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FINAL WORK PLAN FOR PLUME DELINEATION AT STUDY AREA 17 NTC ORLANDO FL

8/9/2002

TETRA TECH

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0802-A124

August 9, 2002

Commander, Southern Division
Naval Facilities Engineering Command
Attn: Ms. Barbara Nwokike, Code ES333
P.O. Box 190010
2155 Eagle Drive
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Reference: CLEAN Contract No. 62467-94-D-0888
Contract Task Order No. 0234

Subject: Final Work Plan for Plume Delineation at Study Area 17
Naval Training Center, Orlando

Dear Ms. Nwokike:

Enclosed is the final Work Plan for delineating the downgradient plume at Study Area 17. The Work Plan incorporates comments on the draft plan received from the Orlando Partnering Team.

If you have any questions, please contact me at (865) 220-4730.

Sincerely,

Steven B. McCoy, P.E.
Task Order Manager

SBM:ckf

Enclosures

c: Ms. Barbara Nwokike, Southern Division (Orlando Office) (hardcopy and CD)
Mr. Wayne Hansel, Southern Division (hardcopy and CD)
Mr. Mark Salvetti, Harding ESE (CD)
Mr. David Grabka, FDEP (hardcopy and CD)
Mr. Gregory Fraley, USEPA Region 4 (hardcopy and CD)
Mr. Steve Tsangaris, CH2M Hill (CD)
Mr. Skip Barton, (hardcopy)
Mr. Mike Campbell, Tetra Tech NUS (hardcopy)
Mr. Allan Jenkins, Tetra Tech NUS (hardcopy)
Mr. Mark Perry, Tetra Tech NUS (hardcopy)
Ms. Debbie Wroblewski, Tetra Tech NUS (cover letter only)
Mr. J.E. Bentkowski, Gannett Fleming (hardcopy and CD)
File/db (hardcopy and CD)

Rev. 1
08/09/02

WORK PLAN
for
PLUME DELINEATION AT STUDY AREA 17

Naval Training Center
Orlando, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0234

August 2002

WORK PLAN
FOR
PLUME DELINEATION AT
STUDY AREA 17

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:

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

Submitted by:

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CONTRACT NO. N62467-94-D-0888
CONTRACT TASK ORDER 0234

AUGUST 2002

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PROFESSIONAL GEOLOGIST CERTIFICATION

I hereby certify that this document, *Work Plan for Plume Delineation at Study Area 17, Naval Training Center, Orlando, Florida,* was prepared under my direct supervision in accordance with acceptable standards of geological practice.

Allan T. Jenkins 8/9/02

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FLORIDA
PROFESSIONAL GEOLOGIST

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ACRONYMS

bgs	below ground surface
BRAC	Base Realignment and Closure
CCI	CH2MHill Constructors, Inc.
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CPT	cone penetrometer testing
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
DPDO	Defense Property Disposal Office
DPT	direct push technology
DQO	Data Quality Objective
EISOPQAM	*Environmental Investigation, Standard Operating Procedures and Quality Assurance Manual*
ESSR	Environmental Site Screening Report
FDEP	Florida Department of Environmental Protection
GCI	Geo-Cleanse International, Inc.
GCTL	Groundwater Cleanup Target Level
HLA	Harding Lawson Associates
IDW	investigation-derived waste
IRA	Interim Remedial Action
ISCO	in situ chemical oxidation
mL/min	milliliters per minute
MS	matrix spike
MSD	matrix spike duplicate
NFESC	Naval Facilities Engineering Service Center
NTC	Naval Training Center
NTU	Nephelometric Turbidity Unit
OPT	Orlando Partnering Team
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, and completeness
PE	polyethylene
PID	photoionization detector
POP	Project Operations Plan
PP	polypropylene
QA	quality assurance
QC	quality control
SA	Study Area

ACRONYMS (CONTINUED)

TCE	trichloroethene
TCL	Target Compound List
TOC	top of casing
µg/L	micrograms per liter
USEPA	U. S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound

1.0 INTRODUCTION

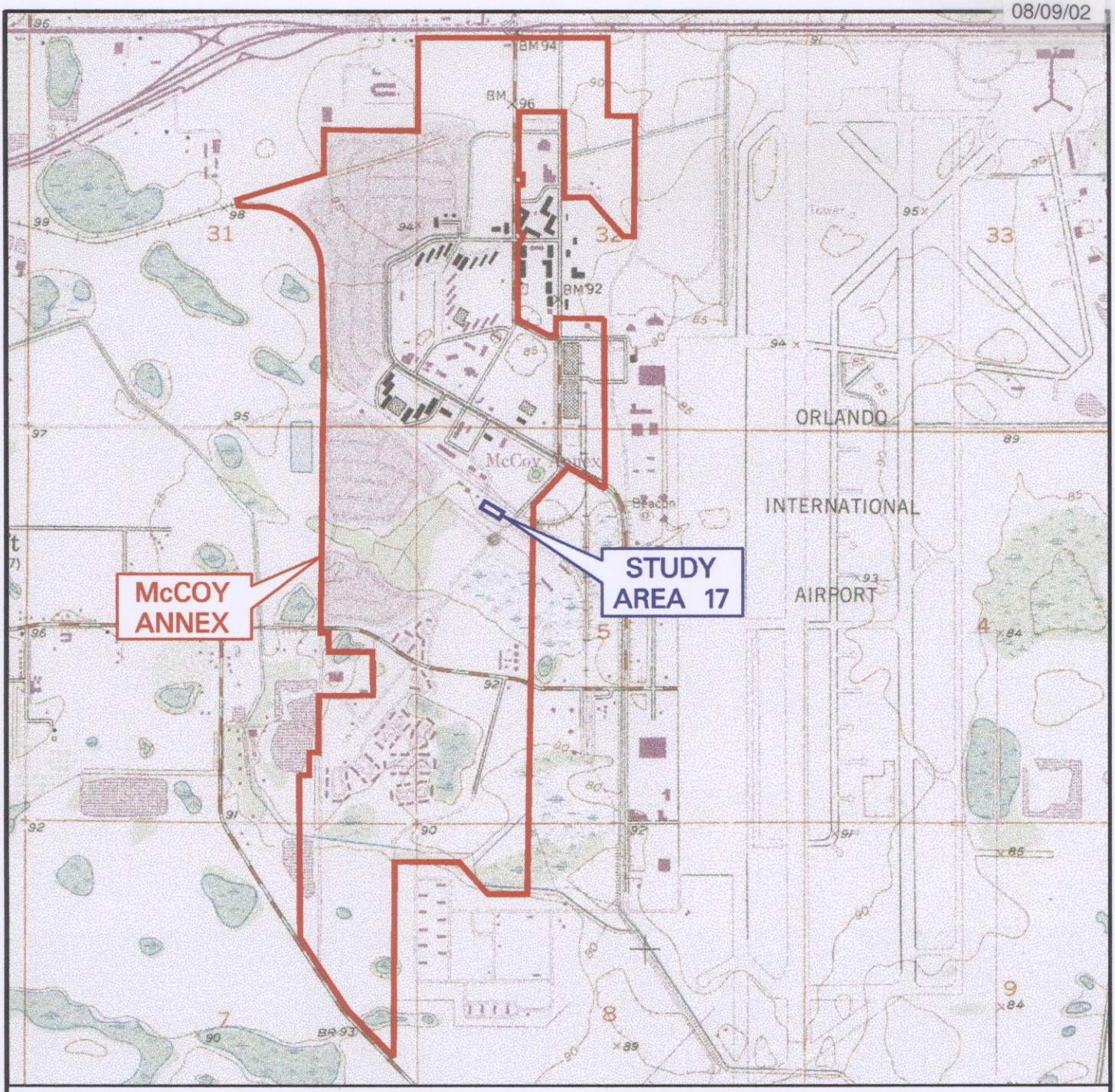
This document presents the technical approach and describes the methodologies and techniques to be used to perform delineation of the groundwater plume at Study Area 17 (SA 17). SA 17 is located within the McCoy Annex that is one of four parts of the Naval Training Center (NTC) located in Orlando, Florida. The location of the McCoy Annex and the area of SA 17 are shown in Figure 1-1.

1.1 PURPOSE

Previous groundwater investigations conducted at SA 17 have shown that the surficial aquifer is contaminated with trichloroethene (TCE) and its degradation products [cis-1,2-dichlorethene (cDCE) and vinyl chloride(VC)] at concentrations ranging up to 134,000 micrograms per liter (µg/L). Contamination greater than the Florida Department of Environmental Protection (FDEP) groundwater cleanup target level (GCTL) of 3 µg/L for TCE has been detected in groundwater beneath the source area at a depth of 63 feet below ground surface (bgs). The extent of groundwater contamination is not defined in the downgradient direction and the plume may extend beyond the area of SA 17. In order to complete the FDEP-approved remediation of the surficial aquifer [i.e., in situ chemical oxidation (ISCO) of the source areas and subsequent monitored natural attenuation], the horizontal and vertical extent of contamination must be defined. It is the goal of the proposed investigation to provide sufficient information to adequately define the limits of the groundwater plume. The data generated will subsequently be incorporated into a site investigation report that will be submitted to the FDEP and to the U.S. Environmental Protection Agency (USEPA) for review, comment, and approval.

1.2 SITE DESCRIPTION

SA 17 occupies approximately 25 acres in the central part of the McCoy Annex (Figure 1-1). The site includes Buildings 7178, 7190, 7198, and the adjacent area that formerly served as the Defense Property Disposal Office (DPDO) complex for the McCoy Annex. The layout of the pertinent site features and location of previous investigation data points are shown in Figure 1-2. The southwestern corner of the site is undeveloped. The entire southeastern portion of the site, beneath which the highest levels of groundwater contamination have been encountered, consists of a soil and grass covered area that was formerly used by the motor pool. A shallow ditch that drains to the east extends along the entire southern boundary of the site.



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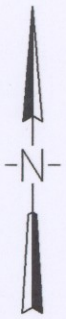

