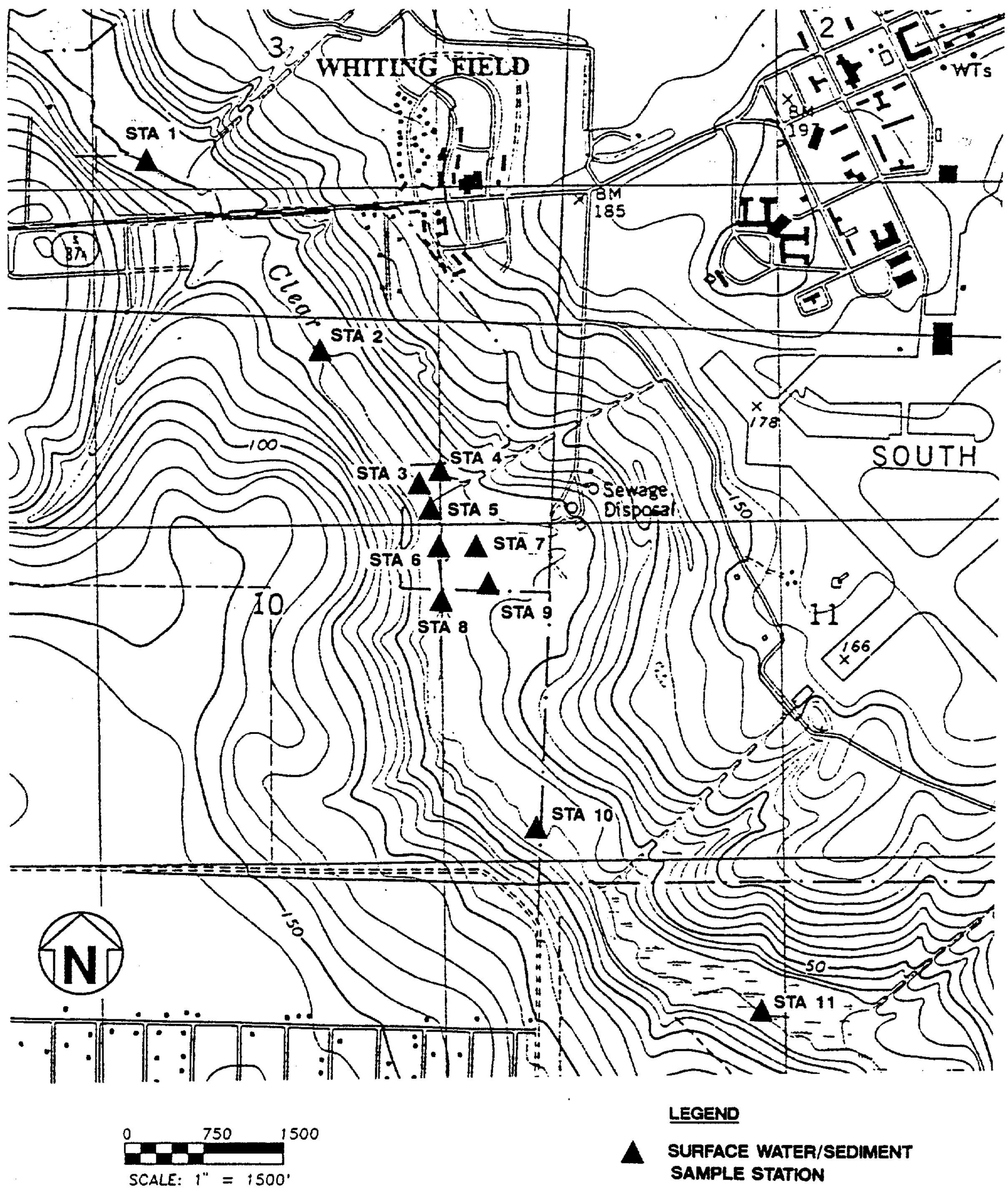


FIGURE 7-2
PROPOSED PHASE II-A SURFACE WATER & SEDIMENT SAMPLING LOCATIONS

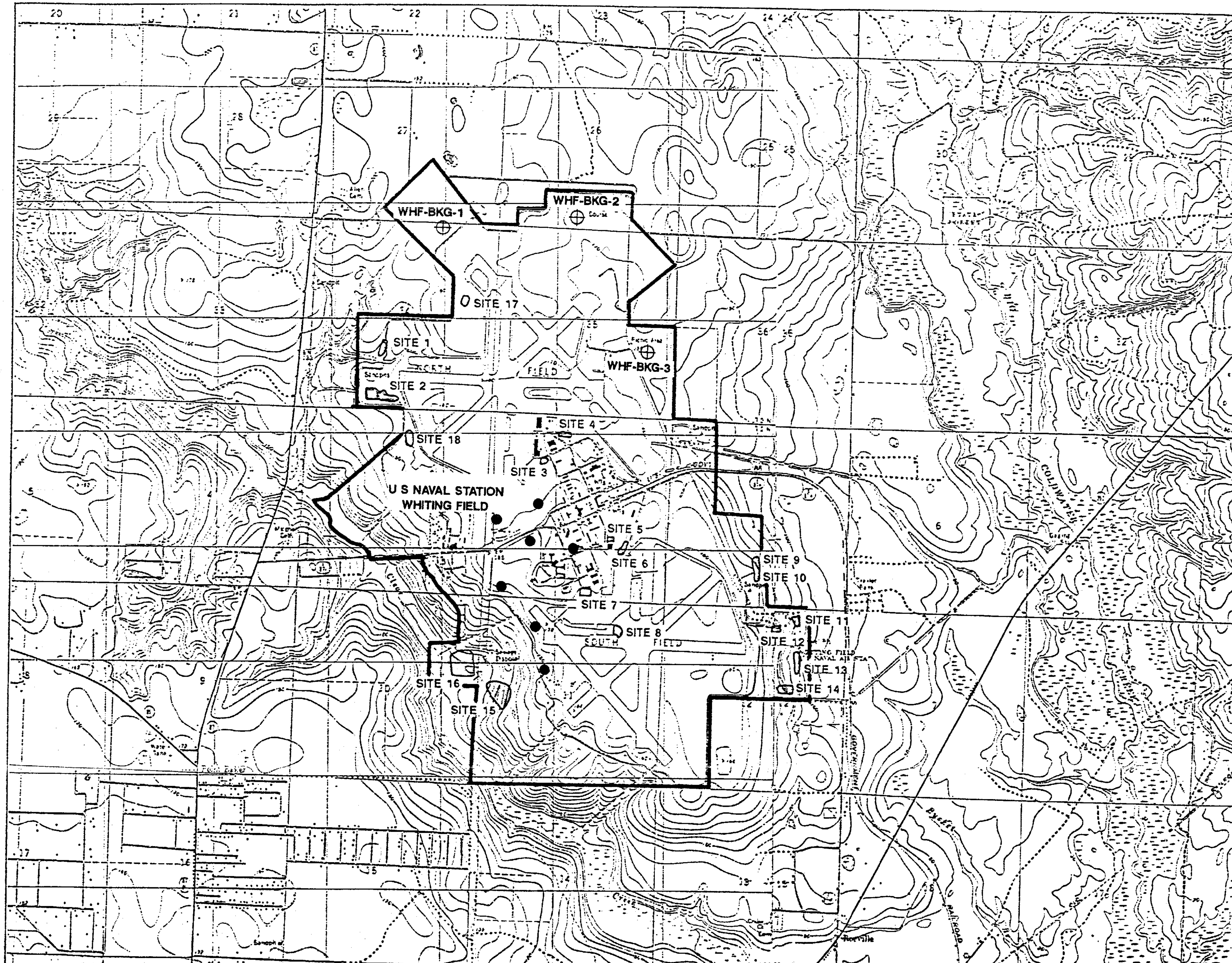
RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

Table 7-2
Rationale for Surface Water and Sediment Sampling Locations

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Station No.	Rationale
1	Characterize upstream surface water and sediment quality in Clear Creek.
2	Characterize the nature of contamination downstream of the drainage ditch discharge from the northwest part of the installation.
3	Characterize the nature of surface water and sediment contamination downgradient of the industrial area.
4	Evaluate degree of floodplain surface water and sediment contamination downgradient of the industrial area.
5	Evaluate degree of surface water and sediment contamination at the drainage culvert discharge.
6	Characterize the nature of surface water and sediment contamination downgradient of Site 16.
7	Characterize the nature of floodplain surface water and sediment contamination downgradient of Site 16.
8	Characterize the nature of surface water and sediment contamination downgradient of Site 15.
9	Characterize the nature of floodplain surface water and sediment contamination downgradient of Site 15.
10	Characterize the nature and extent of downstream contamination.
11	Characterize the nature and extent of downstream contamination below the south field drainage culvert discharge.



LEGEND

⊕ PROPOSED BACKGROUND MONITORING WELL LOCATION

● PROPOSED PCPT EXPLORATION AND BAT GROUNDWATER SAMPLE LOCATION

SCALE IN FEET

0 3000 6000

SOURCE:
USGS QUADRANGLE MILTON NORTH, FLORIDA
PHOTOREVISED 1987
AND USGS QUADRANGLE HAROLD, FLORIDA 1973.

FIGURE 7-3
PROPOSED PHASE II-A
BACKGROUND MONITORING WELL
& PCPT/BAT EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

00229I16Z

7.2 SITE 1, NORTHWEST DISPOSAL AREA. The RI Phase II-A exploration program at Site 1 will consist of the following activities.

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling and analysis,
- soil borings,
- test pitting, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A along with supporting rationale for each activity is presented in Table 7-3. Figure 7-4 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-3
RI Phase II-A Rationale for Explorations at Site 1

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	5 Acres	Define trenches, site boundaries, and locate buried objects.
Test pitting	3	Identify buried objects from the EM and GPR survey and define wastes associated with the site.
Subsurface soil sampling	5	Characterize the nature and extent of subsurface soil contamination.
Surface soil sampling	3	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	1	Characterize the nature and extent of downgradient groundwater contamination and provide groundwater flow information.
Monitoring well sampling	2	Characterize the nature of downgradient groundwater contamination.

Note: EM and GPR = electromagnetic and ground penetrating radar.

The geophysical survey at Site 1 will be performed using terrain conductivity (EM-31) and ground penetrating radar (GPR) techniques. The survey will be conducted to define trench and disposal area boundaries and to locate buried wastes. Transect lines across the site area will be spaced 50 feet apart with data collected every 50 feet. Areas where subsurface objects appear to be present will be staked and flagged for excavation during the test pitting task.