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FIGURE 1-1
LOCATION OF STUDY AREA 17
STUDY AREA 17 - McCOY ANNEX

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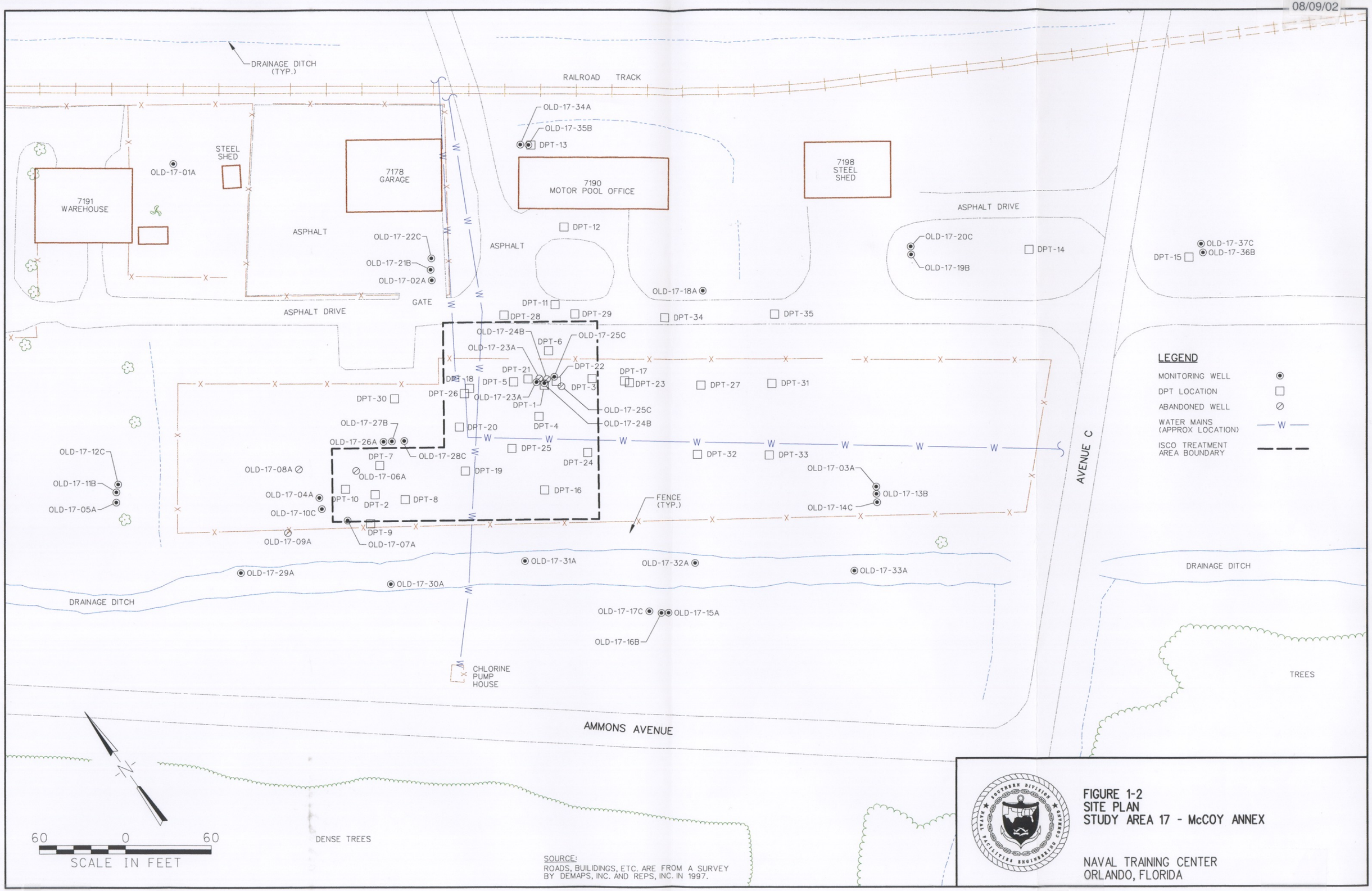

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FIGURE 1-2
SITE PLAN
STUDY AREA 17 - McCOY ANNEX

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1.3 PROJECT GUIDANCE

To ensure that all consultants planned and executed their field activities in a manner consistent with Southern Division, Naval Facilities Engineering Command, and regulatory requirements, the *Project Operations Plan for Site Investigations and Remedial Investigations* [POP] (ABB-ES, 1997) was prepared and implemented. The proposed investigation will follow the methods and procedures as described in the POP, but will implement alternate methods and procedures, where applicable, in accordance more recent guidance published by the FDEP and USEPA, as follows:

- Florida Department of Environmental Protection, DEP Standard Operation Procedures for Laboratory Operations and Sample Collection Activities, DEP QA-001/01, January 2002.
- U.S. Environmental Protection Agency, Region 4, Environmental Investigations Standard Operation Procedures and Quality Assurance Manual, November 2001.

Health and safety aspects of Tetra Tech NUS' work at NTC, Orlando are controlled in accordance with the *Health and Safety Plan for Performing Investigative Work and Data Sampling* (Tetra Tech NUS, Inc., 2001).

2.0 PREVIOUS GROUNDWATER INVESTIGATION SUMMARY

The initial site screening conducted in 1995 determined that surface soils at the site contained concentrations of polynuclear aromatic hydrocarbons (PAHs) exceeding screening criteria. The initial investigation also demonstrated that groundwater in the surficial aquifer contained concentrations of organic contaminants above screening criteria. In May 1999, surface soil was excavated to a depth of 2 feet across an area of approximately 300 by 100 feet. The soil excavation and off-site disposal mitigated PAH-contaminated soil to levels compatible with a future non-residential land use (SUPSHIP, 1999). Subsequent environmental planning and investigation at the site have focused only on the groundwater contamination.

2.1 INVESTIGATION CHRONOLOGY

A chronological summary of the groundwater investigation at SA 17 is provided in Table 2-1. The Initial Site Screening performed during 1995, 1997, and 1998 described the aquifer framework and demonstrated that heavier-than-water contaminants (i.e., chlorinated solvents) had been released to the surficial aquifer. The later phases of this work determined that the interaction of the contaminants with subtle changes in the vertical stratigraphy had resulted in a complex plume configuration beneath the site. Subsequent investigations conducted during 2000 and 2001 focused on identifying the vertical and lateral extent of contamination source areas that were targeted for an interim remedial action (IRA).

TABLE 2-1

GROUNDWATER INVESTIGATION CHRONOLOGY AT SA 17
NTC, ORLANDO

Dates	Work Description	Source Reference
Feb. - May 1995	Initial Site Screening: MWs 1 through 5 and 24T	HLA, 1999
Jan. - Feb. 1997	Phase I: MWs 6 through 10	HLA, 1999
Mar. - Apr. 1998	Phase II: CPT/DPT Q1 through Q31; piezometers 1 - 6	HLA, 1999
Apr. - Jun. 1998	Phase II: MWs11 through 33	HLA, 1999
Feb. 2000	Phase I confirmation: re-sample 14 MWs	CCI, 2000a
Mar. - Apr. 2000 Aug. 2000	Phase II characterization: DPTs 1 through 20; MWs 34 through 37	CCI, 2000a
May - Jun. 2001	Phase III: VD Wells 39 through 48; DPTs 21 through 35	GCI, 2001

2.2 HYDROGEOLOGIC SETTING

Cone penetrometer testing (CPT) was conducted during the early stages of the site investigation to characterize the subsurface geology to depths of 65 feet bgs at SA 17. Geologic cross sections

presented in the Environmental Site Screening Report (ESSR) (HLA, 1999) are provided in Appendix A. In general, the upper 30 feet of sediments consists primarily of fine sand with the exception of two thin (approximately 5 to 10 feet) layers of silty sand. The upper layer of silty sand lies at about 10 to 15 feet bgs, is discontinuous, and appears to dip to the east and northeast. The lower layer of silty-sand lies at about 25 to 30 feet bgs, appears to be continuous across the site, but thins slightly to the north and east in the area investigated. The groundwater chemistry investigation results suggest that these layers act as aquitards and retard the downward flow of groundwater (and contaminants) at the site.

Below the lower layer of silty sand (see above) there is an interval of fine- to coarse-grained sand that extends from about 30 to 50 feet bgs. Because of its green coloration, this layer is interpreted to mark the upper part of the Hawthorn Group sediments. This interval is underlain by another silty-sand layer that extends from 50 to 55 feet bgs, which is in turn underlain everywhere by approximately 10 feet of sandy, silty clay. This clay is considered to be the bottom of the surficial aquifer. It is in turn underlain by fine- to coarse-grained sand of the Hawthorn Group sediments.

Water level measurements in the site's monitoring wells were collected during investigations in July 1998 and April 2000. The data were used to construct potentiometric contours and to demonstrate the groundwater flow patterns at different depths in the surficial aquifer. As shown on the figures provided in Appendix A, the groundwater flow direction in the shallow portion of the aquifer, above the uppermost silty-sand layer (see cross section in Appendix A), indicates radial flow away from a groundwater high located across the central portion of SA 17. The location of a buried water-supply line that runs across SA 17 (see Figure 1-2) suggests that leakage from the line may be responsible for the localized groundwater high and resulting radial flow pattern. Alternatively, the absence of an artificial recharge source and the presence of the ditch along the southern perimeter of SA 17 suggests that the local water table would otherwise slope toward the south and that shallow groundwater would flow and discharge into the ditch during typical water table conditions. Figures in Appendix A showing the groundwater flow direction in the intermediate portion of the aquifer, between the two, upper silty-sand intervals (15 to 30 feet bgs), suggest that local recharge may also influence this interval. These figures show that flow in the intermediate zone is toward the ditch to the south, but that a component of flow also migrates to the east. Figures in Appendix A showing the groundwater flow direction in the deep portion of the aquifer, below the lower, silty-sand interval (>30 feet bgs), suggest that local recharge has no influence on this interval. These figures show that flow in the deep zone is toward the south or the east, possibly alternating during different portions of a seasonal cycle.

The groundwater elevations measured in the two deepest wells at SA 17 (i.e., OLD-17-25C and -28C) in July and August 1998, and in April 2000, were 26 to 30 feet lower than the elevations

reported in the wells completed in the surficial aquifer. Because the well screens for these two wells are installed beneath the clay interval that lies about 55 feet bgs at the site, they represent potentiometric conditions in the Hawthorn aquifer below the surficial aquifer. The large potentiometric difference between the two aquifers indicates that the clay has low permeability and suggests that groundwater flow (and contaminant migration) between the two units is limited.

The hydraulic conductivity of the surficial aquifer was estimated by performing slug tests in wells completed at various depths in the surficial aquifer (HLA, 1999). Table 2-2 presents a summary of the slug test results presented in the ESSR (HLA, 1999) and provides the geometric mean of the data for each aquifer depth. As indicated in the table, the test results for all wells are within a relatively narrow range; however, the deeper portion of the aquifer has a slightly higher conductivity. The horizontal gradient for each aquifer depth zone was also presented in the ESSR and is summarized in Table 2-3. Collectively, the site-specific hydraulic conductivity and hydraulic gradient, along with literature values for porosity, bulk density, partitioning coefficients, and fraction of organic carbon, were used to estimate the groundwater seepage velocity (Table 2-3) and contaminant migration velocity at SA 17 (see Appendix B). These calculations suggest that groundwater flow at the site is relatively slow (2-7 ft/year). Due to sorption in the aquifer matrix, the retarded contaminant velocity is expected to range between 1 and 6 ft/year, depending on aquifer depth and chemical-specific properties. Because the buildings at SA 17 were constructed in the 1950s to mid-1960s, it is conservative to infer that contaminant releases and migration of a plume in the aquifer may have began 40 years ago. Assuming contaminant transport via advective flow retarded by sorption in the aquifer, and using an calculated contaminant seepage velocity of 3.8 ft/year for VC in the deep aquifer zone, the leading edge of the contaminant plume is predicted to extend about 150 feet downgradient of the release location.

2.3 GROUNDWATER CONTAMINATION SUMMARY

The subsurface investigations have shown that stratification associated with lithological variation within in the aquifer have resulted in several groundwater flow pathways within the surficial aquifer. The concentrations of some chlorinated volatile organic compounds (CVOCs) in wells at some source locations was greater than one percent of their solubility limit in groundwater (e.g., TCE >11,000 µg/L). This finding suggests that a dense, nonaqueous phase liquid (DNAPL) may exist at depths corresponding to the two silty-sand zones in the upper portion of the surficial aquifer.