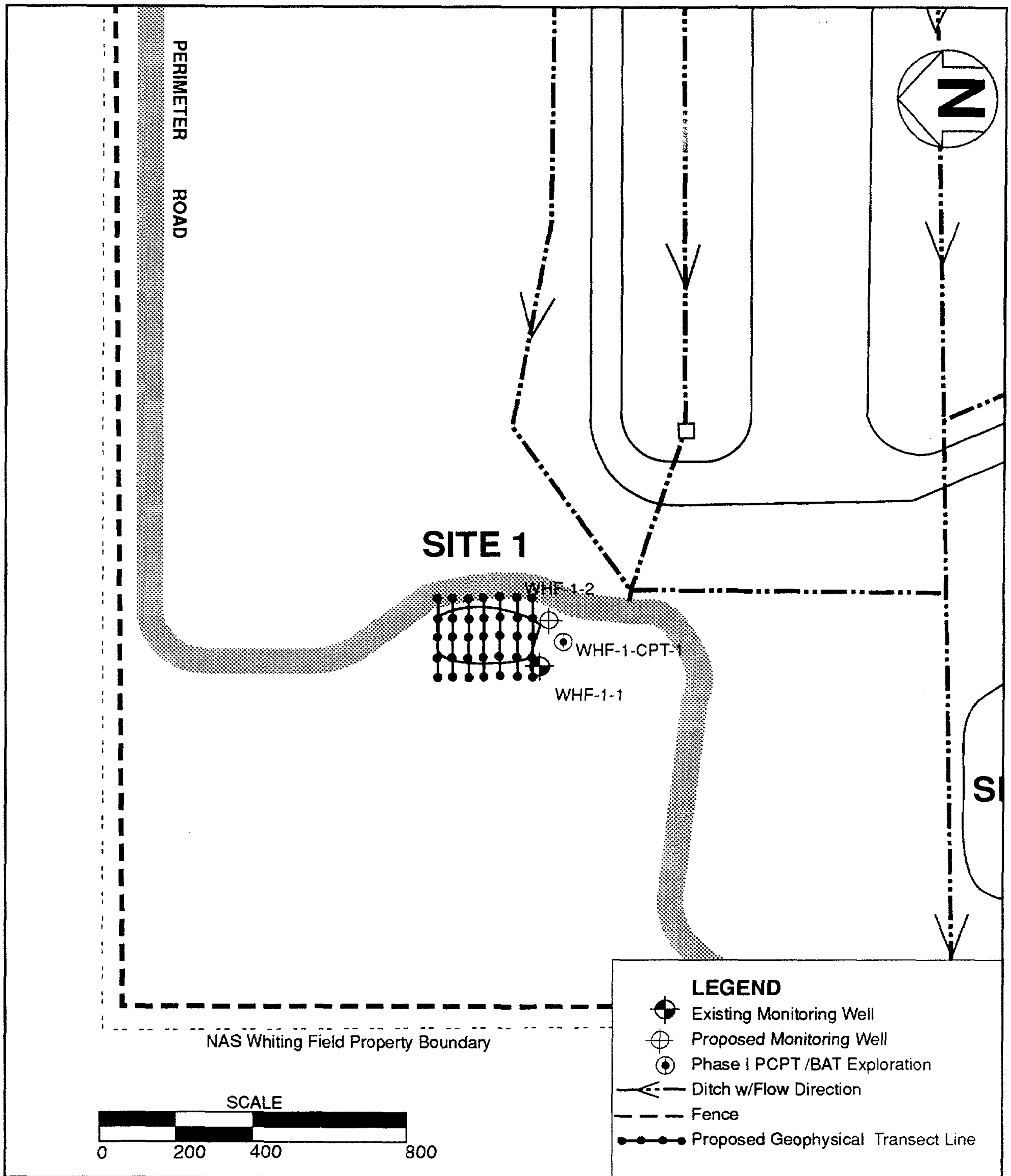


FIGURE 7-4
SITE 1
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

Table 7-4
Monitoring Well Installation Details

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	Well Number	Total Depth (feet bls)	Screened Interval (feet bls)
Background	WHF-BKG-1	120	105 to 120
	WHF-BKG-2	120	105 to 120
	WHF-BKG-3	120	105 to 120
1	WHF-1-2	75	60 to 75
3	WHF-3-1S	115	100 to 115
	WHF-3-1D	180	175 to 180
	WHF-3-2S	115	100 to 115
	WHF-3-2D	180	175 to 180
	WHF-3-3S	115	100 to 115
	WHF-3-3D	180	175 to 180
	WHF-3-4S	115	100 to 115
	WHF-3-5S	115	100 to 115
	WHF-3-6S	115	100 to 115
	WHF-3-7S	115	100 to 115
	WHF-3-7I	150	145 to 150
	WHF-3-7D	180	175 to 180
5	WHF-5-OW-2A	130	115 to 130
	WHF-5-8S	130	115 to 130
	WHF-5-8D	180	175 to 180
	WHF-5-9S	130	115 to 130
	WHF-5-9D	180	175 to 180
	WHF-5-10S	130	115 to 130
	WHF-5-10D	180	175 to 180
6	WHF-6-1S	130	115 to 130
	WHF-6-1D	180	175 to 180
	WHF-6-2S	130	115 to 130
	WHF-6-3S	130	115 to 130
9	WHF-9-3	105	90 to 105
10	WHF-10-2	95	80 to 95
11	WHF-11-3	70	55 to 70
13	WHF-13-2	59	44 to 59
14	WHF-14-2	95	80 to 95

Note: bls = below land surface.

Table 7-4 (Continued)
Monitoring Well Installation Details

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	Well Number	Total Depth (feet bls)	Screened Interval (feet bls)
15	WHF-15-2S	30	20 to 30
	WHF-15-2I	60	55 to 60
	WHF-15-3S	50	40 to 50
	WHF-15-3I	80	75 to 80
	WHF-15-3D	120	115 to 120
	WHF-15-4S	90	80 to 90
	WHF-15-5S	50	40 to 50
	WHF-15-6S	40	30 to 40
	WHF-15-6I	70	65 to 70
	WHF-15-6D	120	115 to 120
16	WHF-16-2I	140	125 to 140
	WHF-16-2D	170	160 to 170
	WHF-16-3S	23	18 to 23
	WHF-16-3I	50	40 to 50
	WHF-16-3II	80	75 to 80
	WHF-16-3D	120	115 to 120
	WHF-16-4S	40	25 to 40
	WHF-16-4I	95	85 to 95
	WHF-16-4D	120	115 to 120
17	WHF-17-2	120	115 to 120
18	WHF-18-2	101	86 to 101
29	WHF-29-1	140	125 to 140
	WHF-29-2	140	125 to 140
	WHF-29-3	140	125 to 140
	WHF-29-4	140	125 to 140
	WHF-29-5	140	125 to 140
30	WHF-30-1	140	125 to 140
	WHF-30-2	140	125 to 140
	WHF-30-3	140	125 to 140
	WHF-30-4	140	125 to 140
	WHF-30-5	140	125 to 140

Note: bls = below land surface.

Table 7-4 (Continued)
Monitoring Well Installation Details

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	Well Number	Total Depth (feet bls)	Screened Interval (feet bls)
32	WHF-32-1	120	105 to 120
	WHF-32-2	120	105 to 120
	WHF-32-3	120	105 to 120
	WHF-32-4	120	105 to 120
	WHF-32-5	120	105 to 120
		120	105 to 120
33	WHF-33-1	130	115 to 130
	WHF-33-2	130	115 to 130
	WHF-33-3	130	115 to 130
	WHF-33-4	130	115 to 130
	WHF-33-5	130	115 to 130
		130	115 to 130

Note: bls = below land surface.

A total of three test pits will be dug at locations where buried objects appear to be present based on the results of the geophysical survey. Test pits will be dug with a backhoe to approximately 10 feet bls. As many as five subsurface soil samples will be collected for analysis from areas in the test pits that visually appear to be contaminated and/or elevated organic vapor concentrations are detected by an OVA.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Levels III and IV DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.3 SITE 3, UNDERGROUND WASTE SOLVENT STORAGE AREA, AND SITE 32, NORTH FIELD MAINTENANCE HANGAR AREA. The RI Phase II-A exploration program at Sites 3 and 32 will consist of the following activities:

- soil gas survey,
- monitoring well installation,
- groundwater sampling and analysis,
- soil borings, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-6. Figure 7-5 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

The soil gas survey at Site 3 will consist of the collection of about 120 soil gas samples on 50-foot centers. The survey will include areas along the edge of the tarmac west of building 2941, along the north and east side of Building 2941, and northeast of Building 2941 in the vicinity of the abandoned underground waste oil and kerosene tanks. Details of the soil gas collection procedures can be found in Appendix A.

Positive soil gas results will be confirmed by a maximum of 10 soil borings with soil sampling and analysis. Three of the 10 borings will be drilled to 50 feet bls or 10 feet beyond the deepest contamination in the areas with the highest degree of soil gas contamination. The remaining seven soil borings will be drilled to 10 feet bls in areas with less soil gas contamination. Split-spoon samples will be collected at 5-foot intervals from all borings for OVA headspace analysis. Based upon OVA readings and visual inspection for contamination, as many as seven subsurface soil samples from each of the 50-foot borings and three samples from each of the 10-foot borings will be collected for laboratory analysis.

In addition, 10 soil borings will be drilled to evaluate potential source area contamination at the three kerosene and waste oil tanks at the north field maintenance hangar (one boring to the water table and three to 10 feet beyond the deepest contamination), the waste oil tank at Site 3 (one boring to the water table and three to 10 feet beyond the deepest contamination), the paint thinner

Table 7-5
Summary of Sampling and Analysis

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	Type	TCL VOC GC/MS	TCL SVOC GC/MS	TCL Pest/PCBs	PAH HPLC	TAL Metals	Total Cyanide	TCLP	Petroleum Hydrocarbons	TOC
Background	SO	--	--	12	12	12	12	--	--	--
	GW	3	3	3	--	3	3	--	--	--
Clear Creek	SW	11	11	11	--	11	11	--	--	--
	SD	11	11	11	--	11	11	--	--	--
PCPT/BAT	GW	14	--	--	--	--	--	--	--	--
1	SO	8	8	8	--	8	8	--	--	--
	GW	2	2	2	--	2	2	--	--	--
9	GW	3	3	3	--	3	3	--	--	--
10	SO	8	8	8	--	8	8	--	--	--
	GW	2	2	2		2	2	--	--	--
11	SO	8	8	8	--	8	8	--	--	--
	GW	3	3	3		3	3	--	--	--
13	SO	10	10	10	--	10	10	--	--	--
	GW	2	2	2	--	2	2	--	--	--
14	SO	5	5	5	--	5	5	--	--	--
	GW	2	2	2	--	2	2	--	--	--
15	SO	8	8	8	--	8	8	--	--	--
	GW	11	11	11	--	11	11	--	--	--
16	SO	8	8	8	--	8	8	--	--	--
	GW	11	11	11	--	11	11	--	--	--
17	SO	70	70	40	--	70	70	9	70	--
	GW	2	2	2	--	2	2	--	--	--
18	SO	94	94	50	--	94	94	11	94	--
	GW	2	2	2	--	2	2	--	--	--

See notes at end of table.

Table 7-5 (Continued)
Summary of Sampling and Analysis

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Site	Type	TCL VOC GC/MS	TCL SVOC GC/MS	TCL Pest/PCBs	PAH HPLC	TAL Metals	Total Cyanide	TCLP	Petroleum Hydrocarbons	TOC
3 and 32	SO	101	101	101	--	101	101	20	101	20
	GW	20	20	20	--	20	20	--	--	--
5, 6 and 23	SO	45	45	45	--	45	45	8	45	8
	GW	17	17	17	--	17	17	--	--	--
29 and 30	SO	23	23	23	--	23	23	4	23	4
	GW	10	10	10		10	10	--	--	--
31	SO	24	24	24	--	24	24	--	--	--
Total Installation	SO	412	412	350	12	424	424	52	333	31
	GW	104	90	90	--	90	90	--	--	--
	SW	11	11	11	--	11	11	--	--	--
	SD	11	11	11	--	11	11	--	--	--

Notes: TCL = target compound list.
VOC = volatile organic compounds.
GC/MS = gas chromatograph/mass spectrometer.
SVOC = semivolatile organic compounds.
Pest/PCB = pesticides and polychlorinated biphenyls.
PAH = polynuclear aromatic hydrocarbons.
HPLC = high performance liquid chromatography.
TAL = target analyte list.
TCLP = Toxicity Characteristic Leaching Procedure.
TOC = total organic carbon.
SO = soil.
-- = sample collection not scheduled.
GW = groundwater.
SD = sediment.
PCPT/BAT = piezocone penetrometer test/Bengt-Arne-Torstensson.