TABLE 2-2

SUMMARY OF SLUG TEST RESULTS

STUDY AREA 17
NTC, ORLANDO

Well No.	Screen (ft bgs) Top	Bottom	Slug Test Result (K = feet/day)
A Zone			
2	3	13	1.5
5	3	13	3.4
15	2	12	0.6
18	2	12	0.3
Geometric Mean =			0.9
B Zone			
11	15	20	0.2
16	15	20	0.6
19	25	30	0.5
21	15	20	0.5
Geometric Mean =			0.4
C Zone			
12[a]	47	52	0.9
17	43	48	2.6
20	47	52	3.8
22	43	48	0.6
Geometric Mean =			1.5

[a] Screen interval estimated from cross section A-A'

TABLE 2-3

GROUNDWATER GRADIENT AND FLOW VELOCITY SUMMARY

STUDY AREA 17
NTC, ORLANDO

Aquifer Interval	Gradient[a] (ft/ft)	K[b] (ft/day)	Effective Porosity[c]	Groundwater Seepage Velocity (ft/yr)
A	0.004	0.9	0.2	6.6
B	0.003	0.4	0.15	2.9
C	0.002	1.5	0.25	4.4

[a] Gradient values from ESSR (HLA, 1999)
[b] Hydraulic Conductivity, K; geometric mean of slug tests from ESSR (HLA, 1999)
[c] Effective porosity estimated based on site lithology (AFCEE, 1996) as follows:
A = fine sand; B = silty, fine sand; C = fine to coarse sand.

Chemical data collected from the monitoring wells also indicate that natural biodegradation of chlorinated solvents in the groundwater has resulted in the destruction of TCE and the production of daughter products cDCE and VC. As a result, the character of the groundwater plume changes both in the horizontal and vertical directions across SA 17.

The analytical data from monitoring well sampling conducted in June 1998 and February and April 2000, and from DPT groundwater investigations conducted in April 2000 and June 2001 were used, collectively, to define the current plume configuration at various depths in the surficial aquifer. The June 1998 data were required primarily to define the plume limits in the vicinity of low concentration (i.e., <GCTLs) or non-detect wells that were not subsequently sampled. Most wells within the plume were last sampled during February and April 2000. The DPT results were used to provide better vertical definition of the plume and to investigate the downgradient limits of the plume. Based on the relatively slow calculated groundwater and contaminant seepage velocities (see above), these data should represent approximate current conditions around the plume perimeter. IRAs that have occurred during 2000/2001/2002 (see Section 2.4) are inferred to have had little effect on the overall size of the plume. Data tables and figures from previous reports listing the data are provided in Appendix C.

The primary contaminants that exceed the FDEP GCTLs and that define the limits of the groundwater plume are TCE and its biodegradation daughter products cDCE and VC. TCE, cDCE, and VC were detected during the 2000 and 2001 DPT investigations at maximum concentrations of 134,000 μg/L, 10,000 μg/L, and 1,900 μg/L, respectively. Maximum TCE concentrations have been observed in close proximity to the source areas (i.e., well clusters OLD-17-23A//24B/25C and OLD-17-26A/27B/28C), but display a steep decline within 150 feet downgradient. The contaminants cDCE and VC show increasing concentrations that greatly exceed their respective GCTLs at a distance of 100 feet downgradient of the source areas.

Figures 2-1, 2-2, and 2-3 present maps showing the estimated limits of the plume in the shallow (maximum depth of 15 feet bgs), intermediate (15 to 30 feet bgs), and deep (32 to 50 feet bgs) zones in the surficial aquifer that were prepared using the above-referenced data. Contaminant concentrations that exceed the GCTLs and/or wide data spacing to the east and north of the site have resulted in areas where the downgradient limits of the plume are not well defined; these areas are indicated by the dashed portions of the plume limits contour. A relatively high concentration of VC was observed at location OLD-17-20C (Figure 2-3) at a depth of 50 feet in the surficial aquifer. This concentration of VC suggests that the deep plume may extend further to the east (i.e., 270 feet) than predicted based on the estimated, retarded contaminant velocity (i.e., 150 feet). These areas are the focus of the investigation proposed in this work plan.

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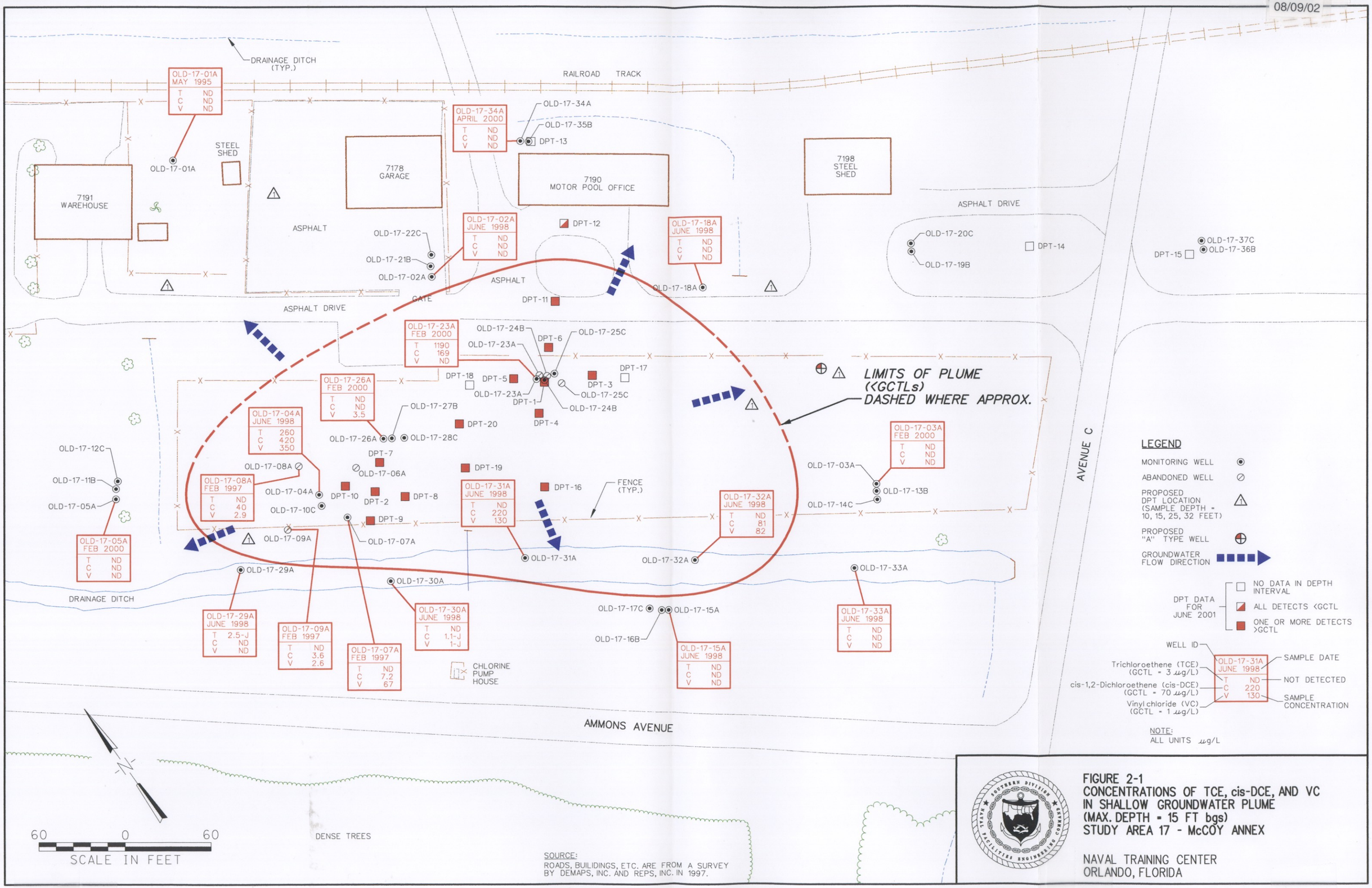

FIGURE 2-1
CONCENTRATIONS OF TCE, cis-DCE, AND VC IN SHALLOW GROUNDWATER PLUME (MAX. DEPTH = 15 FT bgs)
STUDY AREA 17 - McCOY ANNEX

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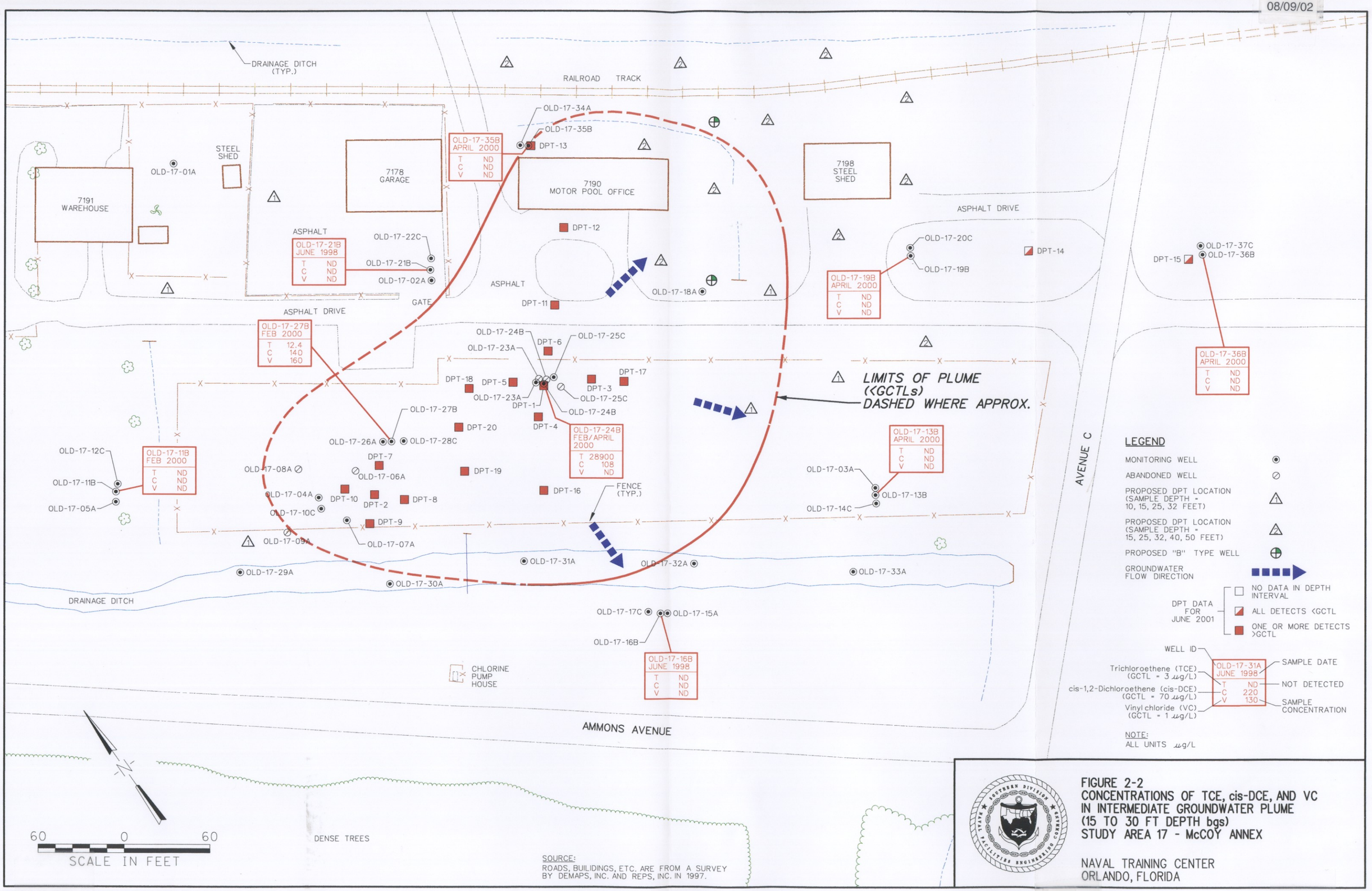

FIGURE 2-2
CONCENTRATIONS OF TCE, cis-DCE, AND VC IN INTERMEDIATE GROUNDWATER PLUME (15 TO 30 FT DEPTH bgs)
STUDY AREA 17 - McCOY ANNEX

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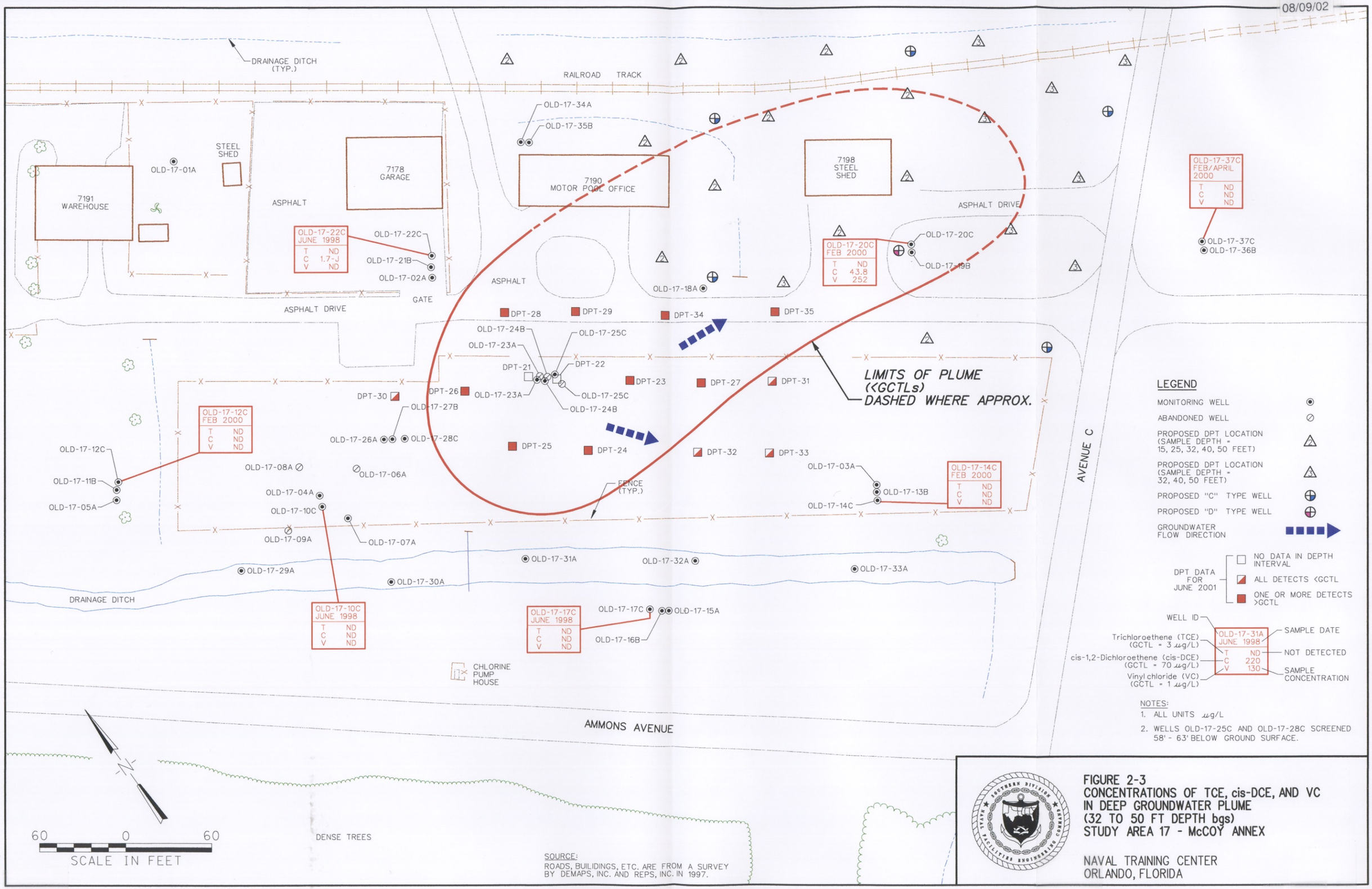

FIGURE 2-3
CONCENTRATIONS OF TCE, cis-DCE, AND VC IN DEEP GROUNDWATER PLUME (32 TO 50 FT DEPTH bgs)
STUDY AREA 17 - McCOY ANNEX

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2.4 INTERIM REMEDIAL ACTIONS

An IRA consisting of ISCO of the plume source areas is ongoing at SA 17. A series of injection wells has been installed at various depths within an "L" shaped treatment area located southwest of Building 7190 (see Figure 1-2). The goal of the ISCO is to reduce concentrations of CVOCs in the groundwater source areas to levels below 500 µg/L. Subsequent plume mitigation via natural attenuation processes is anticipated to be the final remedy for groundwater at the site. Table 2-4 summarizes the IRA activities that have occurred at SA 17.

TABLE 2-4

GROUNDWATER IRA SUMMARY AT SA 17

STUDY AREA 17
NTC, ORLANDO

Dates	Work Description	Source Reference
Sep. 2000	Work Plan for ISCO submitted to OPT	CCI, 2000b
Nov. 2000	IRA injection: ISCO shallow, intermediate, deep zones	[a]
Jan. 2001	IRA injection: ISCO very deep zone	[a]
Mar. 2002	IRA injection: ISCO very deep zone; polishing of intermediate and deep zones	[a]

[a] Personal communication between A. Jenkins, TtNUS, and J. Ottoson, CH2M Hill, Tampa, FL., May 10, 2002,

3.0 PROPOSED GROUNDWATER INVESTIGATION

A critical step in scoping the investigation activities proposed in this work plan consisted of compiling and merging the results of several phases of groundwater investigation (see Section 2.0). The existing groundwater chemistry data at SA 17 suggest that the downgradient limits of the groundwater plume that exceed the GCTLs for the CVOCs of concern (i.e., TCE, cDCE, and VC) have not been adequately defined. DPT groundwater sampling is proposed as an initial screening tool to investigate various locations and aquifer depths across the northern and eastern areas of the site that are considered to represent downgradient data gaps. The DPT sampling will allow multiple-depth sampling as the sampling tool is advanced to specific depths below the ground surface and a sample is collected. The results of the proposed DPT sampling and previous sampling results (presented above) will then be used to select locations and screen depths for new permanent monitoring wells. The new wells will be sampled and the data will be used in conjunction with the existing groundwater data to define the limits of the groundwater plume at various depths in the surficial aquifer. The new monitoring wells may also be included in future monitoring of the site as part of the proposed groundwater remedy. The Orlando Partnering Team (OPT) will evaluate the data and determine if additional DPT or monitoring well sampling rounds are needed. The following sections describe, or reference, the investigation methodology, sampling locations, and analytical program required to define the groundwater plume.

3.1 DPT INVESTIGATION

The proposed DPT investigation will investigate the horizontal and vertical extent of CVOCs in groundwater hydraulically downgradient of the identified source areas (i.e., areas north and east of well cluster OLD-17-23A/24B/25C). DPT sampling has been previously used with good success for several phases of groundwater sampling at SA 17; therefore, the methodology is appropriate for the hydrogeologic and geochemical conditions at the site. The proposed locations for the DPT samples were based on groundwater flow and contaminant transport patterns determined using the latest sample results from previous monitoring well and DPT sampling. A complexity in the investigation is that the direction of flow in the shallow and intermediate portions of the surficial aquifer (i.e., A and B zone wells) has historically displayed a radial flow pattern due to an on-site groundwater mound. Southward flow is attributed to impacts from the ditch, located along the southern portion of the site, on what is likely an eastward flow direction in the local aquifer. In addition, mounding and radial flow in the shallow- and intermediate-depth groundwater (i.e., A and B zone wells) are attributed to recharge from a leaking water line at the site. The deeper portion of the surficial aquifer (C zone wells) appears to be largely unaffected by the canal and the typical flow direction is southeast and south. An additional complexity in the plume

geometry is that CVOCs have migrated downward through the surficial aquifer as they have migrated laterally from the source areas. Therefore, it will be necessary to collect DPT samples at multiple depths in the aquifer. Depending on existing data and location, all depths may not be sampled at each DPT location. The main focus of the DPT investigation is the intermediate and deep portions of the surficial aquifer (i.e., just above and below the lower silty-sand layer). A series of plume maps showing the distribution of CVOCs at various depths in the aquifer area and the proposed DPT locations are presented in Figures 2-1, 2-2, and 2-3.

Data gaps in the shallow portion of the aquifer (A zone) are considered relatively small. Three DPT locations are proposed in the area east of the plume where no recent data points exist, as shown in Figure 2-1. Two DPTs are also proposed to the north where data spacing is wide and where DPTs in 1997 suggested some plume extension in that direction. DPT samples in the A zone will be collected at a depth of 10 feet bgs that should be about 5 to 7 feet below the water table but above the top of the uppermost silty sand layer. These samples will correspond with the water table (A wells) that are typically screened between 2 and 13 feet bgs.

The primary area of concern in the intermediate portion of the aquifer (B zone) also lies to the east where few data points exist; 15 DPT locations are proposed in this area (see Figure 2-2). As in the shallow aquifer, two DPTs are also proposed to the north where data spacing is wide and where DPTs in 1997 suggested some plume extension in that direction. And, one DPT location is proposed along the west end of the plume near the drainage ditch where no data exist. DPT samples in the B zone will be collected at depths of 15, 25, and 32 feet bgs. These sample depths represent the intervals near or on top of the upper silty sand, between the two silty sand layers, and at the bottom or just below the lower silty sand layer. These intervals were selected in part based on the results from DPTs 1 through 20 (CCI, 2000a) that showed high CVOC concentrations associated with these depth intervals.

Eighteen DPT sample locations are proposed in the deep portion of the aquifer (C zone) to the east of the plume where data points are widely spaced (eastward) or do not exist (northeastward) (see Figure 2-3). DPT locations 28, 29, 34, and 35 (GCI, 2001) show that relatively high concentrations of either TCE, cDCE, and/or VC have migrated to the east and northeast, and well OLD-17-20C demonstrates that VC has migrated further downgradient than predicted by the estimated contaminant velocity. DPT samples in the C zone will be collected at depths of 40 and 50 feet bgs. These sample depths represent the intervals within the sand (below the lower silty sand layer) and at the bottom of the sand interval, above the basal silty sand that marks the bottom of the surficial aquifer (see cross section in Appendix A). These intervals were selected because the sand represents the most conductive groundwater flow path in the deep zone of the surficial aquifer and because the interface of the sand with the underlying silty sand and clay layers

represents a potential point of accumulation for DNAPL. Note that all of the "near plume" DPT points in the C zone are coincident with DPT points in the B zone; thus, samples will be collected throughout the intermediate and deep aquifer intervals. Further downgradient, to the east, samples will only be collected in the deep interval where contaminant transport, and thus plume extension, is likely to be greatest.

Figure 3-1 shows the combined set of DPT locations and lists the sample intervals at each location. This figure will be used by the field geologist to locate the DPT sample points and to determine the appropriate sample depths.

Analysis of the DPT groundwater samples will be performed using 48 hour turnaround time at the laboratory to minimize collection and analysis of samples outside the plume area. All DPT samples will be analyzed for VOCs only using USEPA Method 8260B. Downgradient sampling locations and/or specific sample depths may be deleted from the DPT program if the results of early DPT samples show that the lateral and/or vertical limit of contamination has been delineated at upgradient locations.

3.2 MONITORING WELL INSTALLATION

After the vertical and horizontal limits of contamination have been determined from the DPT results, monitoring wells will be installed to provide definitive information on the lateral and vertical extent of contamination and to serve as compliance points for long-term monitoring. Based on the current groundwater flow directions and plume patterns, new wells are tentatively located to the northeast of the source area (i.e., northeast of Buildings 7190 and 7198) and east of the source areas (i.e., south of Buildings 7190 and 7198). The proposed locations shown on Figure 3-1 may be adjusted on the basis of the DPT results. In addition, a round of water level measurements will be recorded prior to new well installation to determine the current groundwater flow patterns at each aquifer depth interval.