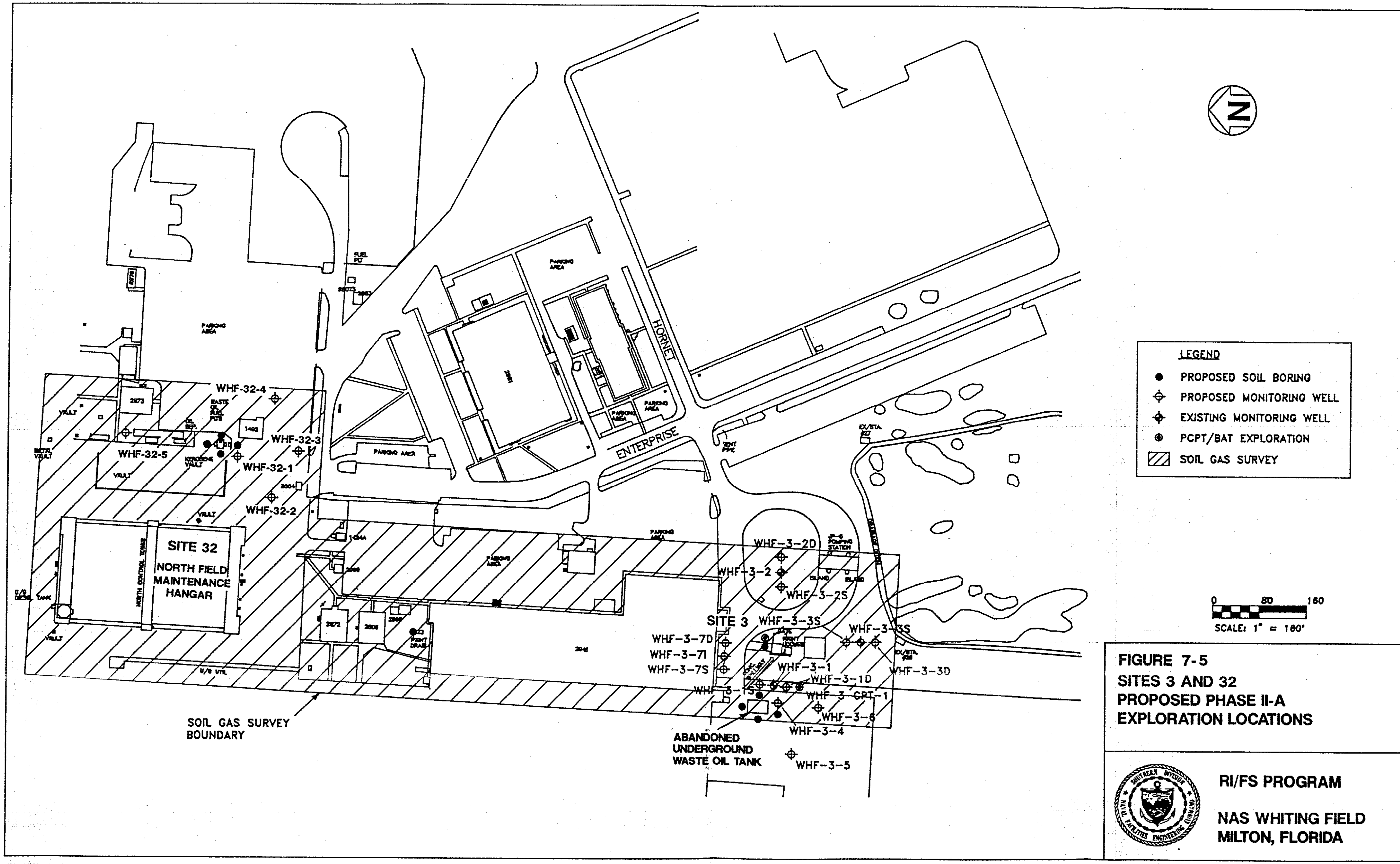


FIGURE 7-5
SITES 3 AND 32
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

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waste tank (one boring to the water table), and the storm sewer north of Building 2941 (one boring to bottom of storm sewer). Split-spoon samples will be collected from all borings for OVA headspace analysis. As many as eight subsurface soil samples will be collected from the water table borings and as many as five samples will be collected from the remaining borings for laboratory analysis.

Table 7-6
RI Phase II-A Rationale for RI Explorations at Sites 3 and 32

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Subsurface soil sampling	100	Characterize the nature and vertical extent of subsurface soil contamination associated with the waste oil, paint thinner, and kerosene tanks.
Monitoring well installation	17	Characterize the nature and extent of groundwater contamination and provide groundwater flow information.
Monitoring well sampling	20	Characterize the nature and extent of groundwater contamination at Sites 3 and 32.
Soil gas survey	120 Points	Identify the areal extent of soil gas contamination and identify locations for soil borings and soil sample collection.
Soil borings	20	Characterize the nature and vertical extent of subsurface soil contamination associated with the waste oil, paint thinner, and kerosene and waste oil tanks.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.4 SITES 5, BATTERY ACID SEEPAGE PIT; 6, SOUTH TRANSFORMER OIL DISPOSAL AREA; AND 33, MIDFIELD MAINTENANCE HANGAR AREA (BUILDING 1454). The RI Phase II-A exploration program at Sites 5, 6, and 33 will consist of the following activities:

- a soil gas survey,
- monitoring well installation,
- groundwater sampling and analysis,
- soil borings, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-7. Figure 7-6 shows approximate locations of the explorations. Monitoring well installation details are shown in Table 7-4.

Table 7-7
RI Phase II-A Rationale for Explorations at Sites 5, 6, and 33

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Subsurface soil sampling	45	Characterize the nature and extent of subsurface soil contamination around the waste oil tank, the AVGAS tank, and in the drainage ditch.
Monitoring well installation	16	Characterize the nature and extent of groundwater contamination and provide groundwater flow information.
Monitoring well sampling	17	Characterize the nature and extent of groundwater contamination at Sites 5, 6, and 33.
Soil gas survey	50 Points	Identify the areal extent of soil gas contamination and identify locations of soil borings and soil sample collection.
Soil borings	8	Characterize the nature and vertical extent of subsurface soil contamination around the waste oil tank, the AVGAS tank, and in the drainage ditch.

Note: AVGAS = aviation gasoline.

The passive soil gas survey will be conducted around Building 1454 at the edge of the tarmac. The survey will consist of approximately 50 sampling points spaced at 50 foot centers. Details of the passive soil gas technique are in Appendix A.

A total of five soil borings will be drilled to the water table (one at the waste oil tank, one at the abandoned AVGAS tank, and three in the drainage ditch) to characterize the nature and extent of subsurface soil contamination at sites 5 and 6. Split-spoon samples will be collected at 5-foot intervals for OVA headspace analysis. Eight subsurface soil samples (0, 5, 10, 25, 25, 45, and 60 feet bls and at the water table) will be collected from the borings at the waste oil tank, the AVGAS tank, and the first boring in the drainage ditch for laboratory analysis. Five subsurface soil samples (0, 5, 10, 15, and 25 or 10 feet beyond the deepest contamination) will be collected from the remaining three borings around the waste oil tank.

Three soil samples (5, 10, and 20 feet bls) will be collected from the remaining two drainage ditch soil borings.

If soil contamination is present in the downgradient waste oil tank water table boring, a monitoring well screened across the water table will be installed at

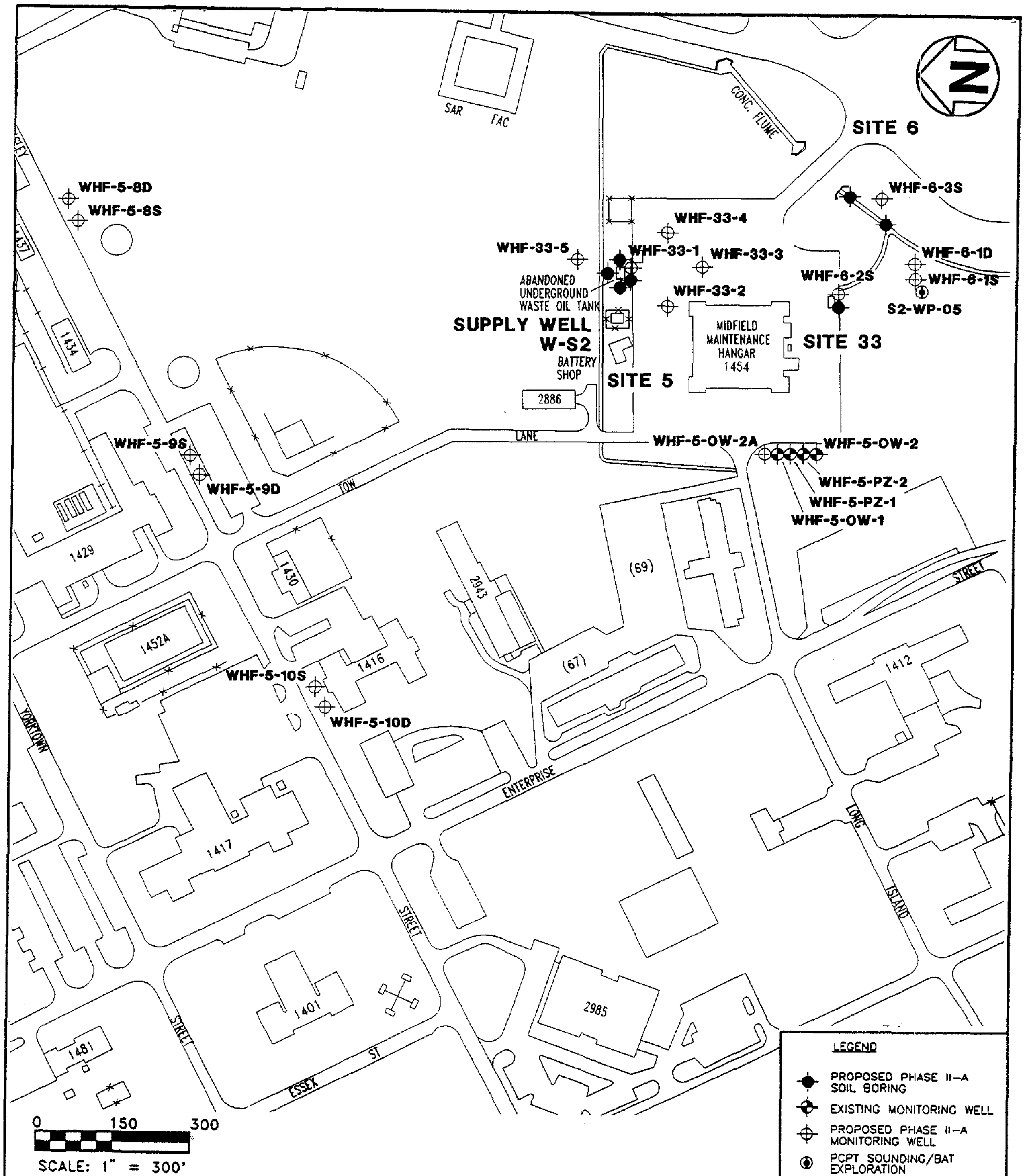


FIGURE 7-6

SITES 5, 6, AND 33 PROPOSED PHASE II-A EXPLORATION LOCATIONS

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

RI/FS PROGRAM

NAS WHITING FIELD MILTON, FLORIDA

that location. Three downgradient and one upgradient water table monitoring wells will also be installed if contamination is detected in the downgradient soil boring. If no contamination is found in the soil borings, monitoring wells will not be installed. Proposed locations of monitoring wells are presented in Figure 7-6.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

<u>7.5 SITE 9, WASTE FUEL DISPOSAL PIT</u>. The RI Phase II-A exploration program at Site 9 will consist of the following activities:

- monitoring well installation, and
- groundwater sampling and analysis.

The specific number of monitoring wells to be installed and groundwater samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-8. Figure 7-7 shows approximate locations of the explorations. Monitoring well installation details are shown in Table 7-4.

Table 7-8
RI Phase II-A Rationale for Explorations at Site 9

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 9.
Monitoring well sampling	3	Characterize the nature and extent of groundwater contamination downgradient of Site 9.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan Workplan). The samples will be analyzed using Levels III and IV DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

<u>7.6 SITE 10, SOUTHEAST OPEN DISPOSAL AREA (A)</u>. The RI Phase II-A exploration program at Site 10 will consist of the following activities.

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling analysis,
- test pitting, and
- subsurface soil sampling and analysis.

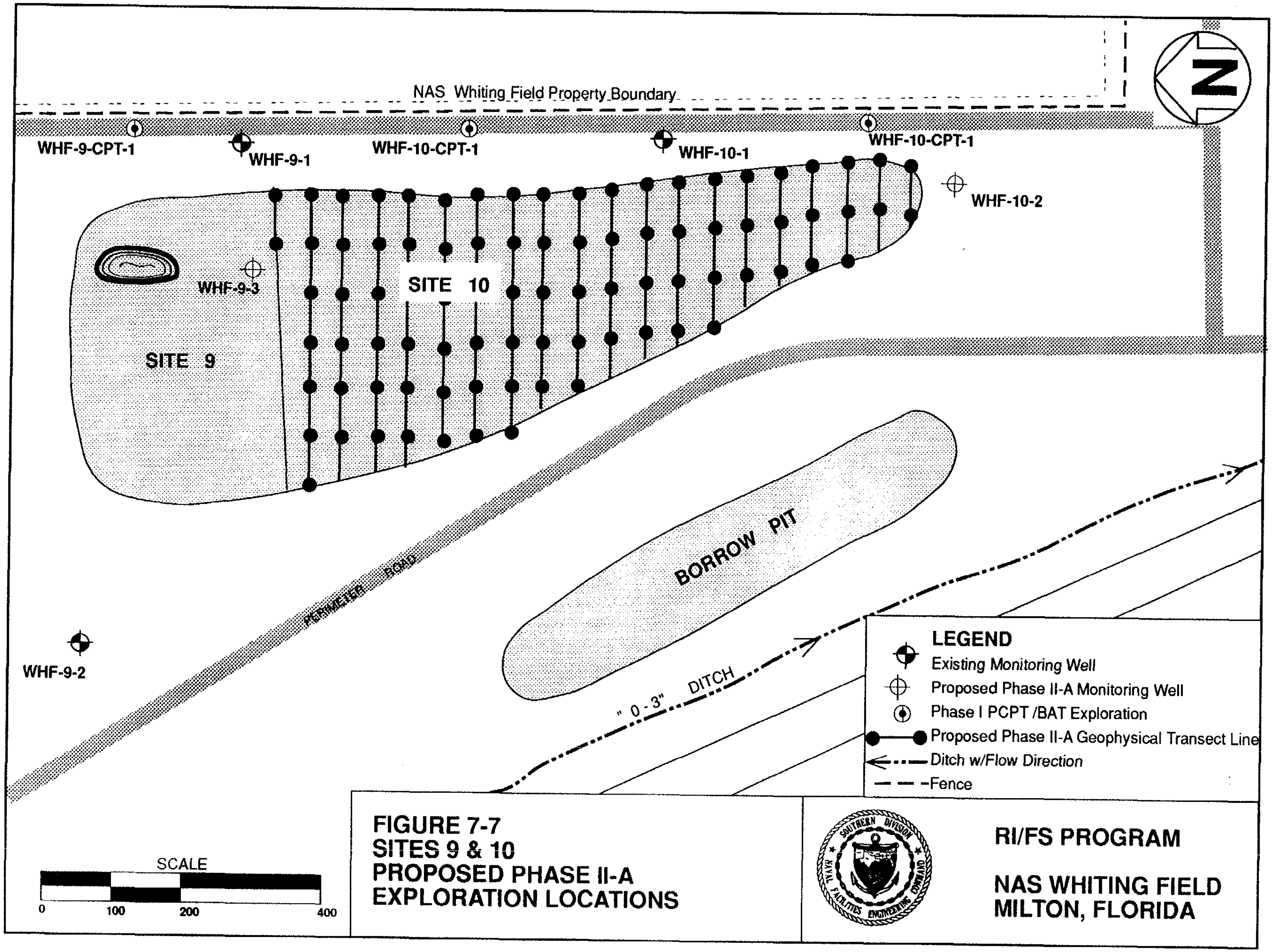


FIGURE 7-7
SITES 9 & 10
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-9. Figure 7-7 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-9
RI Phase II-A Rationale for Explorations at Site 10

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	4 Acres	Define the disposal area boundaries and locate buried objects.
Test pitting	5	Identify buried objects located during the EM/GPR survey and define wastes associated with the site.
Subsurface soil sampling	3	Characterize the nature and extent of subsurface soil contamination.
Surface soil sampling	5	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 10.
Monitoring well sampling	2	Characterize the nature and extent of groundwater contamination downgradient of Site 10.

Note: EM/GPR = electromagnetic/ground penetrating radar.

The EM-31 and GPR geophysical survey will be conducted at Site 10 to define disposal area boundaries and locate buried wastes. Transect lines will be spaced 50 feet apart and data collection points will be spaced at 50 feet along the transect lines. Details of the EM-31 and GPR techniques are presented in Appendix A.

Five test pits will be dug in areas of apparent buried waste identified by the geophysical survey. Five pits will be dug by a backhoe to approximately 10 feet bls. A total of three subsurface soil samples will be collected from the test pits for laboratory analysis.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

<u>7.7 SITE 11, SOUTHEAST OPEN DISPOSAL AREA (B)</u>. The RI Phase II-A exploration program at Site 10 will consist of the following activities.

- EM and GPR geophysical surveys,
- monitoring well installation,

- groundwater sampling and analysis,
- surface soil sampling and analysis,
- test pitting, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-10. Figure 7-8 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-10
RI Phase II-A Rationale for Explorations at Site 11

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

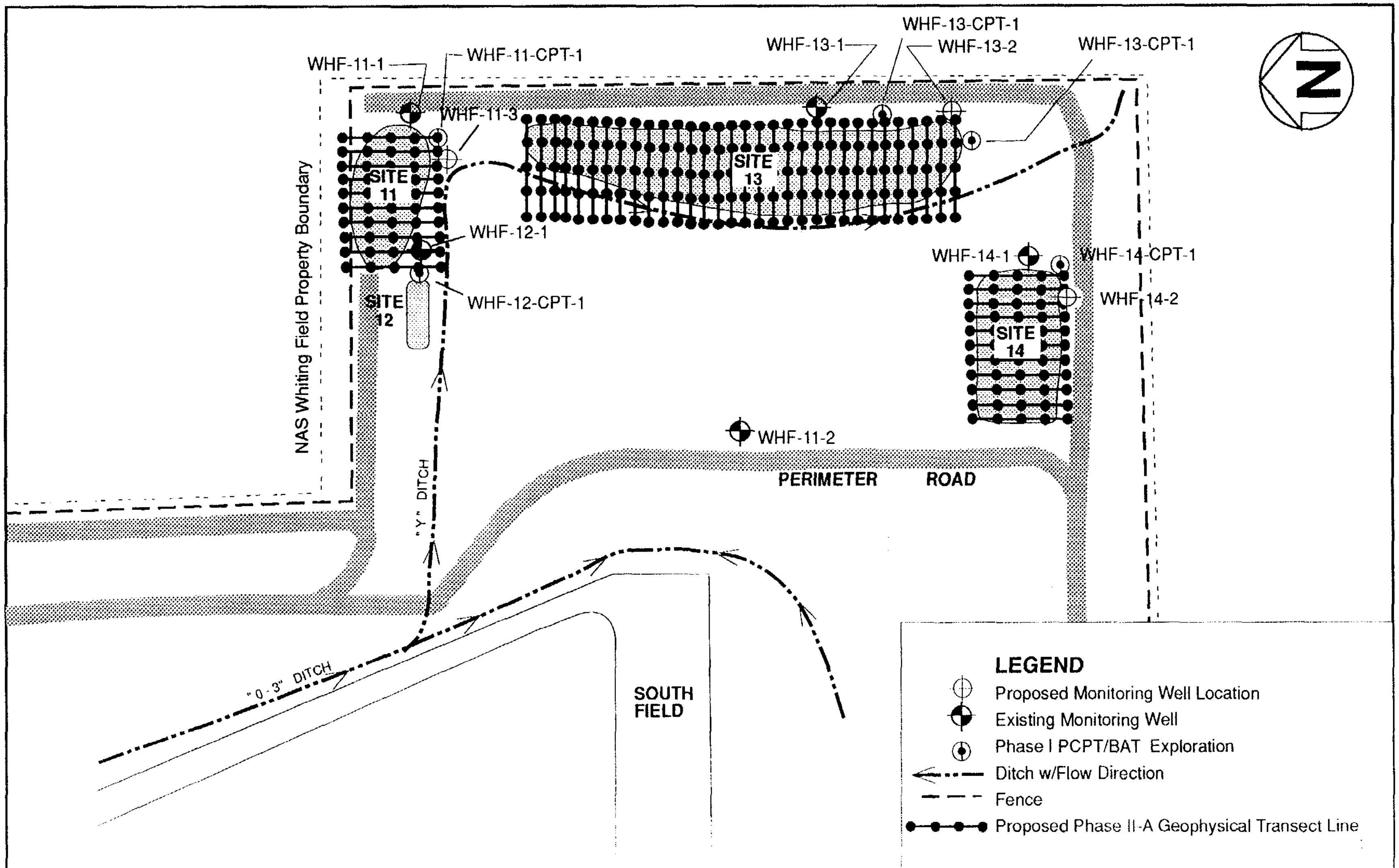
Activity	Quantity	Rationale
EM/GPR Geophysical Survey	3 Acres	Define the disposal area boundaries and locate buried objects.
Test Pitting	3	Identify buried objects located during the EM/GPR survey and define wastes associated with the site.
Subsurface Soil Sampling	3	Characterize the nature and extent of subsurface soil contamination.
Surface Soil Sampling	5	Characterize the nature and extent of surface soil contamination.
Monitoring Well Installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 11.
Monitoring Well Sampling	3	Characterize the nature and extent of groundwater contamination downgradient of Site 11.

Note: EM/GPR = electromagnetic/ground penetrating radar.

The EM-31 and GPR geophysical survey will be conducted at Site 11 to define disposal area boundaries and locate buried wastes. Transect lines will be spaced 50 feet apart and data collection points will be spaced at 50 feet along the transect lines. Details of the EM-31 and GPR techniques are presented in Appendix A.

Three test pits will be dug with a backhoe to approximately 10 feet bls in areas of apparent buried waste identified during the geophysical survey. One subsurface soil sample from each of the test pits will be collected for laboratory analysis from areas of the pits where contamination appears to be present.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.



SCALE IN FEET

0 250 500

FIGURE 7-8
SITES 11, 13, & 14
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

7.8 SITE 13, SANITARY LANDFILL. The RI Phase II-A exploration program at Site 13 will consist of the following activities.

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling and analysis
- test pitting, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-11. Figure 7-8 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-11
RI Phase II-A Rationale for Explorations at Site 13

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	4 Acres	Define the landfill boundaries and locate buried objects.
Test pitting	5	Identify buried objects located during the EM/GPR survey and define wastes associated with the site.
Subsurface soil sampling	5	Characterize the nature and extent of subsurface soil contamination.
Surface soil sampling	5	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 13.
Monitoring well sampling	2	Characterize the nature and extent of groundwater contamination downgradient of Site 13.

Note: EM/GPR = electromagnetic/ground penetrating radar.

The EM-31 and GPR geophysical survey will be conducted at Site 13 to define disposal area boundaries and locate buried wastes. Transect lines will be spaced 50 feet apart and data collection points will be spaced at 50 feet along the transect lines. Details of the EM-31 and GPR techniques are presented in Appendix A.

Five test pits will be dug with a backhoe to approximately 10 feet bls in areas of apparent buried waste identified during the geophysical survey. One subsurface soil sample from each of the test pits will be collected for laboratory analysis from areas of the pits where contamination appears to be present.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.9 SITE 14, SHORT-TERM SANITARY LANDFILL. The RI Phase II-A exploration program at Site 14 will consist of the following activities:

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis, and
- surface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-12. Figure 7-8 shows approximate locations of the explorations. Monitoring well installation details are shown in Table 7-4.

Table 7-12
RI Phase II-A Rationale for Explorations at Site 14

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	3 Acres	Define the landfill boundaries and locate buried objects.
Surface soil sampling	5	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 14.
Monitoring well sampling	2	Characterize the nature and extent of groundwater contamination downgradient of Site 14.

Note: EM/GPR = electromagnetic/ground penetrating radar.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.10 SITE 15, SOUTHWEST LANDFILL. The RI Phase II-A exploration program at Site 15 will consist of the following activities:

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling and analysis,
- test pitting, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale for each activity is presented in Table 7-13. Figure 7-9 shows approximate locations of the explorations. Monitoring well construction details are shown in Table 7-4.

Table 7-13
RI Phase II-A Rationale for Explorations at Site 15

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	15 Acres	Define the landfill boundaries and locate buried objects.
Test pitting	10	Identify buried objects located during the EM/GPR survey and define wastes associated with the site.
Subsurface soil sampling	5	Characterize the nature and extent of subsurface soil contamination.
Surface soil sampling	3	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	10	Characterize the nature and extent of groundwater contamination at Site 15.
Monitoring well sampling	11	Characterize the nature and extent of groundwater contamination at Site 15.