Based on the known depth of contamination at existing monitoring wells, new wells will be installed with screens within the following depth intervals:

- Shallow wells across the water table between 3 and 15 feet bgs (A zone),
- Intermediate wells, between 15 and 30 feet bgs (B zone), above the Hawthorn Group,
- Deep wells, between 30 and 50 feet bgs (C zone), in Hawthorn Group sands, and
- Hawthorn well, below 60 feet depth bgs (D zone), immediately below the Hawthorn clay.

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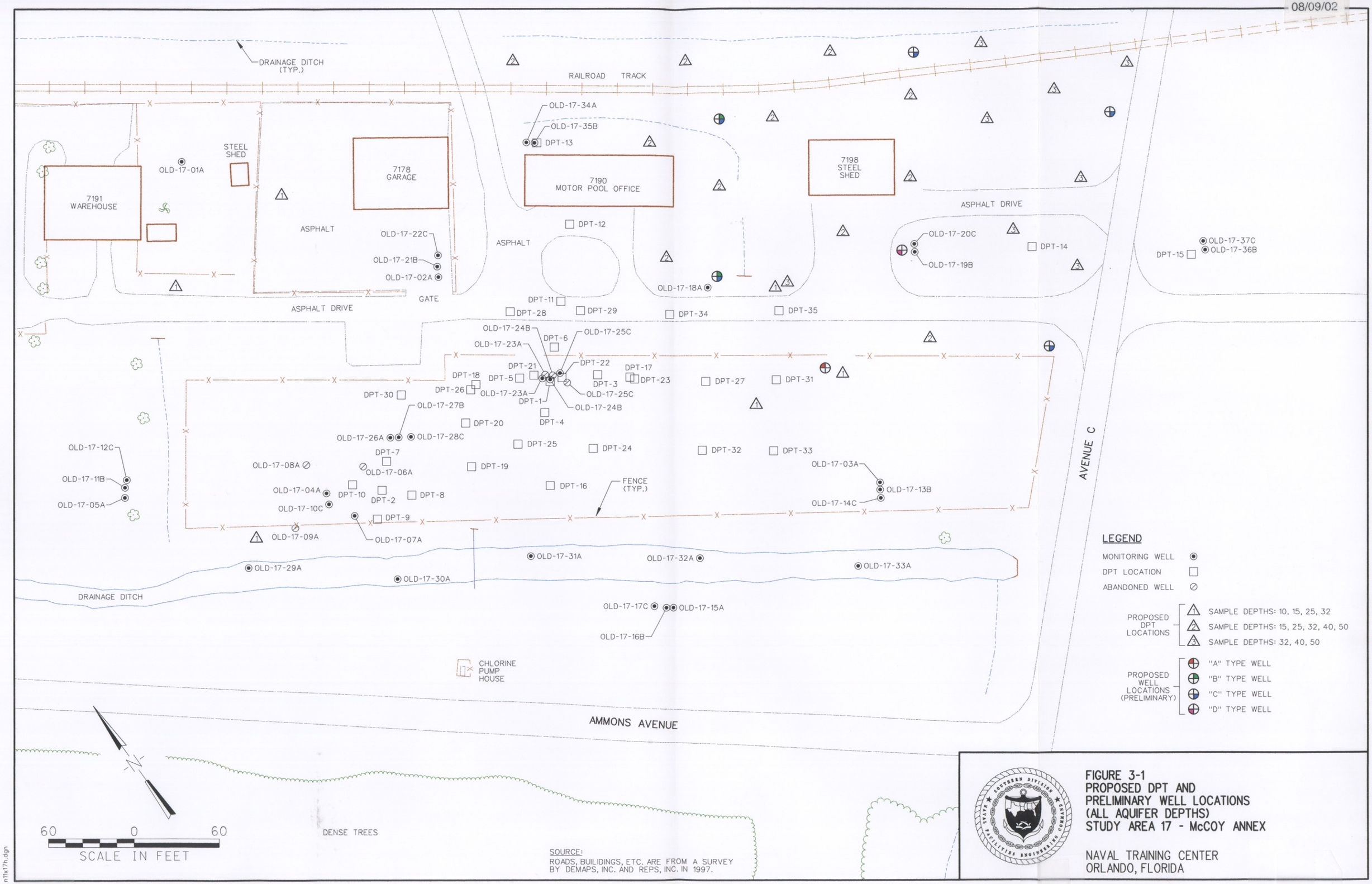

SOURCE:
ROADS, BUILIDINGS, ETC. ARE FROM A SURVEY BY DEMAPS, INC. AND REPS, INC. IN 1997.

FIGURE 3-1
PROPOSED DPT AND PRELIMINARY WELL LOCATIONS (ALL AQUIFER DEPTHS)
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

n1x17h.dgn

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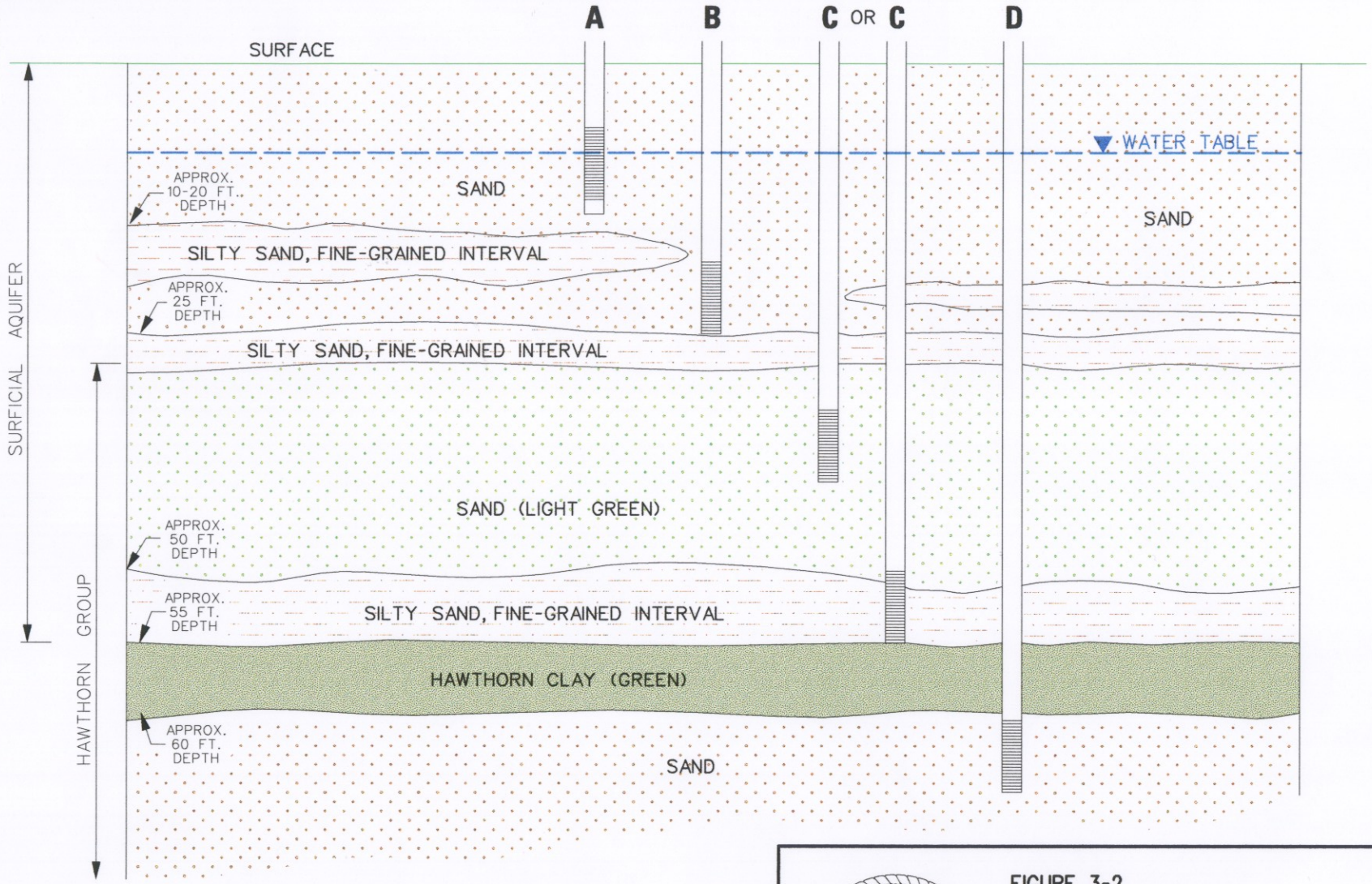
The approximate relationship of the screen depth intervals for the proposed wells with the site hydrogeologic setting is shown in Figure 3-2. Existing wells OLD-17-25C and -28C that are screened below the Hawthorn clay (similar to D zone above) detected the presence of CVOCs when they were first sampled in June 1998. Only TCE, at 39 μg/L in well OLD-17-25C, exceeded the GCTLs at that time. Both wells were re-sampled in February 2000 for VOCs and no exceedances of the GCTLs were observed. And, well OLD-17-25C was sampled during April 2002 for VOCs as part of the IRA monitoring (unpublished data from CCI, personal communication from J. Ottoson) and there were again no exceedances of the GCTLs. From these data it is inferred that the groundwater plume is limited to the surficial aquifer (i.e., above the Hawthorn clay) and that little investigation of the D zone in the aquifer is necessary. Because of the deep contamination at OLD-17-20C, one D well is proposed at that location. The final well locations and screen intervals will be determined following analysis of the DPT results.

3.2.1 Well Construction

A review of the previous well sampling forms showed that groundwater sample turbidity was a persistent problem during the June 1998 and February 2000 sampling events. Turbidity at or below 10 NTUs was rarely achieved and readings greater than 20 NTUs were common. The purging rate was noted to be typically 500 ml/min, or greater, during both sampling events. While a lower purge rate at some wells was shown to reduce turbidity somewhat, the data are insufficient to determine if an even lower purge rate, for example 100 ml/min, would reduce turbidity to acceptable levels (i.e., <20 NTUs). Based on similar turbidity observations at nearby NTC sites (e.g., OU 2), changes in well construction procedures for SA 17 will be implemented in an attempt to reduce turbidity problems encountered at the site. Specific changes to the procedures for this purpose include:

- Use of 1-inch inside diameter (ID) prepacked wells with additional filter pack installed in the annulus around the prepacked wells.
- Use of hollow stem augers with an auger flight plug to reduce inflow of aquifer material into the augers.
- Use of potable water during drilling and well installation to provide head and thereby reduce inflow of aquifer materials after the plug is knocked out.
- Use of a finer sand pack (U.S. Standard Sieve Size No. 30/45) expected to better match the formation material.

Because of the potential for heaving sands, an auger flight plug will be used during drilling and potable water will be used to maintain a hydraulic head inside the augers during well construction. The depth of



NOTE:

"C" AND "D" WELLS MAY OR MAY NOT BE DOUBLE CASED DEPENDING ON LOCATION.

NOT TO SCALE

FIGURE 3-2
WELL DEPTH SCHEMATIC
STUDY AREA 17 - McCOY ANNEX

NAVAL TRAINING CENTER
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the borehole must be measured prior to installing the well string to ensure that heaving sands have not entered the borehole and it is open to the required depth. If aquifer material has heaved into the borehole, the driller will be directed to clear the borehole (e.g., bail out the loose material). Monitoring wells will be installed through the augers upon completion of each well boring.