Note: EM/GPR = electromagnetic/ground penetrating radar.

The EM-31 and GPR geophysical survey will be conducted at Site 13 to define landfill boundaries and locate buried wastes. Transect lines will be spaced 50 feet apart and data collection points will be spaced at 50 feet along the transect lines. Details of the EM-31 and GPR techniques are presented in Appendix A.

Ten test pits will be dug with a backhoe to approximately 10 feet bls in areas of suspected buried waste identified during the geophysical survey. A total of five subsurface soil samples will be collected for laboratory analysis from areas of the pits where contamination appears to be present.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

<u>7.11 SITE 16, OPEN DISPOSAL AND BURN AREA</u>. The RI Phase II-A exploration program at Site 16 will consist of the following activities:

- EM and GPR geophysical surveys,
- monitoring well installation,
- groundwater sampling and analysis,

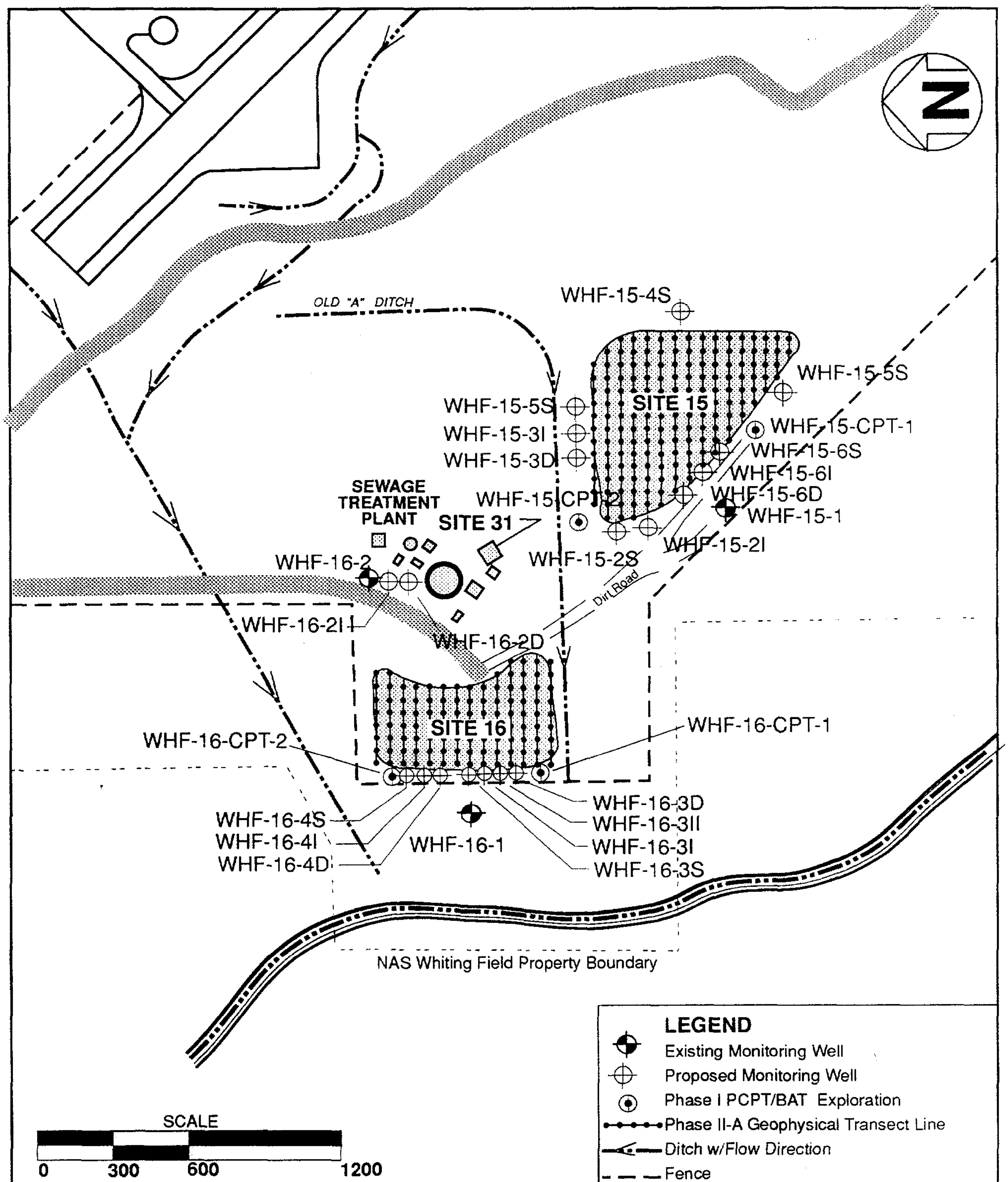


FIGURE 7-9
SITES 15 & 16
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

- surface soil sampling and analysis,
- test pitting, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale is presented in Table 7-14. Figure 7-9 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-14
RI Phase II-A Rationale for Explorations at Site 16

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
EM/GPR geophysical survey	10 Acres	Define the landfill boundaries and locate buried objects.
Test pitting	10	Identify buried objects located during the EM/GPR survey and define wastes associated with the site.
Subsurface soil sampling	5	Characterize the nature and extent of subsurface soil contamination.
Surface soil sampling	3	Characterize the nature and extent of surface soil contamination.
Monitoring well installation	9	Characterize the nature and extent of groundwater contamination at Site 16.
Monitoring well sampling	11	Characterize the nature and extent of groundwater contamination at Site 16.

Note: EM/GPR = electromagnetic/ground penetrating radar.

The EM-31 and GPR geophysical survey will be conducted at Site 13 to define landfill boundaries and locate buried wastes. Transect lines will be spaced 50

- three soil samples from each of the remaining five pits,

- five soil samples from the runoff path of the most recent pit used for fire fighting exercises, and feet apart and data collection points will be spaced at 50 feet along the transect lines. Details of the EM-31 and GPR techniques are presented in Appendix A.

Ten test pits will be dug with a backhoe to approximately 10 feet bls in areas of suspected buried waste identified during the geophysical survey. A total of five subsurface soil samples will be collected for laboratory analysis from areas of the pits where contamination appears to be present.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.12 SITE 17, CRASH CREW TRAINING AREA. The RI Phase II-A exploration program at Site 17 will consist of the following activities:

- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling and analysis,
- soil borings, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale is presented in Table 7-15. Figure 7-10 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-15
RI Phase II-A Rationale for Explorations at Site 17

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Soil borings	10	Characterize the nature and extent of subsurface soil contamination below the fire-fighting pits and the runoff path.
Subsurface soil sampling	34	Characterize the nature and extent of subsurface soil contamination below the fire-fighting pits and the runoff path.
Surface soil sampling	36	Characterize the nature and extent of surface soil contamination in the fire-fighting pits, below the waste piles, and runoff path from the largest pit.
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 17.
Monitoring well sampling	2	Characterize the nature and extent of groundwater contamination downgradient of Site 17.

A total of 36 surface soil samples will be collected as follows:

- five soil samples from each of the two previous fire-fighting pits most recently used for fire-fighting activities,
- three soil samples from directly below each of the two waste piles.

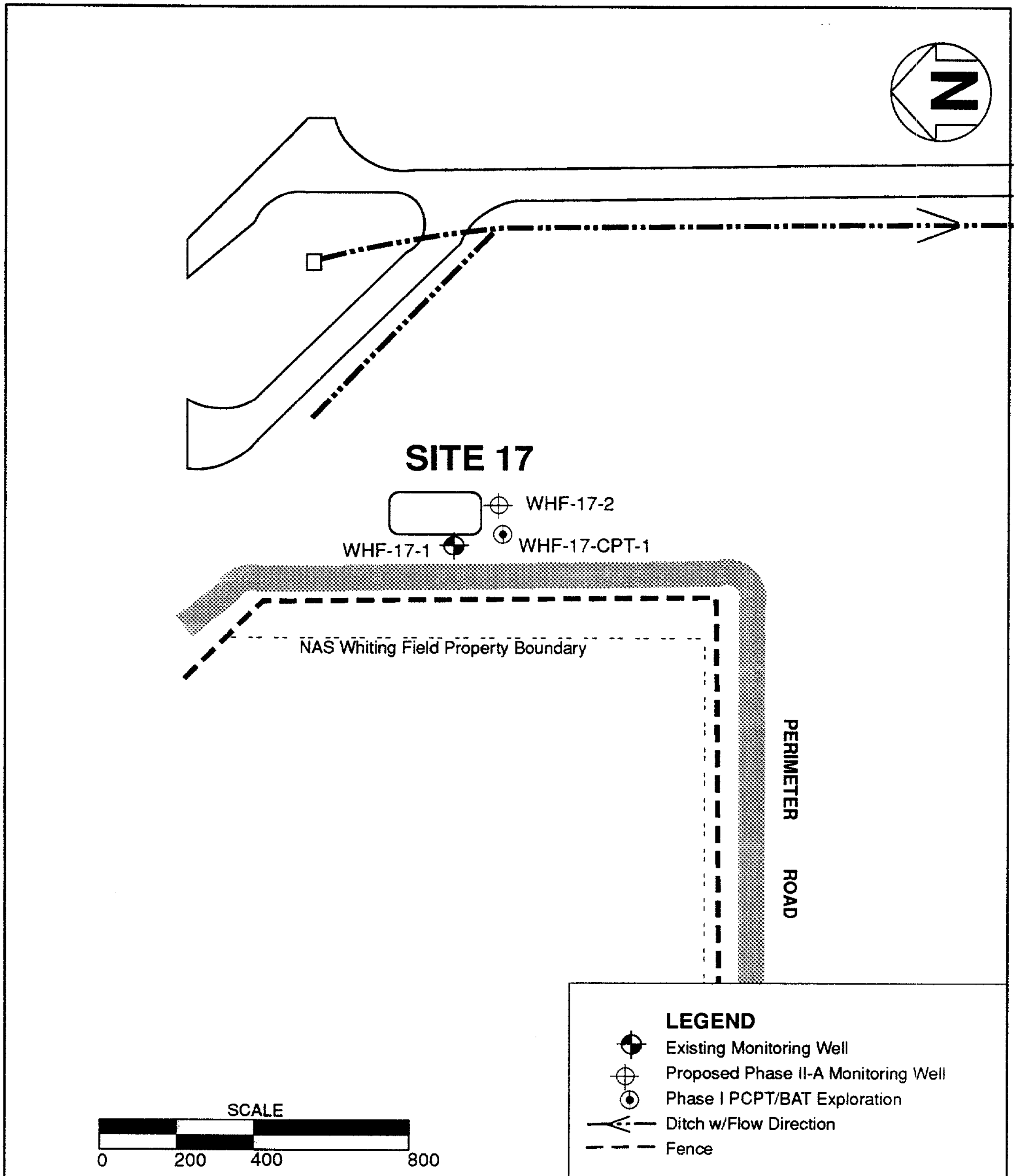


FIGURE 7-10
SITE 17
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

A total of eight soil borings will be drilled with the collection of 34 subsurface soil samples as follows:

- one soil boring in the center of the pit most recently used for fire fighting activities with the collection of four soil samples from 5, 10, 15, and 20 feet bls;
- two additional soil borings in the pit most recently used for fire fighting activities with the collection of two soil samples from each boring at 5 and 10 feet bls;
- one soil boring in the center of the remaining six pits with the collection of four soil samples from each boring at 5, 10, 15, and 20 feet bls; and
- one soil boring in the center of the runoff path drilled just beyond the boundary of the most recent pit used for fire fighting exercises with the collection of two soil samples from 5 and 10 feet bls.

Split-spoon samples will be collected at 5-foot intervals from all soil borings for OVA headspace analysis. All soil borings will be drilled and sampled to the depths specified above. If OVA readings are above background levels for the last (deepest) soil sample collected for laboratory analysis, the soil boring will continue until the OVA readings are below background levels.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

<u>7.13 SITE 18, CRASH CREW TRAINING AREA</u>. The RI Phase II-A exploration program at Site 18 will consist of the following activities:

- monitoring well installation,
- groundwater sampling and analysis,
- surface soil sampling and analysis,
- soil borings, and
- subsurface soil sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale is presented in Table 7-16. Figure 7-11 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

A total of 52 surface soil samples will be collected at Site 18 to characterize the nature and extent of surface soil contamination. The soil sample collection is as follows:

- 5 soil samples from each of the 2 previous fire-fighting pits most recently used for fire fighting activities,

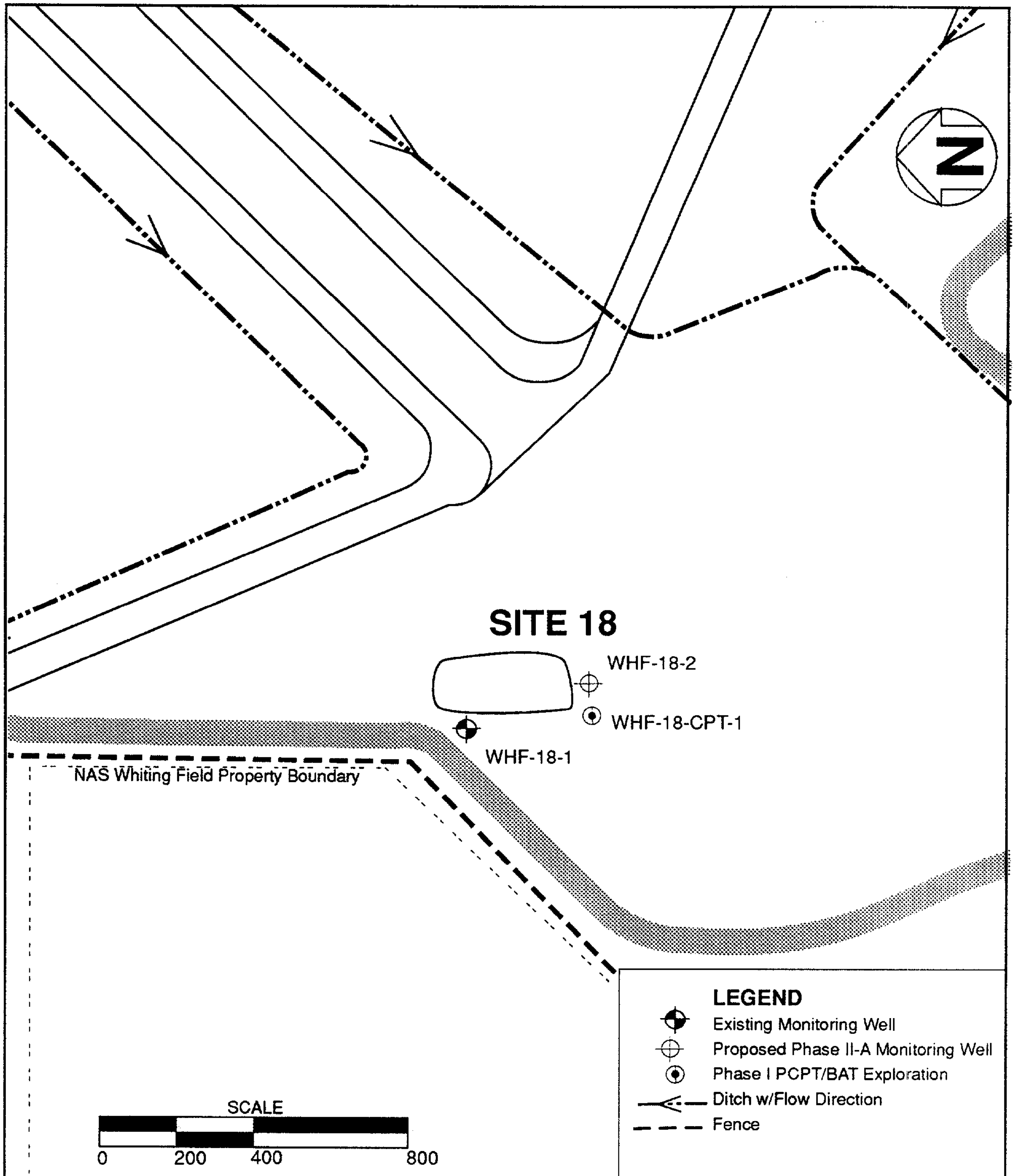


FIGURE 7-11
SITE 18
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

- 3 soil samples from each of the remaining 3 pits and 4 other areas of activity,

- 3 soil samples from directly below the waste piles, and

- 15 soil samples from the runoff path of the most recent pit used for fire-fighting exercises.

Table 7-16
RI Phase II-A Rationale for Explorations at Site 18

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Soil borings	12	Characterize the nature and extent of subsurface soil contamination below the fire-fighting pits and the runoff path.
Subsurface soil sampling	42	Characterize the nature and extent of subsurface soil contamination below the fire-fighting pits and the runoff path.
Surface soil sampling	52	Characterize the nature and extent of surface soil contamination in the fire-fighting pits, below the waste piles, and runoff path from the largest pit.
Monitoring well installation	1	Characterize the nature and extent of groundwater contamination downgradient of Site 18.
Monitoring well sampling	2	Characterize the nature and extent of groundwater contamination downgradient of Site 18.

Twelve soil borings will be drilled at Site 18 and a total of 42 subsurface soil samples will be collected from the soil borings to characterize the nature and extent of subsurface soil contamination. Soil borings and associated soil samples include:

- one boring in the center of each of the burn pits and in four other areas of activity with collection of soil samples from 5, 10, 15, and 20 feet bls;

- two additional soil borings from the burn pit most recently used for fire-fighting activities with the collection of soil samples from 5 and 10 feet bls; and

- one soil boring in the center of the runoff path drilled just beyond the boundary of the most recent pit used for fire fighting exercises.

Split-spoon samples will be collected at 5-foot intervals from all soil borings for OVA headspace analysis. All soil borings will be drilled and sampled to the depths specified above. If OVA readings are above background levels for the last (deepest) soil sample proposed for collection and laboratory analysis, the soil boring will continue until the OVA readings are at or below background levels. Once background levels on the OVA are reached, a soil sample from the last sampling interval will be collected for laboratory analysis.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan Workplan). The samples will be analyzed using Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.14 SITE 29, AUTO HOBBY SHOP (BUILDING 1404), AND SITE 30, SOUTH FIELD MAINTENANCE HANGAR (BUILDING 1406). The RI Phase II-A exploration program at the auto hobby shop and south field maintenance hangar will consist of the following activities:

- a soil gas survey,
- soil borings,
- monitoring well installation, and
- groundwater sampling and analysis.

The specific number of explorations to be conducted and samples to be collected during Phase II-A and the supporting rationale is presented in Table 7-17. Figure 7-12 shows approximate locations of the explorations. Proposed monitoring well installation details are shown in Table 7-4.

Table 7-17
RI Phase II-A Rationale for Explorations at Sites 29 and 30

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Subsurface soil sampling	46	Characterize the nature and extent of subsurface soil contamination resulting from leaks and spills from the underground waste oil tank.
Soil borings	8	Characterize the nature and extent of subsurface soil contamination resulting from leaks and spills from the underground waste oil tanks.
Monitoring well installation	10	Characterize the nature of groundwater contamination at Sites 29 and 30.
Monitoring well sampling	10	Characterize the nature of groundwater contamination at Sites 29 and 30.
Soil gas survey	50 points	Define the areal extent of soil gas contamination around the south field maintenance hangar.

The passive soil gas survey conducted around the south field helicopter maintenance hangar along the edge of the tarmac will consist of approximately 75 sampling points.

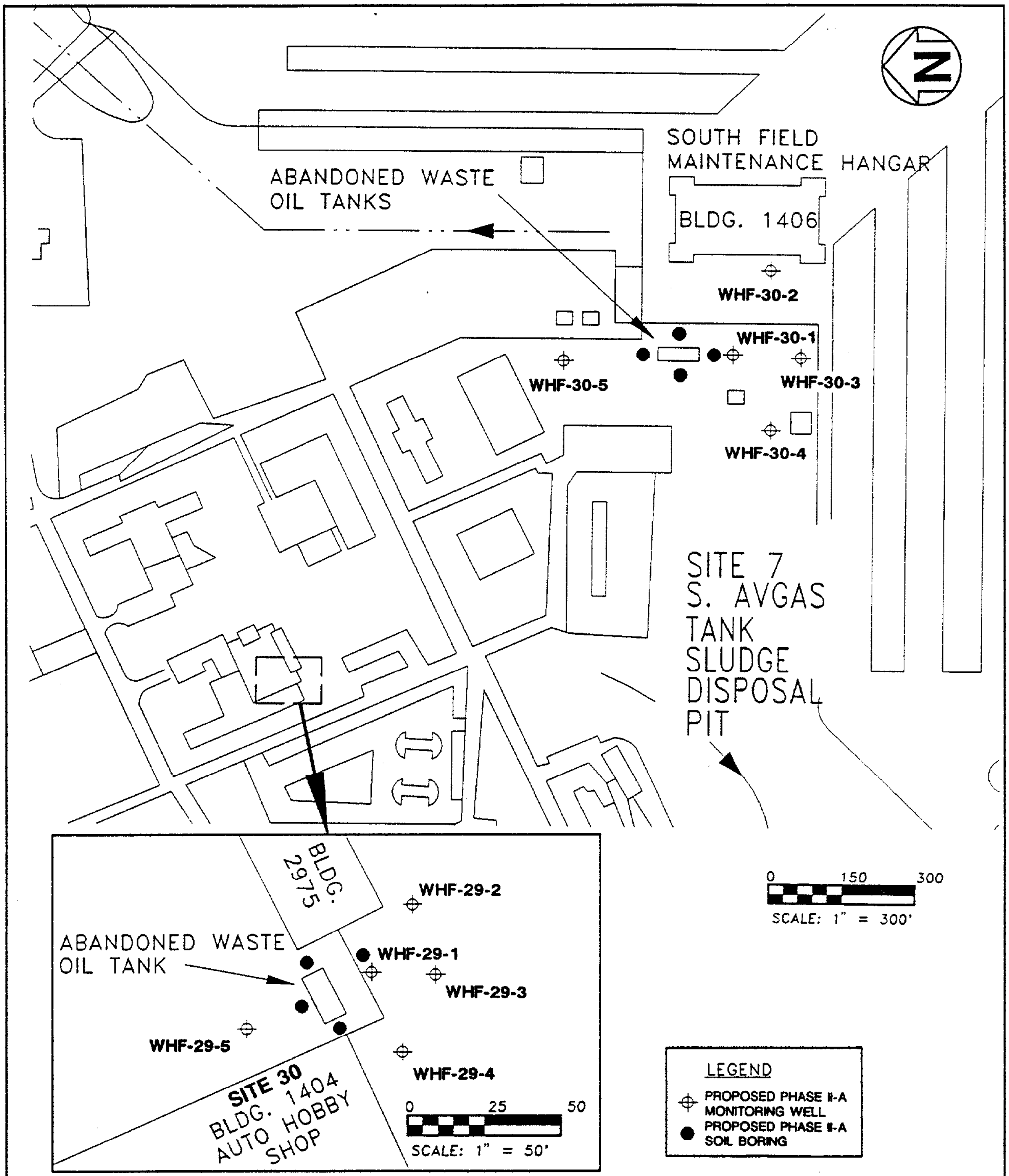


FIGURE 7-12
SITES 29 AND 30
PROPOSED PHASE II-A
EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

Four soil borings (one to the water table and three to 10 feet beyond the deepest contamination) will be drilled around the waste oil tanks at the auto hobby shop and the south field maintenance hangar. Split-spoon samples will be collected at 5-foot intervals for OVA headspace analysis. Eight subsurface soil samples (0, 5, 10, 15, 20, 30, and 60 feet bls and at the water table) will be collected from the water table boring and five soil samples will be collected from the three other borings at 0, 5, 10, and 15 feet bls and 25 feet bls or 10 feet beyond the deepest contamination.

If contamination is present in the downgradient water table boring, a monitoring well screened across the water table will be installed at that location. Three downgradient and one upgradient water table monitoring wells will also be installed if contamination is detected in the downgradient soil boring. If no contamination is found in the soil borings, monitoring wells will not be installed. Locations of proposed monitoring wells are presented in Figure 7-12.