Monitoring wells installed in the shallow and intermediate zones (i.e., A, B, and C wells, maximum depth of 55 feet bgs) will be constructed of Schedule 40, flush-joint threaded, 1-inch ID polyvinyl chloride (PVC) riser pipe and flush-joint threaded, factory-slotted well screen with a prepacked filter pack and a flush-threaded end cap. All well screens will be factory-slotted to 0.006-inch size with a 30/65 sieve-size (or equivalent) prepack filter. Each section of well casing and screen will be National Sanitation Foundation approved. Well screens will be 10 feet long for the shallow (A depth) wells and 5 feet long for intermediate (B and C depth) wells. The bottoms of the well screens will be placed a minimum of 6 inches, but no more than 3 feet, above the bottom of the drilled boreholes. Solvents or glues will not be permitted during construction of monitoring wells.

A clean silica sand pack of U.S. Standard Sieve Size No. 30/45 sand will be installed through the augers as the augers are removed from the boring. The sand pack will be extended from 0.5 foot below the well screen to 2.0 feet above the top of the well screen. The top of the sand pack will be sounded to verify its depth during placement. The well will be gently surged with a surge block for approximately 10 minutes to ensure that no bridging of the sand pack has occurred. If after surging the well the sand level subsides, additional sand will be placed into the annulus to return the top of the sand to 2 feet above the top of the screen. In that case, the well will be gently surged again for an additional 10 minutes and, if necessary, sand will be added again to bring the level to 2 feet above the top of the screened interval.

Water table wells (A depth) will be installed with very fine sand above the filter pack because bentonite will not remain hydrated. A minimum 2-foot-thick bentonite pellet seal will be installed above the sand pack for the intermediate wells (B and C depth) and allowed to hydrate as recommended by the manufacturer. The remaining annulus above the hydrated bentonite seal (or fine sand) will be backfilled to the surface, using a tremie pipe, with a 20:1 cement/bentonite grout.

For the deepest wells (i.e., D wells) installed below the Hawthorn clay, a 4-inch ID, Schedule 40 PVC protective casing will be installed a minimum of two feet below the top of the clay and grouted into place. Following a minimum of 24 hours to permit curing of the grout, the well bore will be drilled through the protective casing using mud rotary techniques to total well depth. Because of the expected well depth of approximately 65 feet bgs, stronger, larger diameter well materials will be used. Therefore, these deep wells will be completed using a nominal 2-inch ID well screen with a nominal 3-inch outside diameter

prepacked filter. Wells screens will be 5 feet long and consist of factory-slotted 0.006-inch screen with a 30/65 sieve-size (or equivalent) prepack filter. Because of the working depth and small annular tolerances, the natural formation material will be allowed to collapse around the well screen. If needed, additional filter sand may be placed in the annulus to provide two feet of filter sand above the top of the screen. Above the prepack filter, a minimum of two feet of bentonite (pellets or chips) will be placed, followed by a bentonite-cement grout (see above) to the approximate ground surface. The depths and thicknesses of the well construction materials will be recorded.

3.2.2 Completion Above Grade

A protective steel casing (minimum 4-inch diameter) equipped with a locking steel cap will be installed around each well. A temporary metal identification tag will be placed on the outside of the protective casing. Protective casings will be grouted at least 3 feet into the ground and will have at least one drain hole immediately above the concrete pad; however, the depth of the protective casing may be less if the depth to the top of the well screen is less than 3 feet bgs and/or the water table is shallow. Pea gravel will be placed in the annular space from the ground surface to approximately 6 inches below the top of the well riser. Approximately 3 inches of clearance will be left between the lid of the well cover and the top of the well riser. Prior to installation of the protective casing, a 1/8-inch vent hole will be drilled or slotted in the well riser approximately 2 inches below the well cap. A locking “J-plug type” cap will be placed and secured on top of each well riser to protect from tampering/opening. All locks on all wells (caps and/or casing covers) will be keyed alike with heavy-duty, brass, weather-resistant locks.

A 3-foot by 3-foot by 6-inch-thick concrete apron with a 1-inch per foot slope from the center will be constructed around each well. Where possible, pad edges will be squared to surrounding structures, other concrete pads in the area, and/or property lines. For wells in high traffic areas, four marker posts (4-inch nominal diameter, 5-foot-long steel pipe filled with cement) will be cemented approximately 2 feet into the ground around the outside of the concrete apron.

3.2.3 Flush-Mount Wells

In some areas, such as parking lots or high-traffic areas, flush-mount, sealing well covers will be installed. Vent holes will not be used for flush-mounted well completions. The flush-mount cover will be an 8-inch-round security vault provided with sealing gasket to reduce the water infiltration. Approximately 4 inches of clearance will be left between the lid of the well cover and the top of the well riser. A 2-foot by 2-foot by 6-inch-thick concrete apron (saw-cut or saw-scored and jack-hammered hole in paved areas) will be constructed around each flush-mount well. The flush-mounted casings will be completed 2 inches

above existing grade and the apron tapered to be flush with existing grade at the edges so water will run off the apron.

3.2.4 Well Development

All newly installed monitoring wells will be developed in order to remove residual materials resulting from the well construction and to restore the hydraulic conditions along the well bore. In addition, because potable water will be used to prevent formation heaving during well construction, development will help to mitigate the effects of any water lost to the formation. The aquifer at SA 17 consists predominantly of fine- to coarse- grained, quartz sand, but variable proportions and/or interbeds of fine-grained materials (silts and clay) have been encountered. Because the well screens used will be 5 or 10 feet in length, there is potential for the screened interval to span some of these fine grained formation materials. The intended use of the wells is for groundwater monitoring and future use will be limited to low-yield and low-stress purging or pumping. Therefore, only low-stress, low-yield development methods will be used to avoid damaging the filter pack and to prevent over-development of the formation that could aggravate turbidity problems in the wells.

The preferred method of development will be either surging with a bailer or a surge block, or controlled-stress pumping, or a combination of the two methods. When surging, equipment will be sized and/or equipped with pressure relief devices and operated in a manner to prevent the buildup of excessive pressure that could disturb the filter pack. When pumping, the flow rate will be limited so that the water entrance velocity does not exceed 0.1 feet per second (generally accepted to be the upper limit of linear flow). This flow rate limit can be calculated by multiplying the open area per foot of screen by the submerged screen length and by a factor of 0.31 to determine the maximum gallons per minute (gpm) pumping rate. For example, for a nominal 1-inch diameter PVC, 0.006-inch slotted screen, the maximum pumping rate would be no more than about 0.3 gpm per foot of submerged screen. Temperature, pH, and conductivity will be monitored during development and recorded at regular intervals. If the well is drawn down during pumping it will be allowed to recover prior to commencement of surging activities to focus the energy across the entire saturated interval. Development will be considered complete when the water removed from the well is visibly free of sediment and the water quality parameters have stabilized.

In some instances, such as when the well screen is placed adjacent to very fine grained formations to monitor groundwater plumes, the current “best practice” well design, construction, and development procedures can not sufficiently limit turbidity in monitoring wells. If this situation occurs at SA 17, the field geologist overseeing the well development activities will determine when development is completed, and the contributing conditions will be documented.

3.3 PROCEDURES FOR DPT PURGING AND SAMPLING

DPT groundwater samples will be collected by attaching a factory-slotted well point/screen to the end of the drive rods and advancing the string to the desired sample collection depth. At the desired sampling depth the well point will be exposed to the aquifer and allowed to equilibrate, after which a water level measurement will be recorded. If sufficient water has entered the well point, then sample tubing will be placed down the rods and a peristaltic pump will be used to "purge" the well point. Because DPT samples will be collected nearly immediately, stagnant water will not exist and the goal of purging is to reduce the turbidity and remove the groundwater directly impacted by the installation procedure (USEPA, 2001). Initially during purging, the tubing will be slowly lowered to the bottom of the well point and pumped to remove any accumulated formation material. Afterward, the tubing will be slowly raised to near the top of the water column. If the water level is drawn down, the pump rate will be lowered to the extent practicable, or the tubing will be lowered to chase the water level. Continued pumping in this manner should result in a relatively clear, low turbidity sample. After the water clears, pumping will continue until three readings, at 5-minute intervals, of pH, specific conductivity, temperature, and turbidity are recorded. Note when fine-grained formations are encountered, the well point yield may not allow sustained pumping and several cycles of pumping may be required to attain a relatively clear sample. Also, in fine-grained formations, purging may be unable to produce a low turbidity, clear sample. Because the DPT samples are intended for screening for VOCs, extended effort to reduce sample turbidity is not justified and the best sample obtainable will be collected. Samples for VOC analyses will be collected by stopping the pump, crimping the discharge end of the tubing, removing the tubing, and allowing the water in the tubing to gravity flow out the bottom of the tubing into the laboratory sample container.

If screening samples are to be collected at deeper depths at the same DPT location, two options may be utilized. Option 1 consists of removing the sample tubing and purging the drive rods and well point with deionized water prior to advancing to the next sample depth. Option 2 consists of removing and grouting the first DPT hole, moving laterally a few feet, and driving a new hole to the next sample depth using pre-cleaned rods and a clean well point. The option selected may depend on the accessibility to decontamination facilities, the number of drive rods and well points available, and the level of contamination anticipated down the hole.

Once sampling at a given DPT location is completed, the rods and well point will be removed from the hole and the hole will be abandoned. The hole will be abandoned by re-entering the rods in the hole without the well point to total depth and then simultaneously pumping grout down the rods as the rods are

removed. The surface of all holes will be finished smooth to grade with a material consistent and/or compatible with the existing surface.

In summary, the techniques for DPT sampling at SA 17 will be consistent with the POP (ABB-ES, 1997), FDEP SOPs (January 2002), and the USEPA EISOPQAM (November 2001), whenever applicable, noting that site-specific conditions may require adjustments in the methodology.

3.4 PURGING PROCEDURES FOR MONITORING WELLS

The monitoring wells at SA 17 are to be purged using micro-flow purging techniques to minimize the volume of groundwater that must be containerized, managed, and disposed. Purging will commence following completion of well development. Peristaltic pumps and new, dedicated polyethylene (PE), polypropylene (PP), Teflon®, or Teflon-lined tubing will be used for both purging and sampling of the wells. The tubing used in the pump head will consist of clean, dedicated silastic, PE, PP, Teflon®, or Teflon-lined tubing. Calibrated field meters consisting of either in-line flow-through cells or cleaned, down-hole instrument probes will be used for real-time parameter monitoring during well purging. Identifying numbers, descriptions, and calibration of any purging/sampling equipment will be recorded. If possible, samples will be collected from the least contaminated location first, then proceed to more highly contaminated locations.

Prior to the initiation of purging, the following tasks will be completed:

- All down-hole equipment will be properly decontaminated.
- An equipment blank will be collected for each lot of new tubing used during the purging/sampling event.
- Purge/sample tubing will be precut at an off-site clean location, bagged, and transported to the sample location.
- New, clean, plastic sheeting will be placed on the ground surface around the well head to help prevent contamination of the well or sampling equipment.
- The water level in the well will be measured and recorded.
- If undocumented, the total well depth will be measured and recorded.
- The well volume will be calculated and recorded.
- The combined volume of the tubing, pump, and flow through cell (if used) will be calculated and recorded.

The steps listed below are to be followed for the purging procedure.

1. The discharge tubing will be lowered into the well as slowly as possible to minimize disturbance to the water in the well.

2. The end of the tubing will be positioned at the midpoint of the saturated screen length. The end of the tubing will be kept at least 2 feet above the bottom of the well to minimize mobilization of any particulates present (where practical).

3. The water level will be measured and recorded before starting the pump.

4. Purging will begin with the pump at the lowest setting and will slowly increase until discharge occurs.

5. The water level will be checked again and the pump speed adjusted to balance the pump rate with the well yield to prevent drawdown. The water level and pumping rate will be monitored and recorded every 3 to 5 minutes (or as appropriate) during purging.

   Note: Adjustments are best made during the first 15 minutes of pumping to minimize purging time. During pump start-up, drawdown may occur, but then the well may recover as pump rate adjustments are made. Unless site conditions warrant a change, purging will proceed at a rate of approximately 100 milliliters per minute (mL/min). Note that during the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress and recording those adjustments.

6. After water level stabilization: for <u>submerged well screens</u> purge one combined volume of the tubing/pump/flow cell prior to recording field parameters; for <u>partially submerged well screens</u> purge <u>one well volume</u> prior to recording field parameters. Subsequently, field parameters will be monitored and recorded every 3 to 5 minutes (or longer if appropriate) until stabilization.

7. Purging will be considered complete when three consecutive measurements meet all criteria in the following table.

Parameter	Unit	Limit
Temperature	Degrees Celsius (°C)	± 0.2 °C
Specific Conductance	Micro-siemens/centimeter (μs/cm)	± 5%
pH	Standard Unit (SU)	± 0.2
Dissolved Oxygen (DO)	Milligrams per liter (mg/L)	≤ 20% of saturation at field temp. (FDEP Table FS2200-2)[a]
Turbidity	Nephelometric Turbidity Unit (NTU)	≤ 20 NTU[b]

[a] Alternatively (when DO is >20% of saturation), if DO ≤ 2 mg/L, then ± 0.2 mg/L; if DO > 2 mg/L, then ± 10%

[b] Alternatively (when turbidity is >20 NTUs), if turbidity ≤ 50 NTUs, then ± 5 NTUs; if turbidity >50 NTUs, then ± 10%

8. If either of the purging completion criteria in the above table is not met, but have become asymptotic for 60 minutes, consult with the project leader to determine when/if a sample should be collected.

9. For a well with a submerged well screen, purge at least three volumes of the combined tubing/pump/flow cell volume prior to sample collection.

3.5 MONITORING WELL SAMPLING PROCEDURES

All newly installed wells will be sampled for Target Compound List (TCL) VOCs only. Sampling will commence following completion of the well development and purging. Sampling will be conducted using the same tubing and peristaltic pump that was used to purge the well. When purging is complete, samples for VOCs will be collected using the tube evacuation method (ABB-ES, 1997), as follows:

- Fresh gloves will be donned by the sampler.
- The peristaltic pump will be stopped, the tubing will be disconnected prior to the pump head, and a gloved finger will be placed over the end of the tubing to trap the water.
- The tubing will be gently lifted out of the well, ensuring that the open, bottom end of the tubing does not become contaminated outside the well.
- The water trapped in the tubing will be released and allowed to slowly flow into the clean, preserved sample container provided by the laboratory.

The following tasks will be performed when collecting groundwater samples from wells.

- Fresh gloves will be worn for each sample collected.
- A fresh, clean plastic sheet will be placed on the ground around the well head.

- All samples will be immediately preserved according to the analytical method requirements.
- Sample containers will be immediately labeled and placed on wet ice in a cooler that has been thoroughly washed prior to use; a clean, untreated plastic bag will be used to line the cooler.
- The sample log form will be completed, and the event will be recorded in the field logbook.

3.5.1 Sample Numbering

The monitoring well samples will be numbered as follows:

NTC17*TWWWRR*

where: NTC = Naval Training Center
17 = two-digit SA designation (17)
T = sample type (“G” for groundwater, “D” for duplicate)
WWW = well location and screen depth designation (e.g., 17C)
RR = sampling round number (e.g., 10)

For example, a groundwater sample collected from well OLD-17-20C at SA 17 during sampling round 10 would be designated NTC17G20C10. Samples for field duplicates will be identified with a "blind" number (e.g., NTC17D1000) that is documented in the field logbook along with the corresponding environmental sample. The Task Order Manager will identify the appropriate round number.

3.5.2 Quality Control (QC) Samples

QC samples will be collected at the frequencies listed below.

- One equipment blank per lot (e.g., roll) of purging/sample tubing
- One field duplicate per 10 environmental samples.
- One trip blank per cooler containing samples for VOC analysis.
- One matrix spike/matrix spike duplicate (MS/MSD) per 20 environmental samples.

"MS/MSD" will be added to the sample number on the labels and the chain of custody. New sample numbers will not be created for these samples. MS/MSD samples will be collected in the field by the Field Operations Leader and will require 3X sample volume for each set (1X for environmental sample, 1X for MS sample, and 1X for MSD sample).

If any nondisposable sampling equipment is used and decontaminated, the additional QC samples listed below will be collected.

- One rinsate blank per 10 environmental samples.
- One field blank from each water source used for decontamination.

3.5.3 Sample Shipping

Environmental samples (and associated QC samples) will be shipped via overnight courier on a daily basis to the subcontract fixed-base laboratory. The shipping address and contact information will be provided in the Field Instruction to be prepared for each field event.

3.6 PROCEDURES FOR WATER LEVEL MEASUREMENTS

Following the installation and development of the proposed monitoring wells, a comprehensive, synoptic round of water levels will be collected in all wells at SA 17. Well caps will be removed at least one half-hour before the water levels are first measured. A photoionization detector (PID), or equivalent, will be used to screen for VOCs immediately after well cap removal. A second round of water levels will be collected a minimum of one half-hour after the initial round. If the difference in water levels is greater than 0.10 foot, measurements will continue to be taken every half-hour until the water level stabilizes, or for a maximum of four, sequential measurements.

4.0 DECONTAMINATION

Decontamination of any nondedicated sampling equipment used will be performed in accordance with procedures specified in FDEP SOP 001-01 (January 2002) unless otherwise specified herein. Cleaning will be performed under controlled conditions (i.e., cleaning on site is not recommended, but may follow criteria specified in the FDEP SOPs).

Dedicated PE, PP, Teflon®, or Teflon-lined tubing will be used for purging and sampling the wells for VOCs. Peristaltic pumps will be used for the well purging and for sampling. If redevelopment is required for problematic monitoring wells, centrifugal pumps may be used downhole. The pump body and internal mechanisms, including seals and connections, must comply with FDEP SOPs (January 2002) Tables FS 1000-1, 1000-2, and 1000-3 (i.e., must be Teflon and/or stainless steel construction). All downhole pumps used for purging or sampling VOCs will be decontaminated using the following steps:

1. Rinse pump in hot tap water.
2. Soak pump in hot, sudsy water solution (Liqui-Nox or equivalent).
3. Scrub exterior to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. Rinse with isopropanol.
6. Rinse with analyte-free water.
7. Allow to completely air dry; wrap and seal until used.

Notes: Ambient temperature water may be substituted for hot water if unavailable.
If plastic sampling equipment is to be cleaned, substitute appropriate acid solution for isopropanol (see FDEP SOP FC1001).

All other sampling tools and miscellaneous sampling equipment will be decontaminated using the following steps:

1. Wash with potable water and Liqui-Nox or equivalent.
2. Rinse thoroughly with potable water.
3. Rinse with deionized water or analyte-free water.
4. Rinse with isopropanol.
5. Rinse with analyte-free water and air dry.
6. Wrap with aluminum foil.

Note: The isoproponal rinse may be omitted for delicate equipment such as meter bodies, probes, or cables.

5.0 DATA QUALITY

5.1 DATA QUALITY OBJECTIVES (DQOs)

DQOs are qualitative or quantitative statements developed by the data user to specify the quality of data needed from a particular data activity to support specific decisions. The DQOs are the starting point in the design of an investigation. The DQO development process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data satisfies project requirements.

The DQOs for laboratory analyses will be characterized by rigorous quality assurance (QA)/QC protocols and documentation, providing technically defensible analytical data. The intended uses of the hydrogeologic and analytical data collected will be to evaluate contaminant migration, flow gradients, and geochemistry to determine the extent of concentrations greater than GCTLs in the aquifer and to serve as a basis for future plume monitoring.

5.2 DATA VALIDATION

The approach to providing reliable data that meet the DQOs will include QA/QC requirements for each of the VOC data generated during the field investigation. The QA/QC efforts for laboratory analyses will include collection and submittal of QC samples and the assessment and validation of data from the subcontract laboratory.

Data quality indicators include the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. These parameters will be used within the data validation process to evaluate data quality. The data will be validated in accordance with the USEPA Contract Laboratory Program (CLP) guidelines for organic data review (USEPA, 1999) and the Naval Facilities Engineering Service Center (NFESC) guidelines contained in *Navy Installation Restoration Chemical Data Quality Manual* (NFESC, 1999).

Limited data validation will be performed on all laboratory data and will evaluate data completeness, holding time compliance, calibration compliance, laboratory blank contamination, and detection limits. This type of validation will be performed primarily to eliminate false positives and false negatives.

6.0 INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT

Soil cuttings from DPT and monitoring well installation will be temporarily stored in a roll-off bin or drums. Drilling mud from monitoring well installation will be stored in Department of Transportation-approved 55-gallon steel drums or in a manner approved by the base contact. Decontamination fluids, well development water, and purge water will be temporarily stored in a poly tank or drums. Solids will be sampled, analyzed, and disposed of by a licensed waste hauler following completion of monitoring well sampling at the site. The results of DPT and monitoring well sample analyses will be used by a licensed waste hauler to determine proper disposal of the collected fluids. Each drum will be clearly marked with the following information or as otherwise directed by the base contact:

- Company name (Tetra Tech NUS).
- Base contact (Barbara Nwokike) and phone number (843-820-5566 or 407-895-6714).
- Identification number (TtNUS-SSSS-XXX), where SSSS is the site identifier (e.g., SA 17) and XXX is the well number (e.g., 13C).
- Material contained in the drum (e.g., soil cuttings or purge water).
- Date the IDW was produced.
- Site.

Miscellaneous sampling material (e.g., gloves, tubing, and plastic) will be disposed of in approved dumpsters located in Area C near Building 1056 on Seabee Street.

7.0 LOGBOOKS AND FORMS

The site logbook is a hard-bound, with pre-printed page numbers, controlled-distribution record book in which all major on-site activities are documented. The following information will be recorded in the site logbook in real time on a daily basis:

- Study Area, Operable Unit, or tank site.
- All field personnel present.
- Arrival/departure of site visitors.
- Arrival/departure of major equipment.
- Start/completion of borehole/monitoring well installation or sampling event.
- Weather conditions.
- Health and safety issues including daily safety meetings.
- Problems encountered.
- Deviations from standard operating procedures and documentation explaining rationale.
- Record of pertinent phone calls.
- Sampling information including sample number, QC samples, date and time of collection, analyses to be performed, and the chain-of-custody number.
- Documentation of decontamination activities.
- Documentation of sample storage and shipping information, including all sample numbers and the shipper's airbill number used for each shipment.
- IDW information (location where IDW originated, material in the drums, date produced, and location where drums were left).
- Signature and date at the completion of daily entries.