Explorations will follow procedures presented in the RI Phase I Workplan (Jordan, 1990). All environmental samples will be collected in accordance with procedures outlined in the QAPP (Volume II of the Jordan RI Workplan). The samples will be analyzed using Levels III and IV DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

7.15 SITE 31, SLUDGE DRYING BEDS AND DISPOSAL AREAS. The RI Phase II-A exploration program at the sludge drying beds and disposal areas will include sludge sampling and surface soil sampling. The number of samples to be collected during Phase II-A along with supporting rationale is presented in Table 7-18. Figure 7-13 shows approximate sludge and surface soil sample locations.

Table 7-18
RI Phase II-A Rationale for Explorations at Site 31

Technical Memorandum No. 6
NAS Whiting Field
Milton, Florida

Activity	Quantity	Rationale
Sludge sampling	8	Characterize the nature of sludge contamination in the four sludge drying beds.
Surface soil sampling	16	Characterize the nature and extent of surface soil contamination at the five sludge disposal areas.

Two sludge samples will be collected from each of the four sludge drying beds. The samples will be collected between 1 and 2 feet bls.

A total of eight surface soil samples will be collected from the three sludge disposal areas along the southern perimeter road. Four surface soil samples will be collected (one sample every 300 feet) from sludge disposal areas on each side of the southeastern perimeter road.

The samples will be analyzed in accordance with Level III (10 percent Level IV) DQOs. A summary of the RI Phase II-A sampling and analysis program is presented in Table 7-5.

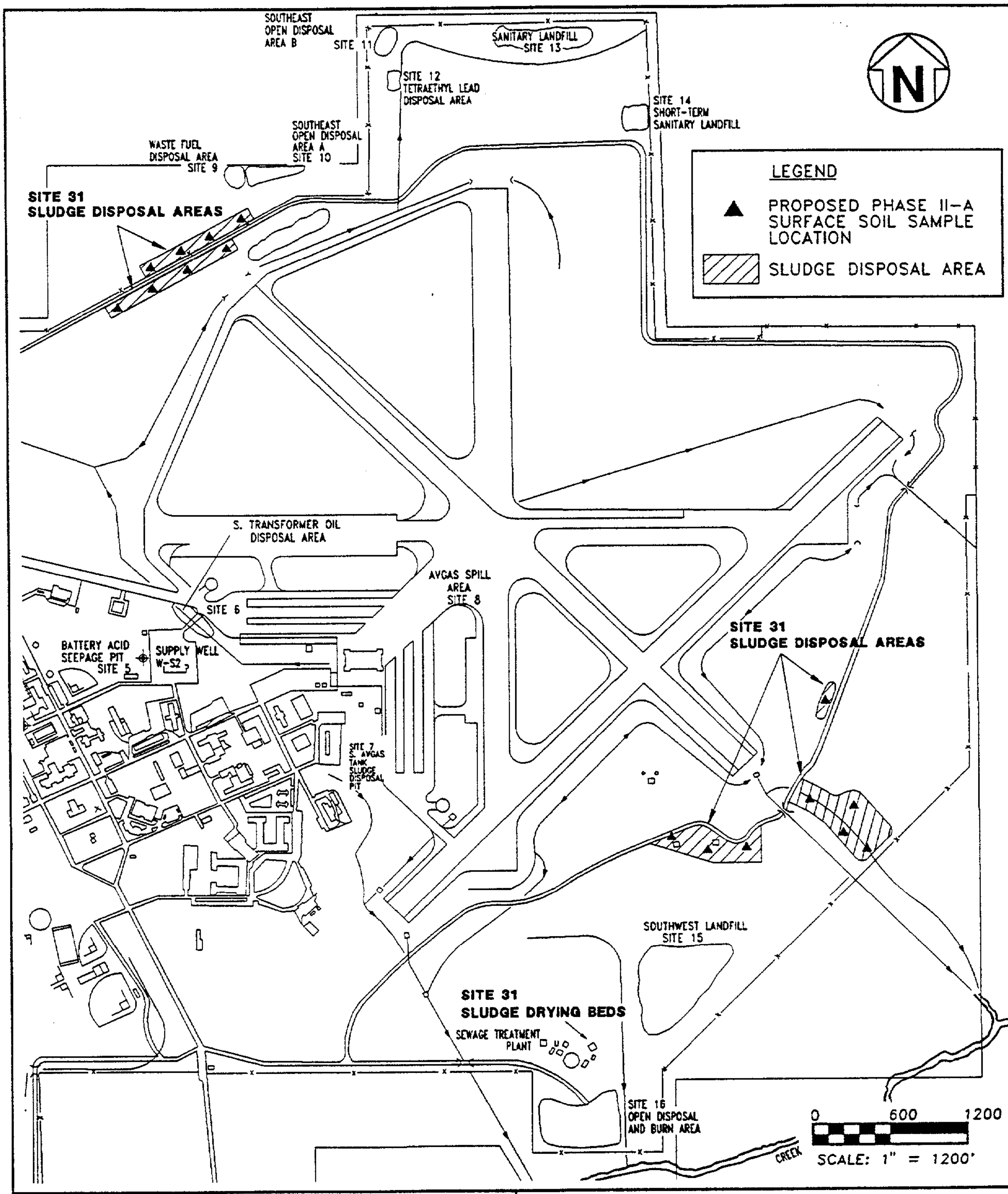


FIGURE 7-13
SITE 31
PROPOSED PHASE II-A EXPLORATION LOCATIONS

RI/FS PROGRAM

NAS WHITING FIELD
MILTON, FLORIDA

REFERENCES

ABB Environmental Services, 1992. Technical Memorandum No. 1 Geologic Assessment. Naval Air Station Whiting Field, Milton, Florida. Prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Boulton, N.S., 1955. Unsteady radial flow to a pumped well allowing for delayed yield from storage. International Association of Scientific Hydrology, Publication 37, pp. 472-477.

Bouwer, H., and J. Rice, 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resource Research 12(3): 423-428.

E.C. Jordan Co., 1990. Remedial Investigation and Feasibility Study Planning Document, June 1990. Naval Air Station Whiting Field, Milton, Florida. Volume I or III, Workplan. Prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Envirodyne Engineers, Inc., 1985. Initial Assessment Study, Naval Air Station Whiting Field, Milton, Florida. Prepared for Naval Energy and Environmental Support Activity, Port Hueneme, California.

Geraghty and Miller, Inc., 1985. Detection and Monitoring Program, Battery Shop Site, Final Report, NAS Whiting Field, Florida. Prepared by SOUTHNAVFACENGCOM, Charleston, South Carolina.

Geraghty and Miller, Inc., 1985. Naval Assessment and Control of Installation Pollutants, Verification Study, NAS Whiting Field. Prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Geraghty and Miller, Inc., 1986. Verification Study. Assessment of Potential Ground-Water Pollution at Naval Air Station Whiting Field, Florida. Prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Fetter, C.W., Jr., 1980. Applied Hydrogeology; Columbus, Ohio: Charles E. Merill Publishing Company.

Hantush, M.S. and Jacob C.E., 1955, Nonsteady radial flow in a infinite leaky aquifer. Transactions of the American Geophysical Union, Vol. 36 No. 1 pp. 95-100.

Kabata-Pendias, A.; and Pendias, H., 1984. Trace Elements in Soils and Plants. CRC Press, Inc. Boca Raton, FL.

Marsh, O.T., 1966. Geology of Escambia and Santa Rosa Counties, Western Florida Panhandle. Florida Geological Survey Bulletin No. 46. 140 p.

U.S. Environmental Protection Agency, 1985. Policy for Floodplains and Wetlands Assessment for Superfund Sites.

REFERENCES (Continued)

U.S. Environmental Protection Agency, 1987. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA/SW-846, Vols. 1A, B, C, and 2, Rev., November 1986, Washington, DC, 1987.

U.S. Environmental Protection Agency, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final. EPA/540/G-89/004 (OSWER Directive 9355.3-01).

Whiting Field Public Works Department, 1991. Personal Communication.

APPENDIX A

Soil Gas Survey SOP

STANDARD OPERATING PROCEDURES FOR APPLYING THE PETREX TECHNIQUE TO ENVIRONMENTAL SOIL GAS SURVEYS

1.0 OPENING STATEMENT CONCERNING THE PURPOSE OF THIS DOCUMENT

As the title of this document points out, the steps and information herein are the "Standard Procedures" for carrying out a Petrex environmental survey. Possible deviations from standard procedures may occasionally be implemented onsite by our field staff to adjust for unique survey conditions. The Petrex Technique is also frequently used for oil and gas, geothermal, and mineral exploration which force slight variations on these "Standard Operating Procedures". Also, surveys performed in winter in frozen ground offer a unique situation and slightly different field practices.

The fact that the standard procedures may occasionally be altered is done to maintain quality service while using the Petrex Technique. It must also be understood that the ion flux data from one survey at a given site and a given time interval should not be compared to the flux numbers from another survey. Since the data is semi-quantitative, only the flux patterns of a survey or the relative difference between flux values off two samples from the same survey should be considered during interpretation.

If any questions arise upon review of this document, please address your questions to NERI technical staff at:

Northeast Research Institute, Inc. (203) 677-9666
309 Farmington Avenue, Suite A-100, Farmington, Connecticut 06032

-or-

Northeast Research Institute, Inc. (303) 238-0090
605 Parfet Street, Suite 100, Lakewood, Colorado 80215

2.0 SAMPLE PRODUCTION AND PREPARATION

2.1 Charcoal Sieving

The static VOC (Volatile Organic Compound) collector is prepared by applying presieved activated charcoal to the end of a ferromagnetic wire.

2.2 Charcoal Bonding

The details of the procedure for preparing the activated charcoal is proprietary information. The procedure results in the production of a collector consisting of size-sorted activated charcoal bonded to the area within 1 cm of the end of a ferromagnetic wire with a Curie point of 358°C.

2.3 Collector Containers

Culture tubes, measuring 25 mm X 125 mm and having a screw cap closure, are washed in a biodegradable detergent, rinsed in methanol, and baked at 180°C for one hour.

2.4 Wire Cleaning

The previously constructed wires are cleaned by heating in a special apparatus at 358°C a total of 35 times under high vacuum. The wires are cleaned in lots of 32 wires. From each lot, two wires are removed for immediate analysis to verify the cleanliness of the lot. The remaining 30 wires are then sealed in one clean culture tube under an inert atmosphere and placed in inventory.

2.5 Packaging for Client

Immediately prior to shipping the wires to the field, the tubes containing 30 wires are removed from inventory and the wires are repackaged under an inert atmosphere in individual tubes. All of the repackaged tubes contain two wires. Ten percent of these have three wires. The collectors are packaged by bagging in Ziploc bags in an inert atmosphere. These bags are then placed in inventory in a temperature-controlled room. The basis for having two wires in each tube is that it allows NERI to analyze one wire by our standard Thermal Desorption-Mass Spectrometry (TD-MS) while the second sample is available for TD-GC/MS or as a backup to the TD-MS. The third wire in selected samples from each survey is used to establish optimum instrument parameters.

2.6 Quality Control and Quality Assurance

Prior to releasing stocked wires for a field survey, two single wires from each lot are checked for cleanliness and collecting potential. This QA/QC phase measures and documents collector preparedness when leaving the laboratory. One of these wires is analyzed without exposure in order to demonstrate that the lot is clean, and the other wire is exposed to hexane vapor for two seconds and then analyzed in order to verify that the charcoal is highly adsorptive. The triplicate wires are used when the wires return from the field. These wires help determine the required machine sensitivity and act as a measure of reproducibility.

2.7 Custody Document

A "custody document" accompanies each group of collectors leaving the laboratory and remains with the group until the collectors have been exposed, analyzed, and disposed of.

3.0 FIELD OPERATIONS

3.1 Locating Sample Sites

Sample placement sites, usually predetermined on an accepted survey proposal, are located from a nearby, surveyable landmark using a compass and pacing or some other measuring device (e.g., pacing wheel, hip chain, or tape measure). A transit may be used for more accurate placement, but such accuracy is seldom required.

3.2 Soil Coring

Once a sample site has been established, a hole is cored to a predetermined depth (sample placement depth is held constant for a given survey). This is accomplished using a variety of tools depending on the nature of the material to be cored. The holes should be vertical and as free from debris as possible. When the sampling is performed in areas covered by asphalt or concrete, a generator-powered rotary hammer drill with a carbide-tipped bit is used to drill a 1-1/2 inch diameter hole in the cover. A hand auger is used to remove the cuttings and road base from the hole.

3.3 Collector Placement

Immediately after the hole is cored, a collector tube is removed from the Ziploc bag and the bag is resealed. The cap is then removed from the tube, and the tube is placed vertically, open end down, into the hole. The hole is then backfilled with the soil core which was removed. The cap is placed in a clean Ziploc bag and stored until collector retrieval. Collectors placed under asphalt or concrete are treated the same as those in uncovered soil, except for modifications to permit easy retrieval and to avoid potential down-hole contamination from surface cuttings. To allow retrieval of these collectors, a piece of galvanized wire is twisted around the neck of the tube and run to the surface so that the sample may be recovered by pulling the retrieval wire. An aluminum plug is then placed near the top of the hole, and the remainder of the hole is plugged with quick setting hydraulic cement.

3.4 Site Identification

Each site is flagged using pin flags, spray paint or ribbon flagging, and the site location is marked and numbered on a base map. A field notebook is used to record the date, collector number, site location description, soil type, and general observations.

3.5 Exposure Time

Time calibration collectors are included as part of every survey. These are QA collectors used to monitor sample loading during the survey. These collectors are placed in an area of known or suspected contamination, and sets are retrieved and analyzed at intervals to indicate the appropriate residence time for survey samples. Separate "travel blank" collectors are also included as a QC measure in every survey. These collectors are transported along with the survey collectors but the tubes are never opened. These control collectors monitor for potential contamination during transport or placement.

3.6 Collector Retrieval

The collectors are retrieved when the time calibration collectors reveal that there has been sufficient loading of gases on the charcoal absorbent. In the field, the soil is removed until the tube is exposed. A cap is taken from the sealed Ziploc bag. The Viton seal is checked to make sure it is seated inside the cap. The culture tube is removed from the hole and any dirt that is on the threads of the tube is wiped off with a clean cloth. In the event the tube is broken or cracked, the collector wire is transferred to a new tube using forceps. The tube is capped and sealed. All flagging material is retrieved.

3.7 Collector Numbering

Each tube is immediately numbered according to the scheme established in the field notes and on the base map. The collector number is written on adhesive labels which are applied to the tube cap. No two sites may have the same number.

3.8 Collector Shipment

Once the collectors have been retrieved, they are sealed in Ziploc bags and then wrapped with bubble packing. Material such as Styrofoam peanuts or newsprint can introduce possible contaminants to the collectors and should not be used for packaging. The collectors, field notes, base map, and chain-of-custody document are either hand carried back to NERI's analytical laboratories, or are shipped by overnight carrier service.

3.9 Decontamination

All down-hole equipment and tool parts which contact excavated soil are constructed of heavy gauge steel and have no natural or synthetic components which could absorb and retain most soil-borne organic contaminants. These tools are decontaminated between use at each sampling location by rotation through a four step cleaning process. These steps are:

1. Immersion and vigorous scrubbing in a mild solution of laboratory grade detergent until all visual accumulations of soil are removed.

2. Thorough rinsing with potable water.

3. Spray rinsing with methyl alcohol.

4. Air Dry.

All derived liquids (and sediment) are contained in dedicated disposable vessels.

4.0 COLLECTOR ANALYSIS

4.1 Numbering Check

Upon receipt of the collectors, the number on each tube is recorded and any missing or duplicated numbers are noted. A missing number generally indicates that the collector could not be retrieved. Samples with identical numbers generally cannot be used unless their true site location can be established.

4.2 Sample Holding

A Petrex soil gas sample consists of a minute quantity of various volatile organic compounds sorbed onto a charcoal element and enclosed in a protective container with a near impervious Viton seal.

Maximum sample holding time is a function of both the chemical stability of the sorbed compounds and the integrity of the seal of the container.

It has been the experience of Northeast Research Institute, Inc. (NERI) that Petrex soil gas samples that are properly repackaged after retrieval from the field and stored under environmentally controlled conditions typically remain compositionally and quantitatively unchanged through periods of greater than four months.

All samples scheduled for analysis via Curie-point pyrolysis/mass spectrometry are analyzed within three weeks of retrieval from the field.

4.3 Instrumentation

Thermal desorption is accomplished using a Fisher radio frequency power supply and a Curie point pyrolyzer designed by NERI and Extrel. The mass spectrometer used is an Extrel SpectrEL quadrupole mass spectrometer. The analysis is controlled and recorded by DEC PDP 11/23 microcomputer. Following the analysis, all data are collected and archived on a PDP 11/73 microcomputer. Data for all active jobs are stored on both of the PDP 11 computers, as well as on magnetic tape. Data for all completed jobs are stored on magnetic tape in perpetuity.

4.4 Calibration

An Extranuclear Quadrupole Spectrometer equipped with a Curie-point pyrolysis/thermal desorption inlet is used for collector analysis. Mass assignment and resolution are manually adjusted using a Perfluorotributylamine (PFTBA) standard. A linear correction, based on the known spectrum of PFTBA, is calculated. This correction is applied to a second PFTBA spectrum. If correct mass (M/Z) values are obtained, the operator proceeds to the next turning step. If not, Step 1 is repeated until correct masses are obtained.

Peak intensity ratios are set from the major peaks in the PFTBA spectrum using the following values:

Mass (M/Z)		Spectrum Intensities
69	=	100%
131	=	25%±5%
219	=	35%±5%
502	=	5%±2%

During the ion signal for mass (M/Z) 69 of PFTBA is measured at a preset sample pressure and detector voltage and compared to previous values at the same setting.

Electron energy is set to 70 electron volts and emission is set at 12 milliseconds. All other operating parameters, such as scans, scan range, mass offset are established in the computer program. These values may only be changed by the laboratory manager.

Tuning is performed at the beginning of a run, so that an individual survey is analyzed at the same set of instrument conditions. The samples are analyzed in random order.

4.5 Instrument Parameters

The instrument is operated with the following parameters.

Vacuum	-	$< 3 \times 10^{-6}$ torr
Ionization Energy	-	70.0 eV
Ionization Current	-	12.0 mA
Desorption Time	-	5.0 sec
Desorption Temperature	-	358^{o}C
Number of Scans/Sample	-	30
Scan Rate	-	1,250 amu/sec

4.6 Mass Spectrometer Analysis and QA/QC

Each collector wire is analyzed in random order. The entire group of survey collectors are analyzed as one run without interruption from other surveys.

The organic gases adsorbed on the carbon are thermally desorbed from the carbon, separated according to ion mass, counted, and a mass spectrum of masses from 29 to 240 is obtained.

Periodic (approximately every 20 samples) machine background analyses are performed as a QC measure to assure minimal influence from internal communication. If there are peaks that are not related to atmospheric gases, the supervisor is notified and the mass spectrometer is shut down and cleaned as necessary.

A written sample number record is kept during the analysis to prevent accidental cross numbering.

The mass spectrometer control program prompts the operator with a warning if a sample number is entered that has already been used. The operator then checks the current number, along with the disk storage location of the previously entered number, to resolve the true numbering situation.

4.7 Data Filing

The raw data file generated by the sample analysis is labeled for storage under a unique file name.

4.8 Schedule of Maintenance

1,000 Samples	Cleaning of sample introducion area, ion source, and expansion chamber by in-house technicians.
4,000 Samples:	Above noted procedures plus cleaning of lenses and quadrapoles
Annually:	Preventative maintenance program conducted by manufactures's service representative.

5.0 DATA INTERPRETATION AND PRESENTATION

5.1 Map Generation

The sample location maps are created by placing the field base map on a digitizing board and entering each site as an X-Y coordinate relative to an orgin. The relative ion counts for each compound can then be plotted at the sample locations. Cultural and topographic features can also be digitized onto the map as reference points.

5.2 Compound Identification

The mass spectrum that is drawn for each sample is compared to a library of mass spectra derived from known volatile organic compounds. Several thousand pure compound spectra have been developed by the Bureau of Standards and are available for spectra comparison. NERI has also developed its own library of spectra through headspace analysis of pure compounds using the Petrex wires. Once a compound has been identified in this manner, the ion current or "flux" for this compound is defined as the total ion current for the "parent peak" or least interfered peak of that compound.

5.3 Relative Flux Determination

The process of determining ion currents (relative intensities) of indicator peaks is computerized. All ion current data are extracted from the original data file and are processed for identification.

The relative ion current intensity (relative intensities) of the gases that are desorbed from the collectors are matched with sample locations on a map of the survey area. These relative intensities are useful for inferring the areal extent of contamination and relative differences in the concentrations of the compounds in the soil or groundwater. This can aid in determining the location of source areas or direction of movement of contamination.

These surface collections and analyses cannot be used to determine the depth to the source contaminants or the precise concentration at depth.

Because compounds can be differentiated by their spectra, analyses from the carbon collectors can be used to help differentiate multiple compounds and multiple source areas within a single survey.

5.4 Data Interpretation

Once the relative intensities for a compound are mapped, the data can be contoured to reveal those areas with "hot spots" and the orientation of plume migration. All other available data, such as geologic setting, soil types, groundwater conditions, type of contaminant, site history, and other factors are taken into account as the interpreter draws his conclusions.

5.5 Additional Uses of Petrex Collectors

Some of the other uses of the Petrex Technique that are utilized in surveys are headspacing of soil and water samples and depth profiling.

5.5.1 Headspace

A headspace soil sample is analyzed by collecting approximately 25 grams of soil, which are transferred to a thermochemically cleaned headspace container. Several adsorption wires are added and the headspace container is sealed and allowed to equilibrate for up to 24 hours, depending on the level of contamination. The wires are then removed and prepared for desorption mass spectrometric analysis as described earlier. An identical process is performed for screening water samples.

5.5.2 Depth Profiling

In order to determine if the source of the soil gas signal is near surface or in a deeper vadose/saturated zone, depth profiling can be used.

At each selected location, shallow bore holes are drilled a few feet apart to depths such as 1, 2, 4, and 6 feet deep. After all the loose cuttings and cavings have been removed from the bottom of the hole, a core of soil may be taken for headspace analysis. Next, a Petrex collector is lowered into the hole and backfilled. The collectors remain in place for the same length of time as the survey wires.

Each of the sampling methods addresses a different aspect that will help indicate the nature of the VOC source. In the case of composite soil sampling, detection of VOCs during analysis implies that the VOCs are actually contained within the soil matrix. When the VOC is anthropogenic in nature, the VOC presence is indicative of soil contamination at that depth interval.

When performing an in situ time-integrated sampling program with Petrex collectors, the collector serves as both an extended headspace sampler relative to the soil matrix in its immediate vicinity, as well as measuring the soil gas flux through that zone during the exposure period.

Soil gas movement through the vadose zone is theorized to be a diffusion process. If the headspace data indicate that the VOC is not present in the soil matrix, then the in situ depth profiling collectors should show a relative increase of ion counts as the depth increases. By combining both pieces of data, the nature of the VOC source (near surface or deep vadose/saturated) can be inferred.

5.6 Data Presentation

Once the data have been compiled, interpreted, and mapped, a report is produced for the client's use. Also, the maps are printed which display the relative intensity of the compounds of the client's specifications. These reports and maps are for the client's use only, and no report or map is released to anyone else without prior written consent of the client. This confidentiality policy is never breached.

6.0 INTERPRETATION OF PETREX MAPS

The policies outlined in this Standard Operating Procedure are strictly followed on each survey. It should be noted that the relative intensities for any compound at one sample location can only be compared to another location within the same survey for the same compound. Relative intensities of different compounds cannot be compared to each other. Also, the relative intensities of one survey cannot be compared to the relative intensities of any other survey, even between two surveys at different times of the year over the same site. However, the same "hot spots" and plumes should contour in the same place over multiple surveys at a given site, allowing for migration.