All pertinent information gathered during the monitoring well installation and sampling activities -- including installation, development, water level surveys, purging, and sampling -- will be written in detail on boring logs, well construction logs, water level survey logs, and purging/sampling logs. In addition to

the general entries placed into the logbook, detailed entries will be made on the appropriate sampling forms and will include (at a minimum) those items listed below:

Groundwater

- Date of purge/sampling.
- Personnel performing the purge/sampling.
- PID reading at top of casing (TOC).
- Groundwater elevation measurements (depths below TOC) prior to placing the tubing in the well and again prior to pump startup.
- Volume of water in the well; volume of water in the tubing/pump/flow cell, as applicable.
- Time, water level, and flow rate during purging (at 3- to 5-minute intervals, or as appropriate).
- Time and values of field parameters during purging (at 3- to 5-minute intervals after drawdown stabilization, or as appropriate).
- Estimated volume of purge water, time, sample number, and all analytical parameters during sampling.
- QC sample identification and number.

Soil Boring / Well Installation

- Date/time of boring and well construction.
- PID (or equivalent) readings of top of borehole, well head, breathing zone, and soil samples.
- Boring/well number, relative location on site, depth intervals, descriptions/classifications of formations penetrated, total boring depth.
- Depth that water was encountered in boring, static water level.
- Source of any water used.
- All well construction intervals, all materials and quantities used.
- Management of soil cuttings, fluids.

8.0 CONTACTS

The following personnel are approved contacts for their respective project areas.

Project Area	Responsible Personnel	Phone Number
Base Contact	Barbara Nwokike	843-820-5566 or 407-895-6714
Task Order Management	Steven McCoy	865-220-4730
Technical Issues	Michael Campbell or Allan Jenkins	865-220-4714 or - 4724
Health & Safety	Matt Soltis	413-921-8912
Procurement	Sandy D'Alessandris	413-921-8435
Laboratory Services	[a]	[a]
Analytical Issues	Joe Samchuck	413-921-8510
Drilling Contractor	[a]	[a]

[a] To be provided in the Field Instruction for each field event.

REFERENCES

ABB-ES (ABB Environmental Services, Inc.), 1997. *Project Operations Plan for Site Investigations and Remedial Investigations.* Naval Training Center, Orlando, Florida.

AFCEE (Air Force Center for Environmental Excellence), 1995. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater, Technology Transfer Division, Brooks Air Force Base, San Antonio, Texas.

CCI (CH2MHill Constructors, Inc.), 2000a. *Phases I and II Confirmatory Sampling Data Report for Study Area 17,* Naval Training Center, Orlando, Florida.

CCI, 2000b. *Work Plan for In-Situ Chemical Oxidation IRA at Study Area 17,* Naval Training Center, Orlando, Florida.

Florida Department of Environmental Protection, 2002. *DEP Standard Operating Procedures for Laboratory Operations and Sample Collection Activities.* DEP QA-001/01, January.

GCI (Geo-Cleanse International, Inc.), 2001. *Phase III Groundwater Investigation Report, Draft, Study Area 17,* Naval Training Center, Orlando, Florida.

HLA (Harding Lawson Associates, Inc.), 1999. *Base Realignment and Closure Environmental Site Screening Report, Study Area 17,* Naval Training Center, Orlando, Florida.

NFESC (Naval Facilities Engineering Service Center), 1999. *Navy Installation Restoration Chemical Data Quality Manual*, September.

SUPSHIP (Supervisor of Shipbuilding, Conversion and Repair – Environmental Detachment, Charleston, S. C.), 1999. *Completion Report, Interim Remedial Action at SA 17, 18, 23, 35, 37, 40, and OU 3 & 4*, Naval Training Center and McCoy Annex, Orlando, Florida.

Tetra Tech NUS, Inc., 2001. *Health and Safety Plan for Performing Investigative Work and Data Sampling*, April.

USEPA, 1999. *USEPA Contract Laboratory Program: National Functional Guidelines for Organic Data Review.* EPA/540/R-99/008, Office of Solid Waste and Emergency Response, Washington, D.C., October.

USEPA, 2001. *Environmental Investigations, Standard Operating Procedures and Quality Assurance Manual* including 1997 revisions. Region 4 Science and Ecosystem Support Division, Enforcement and Investigation Branch, November.

APPENDIX A

FIGURES FROM PREVIOUS INVESTIGATION REPORTS

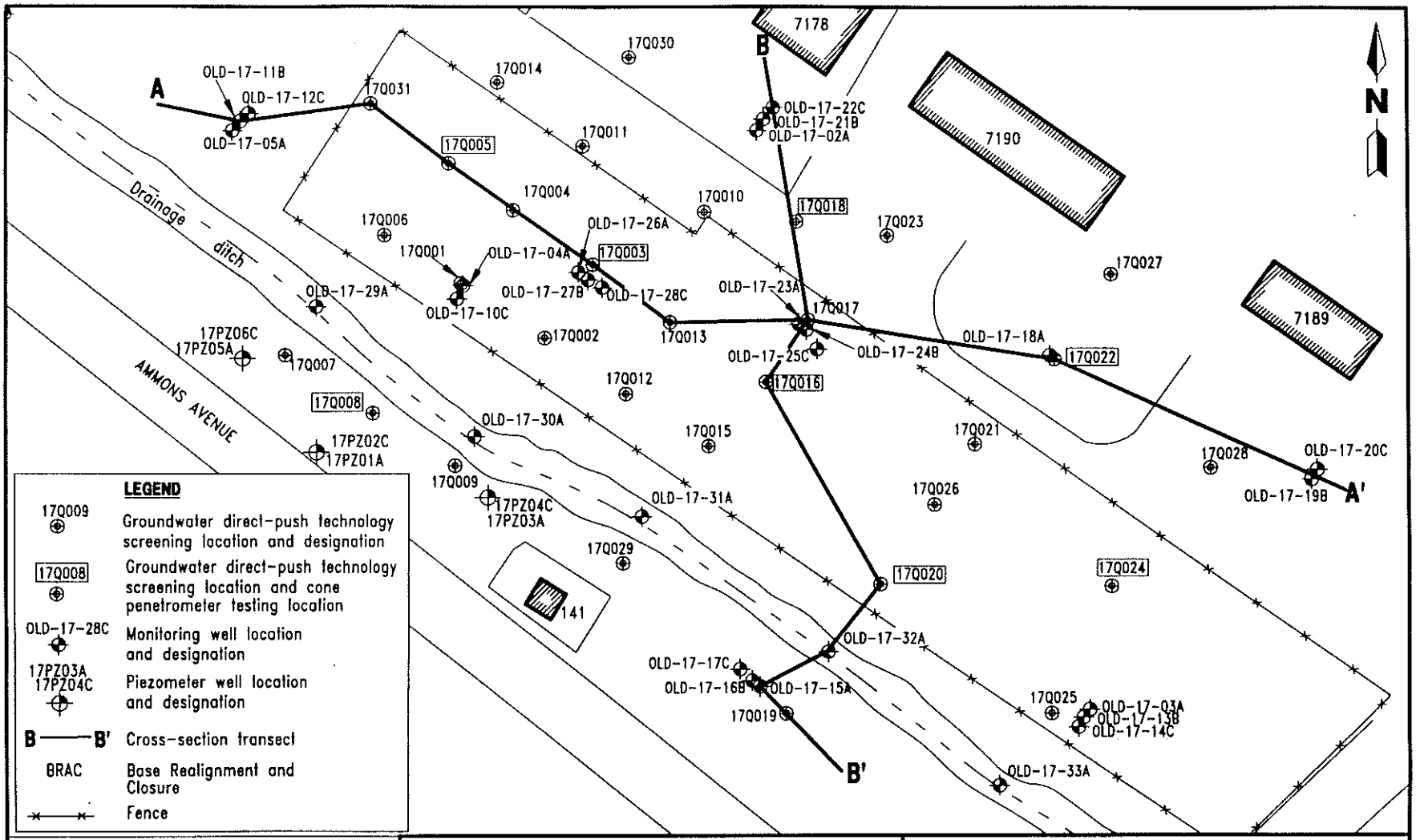

FIGURE 4-2
LOCATION OF SCREENING POINTS AND PERMANENT MONITORING WELLS, GROUNDWATER EVALUATION PHASE II

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA

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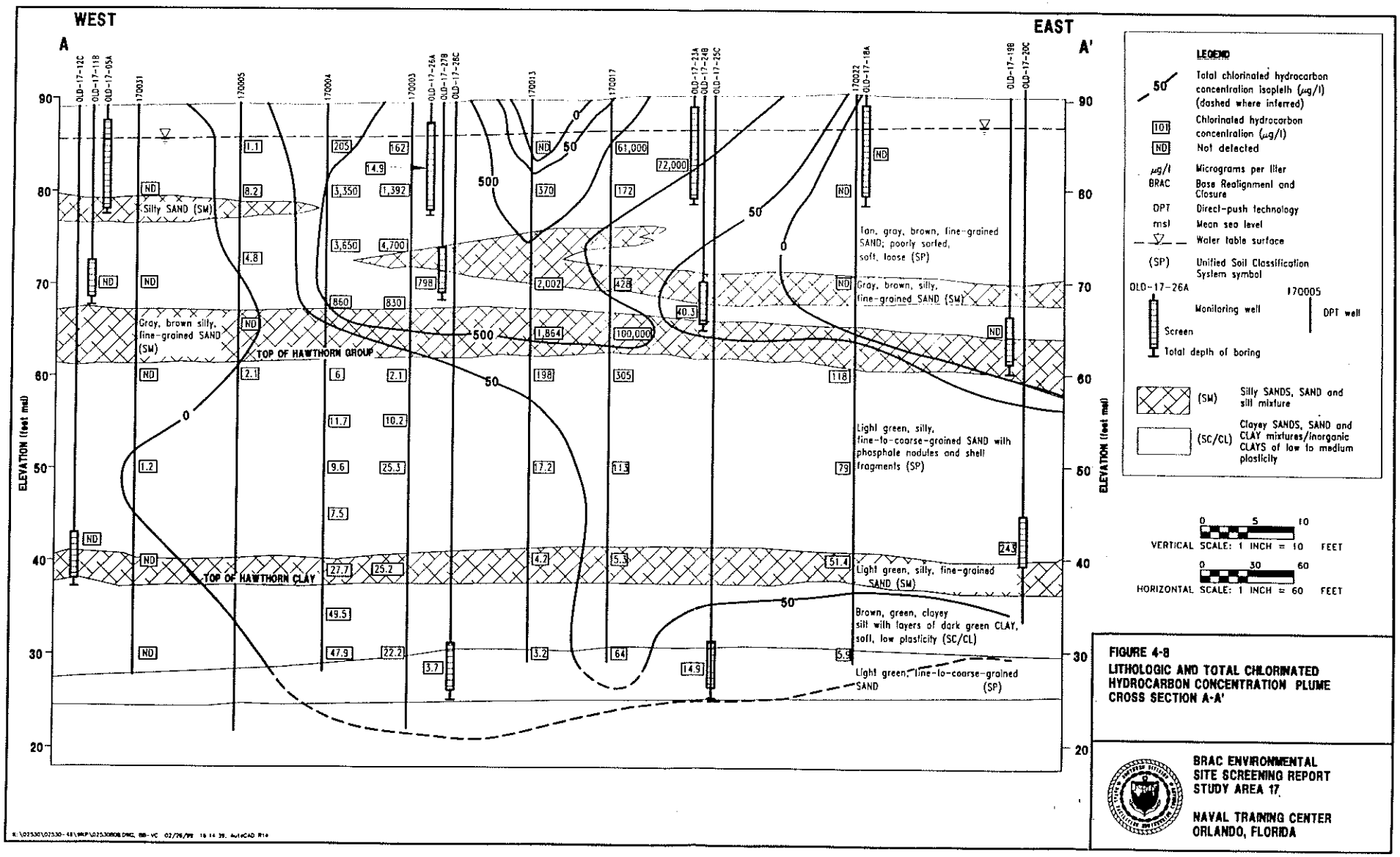
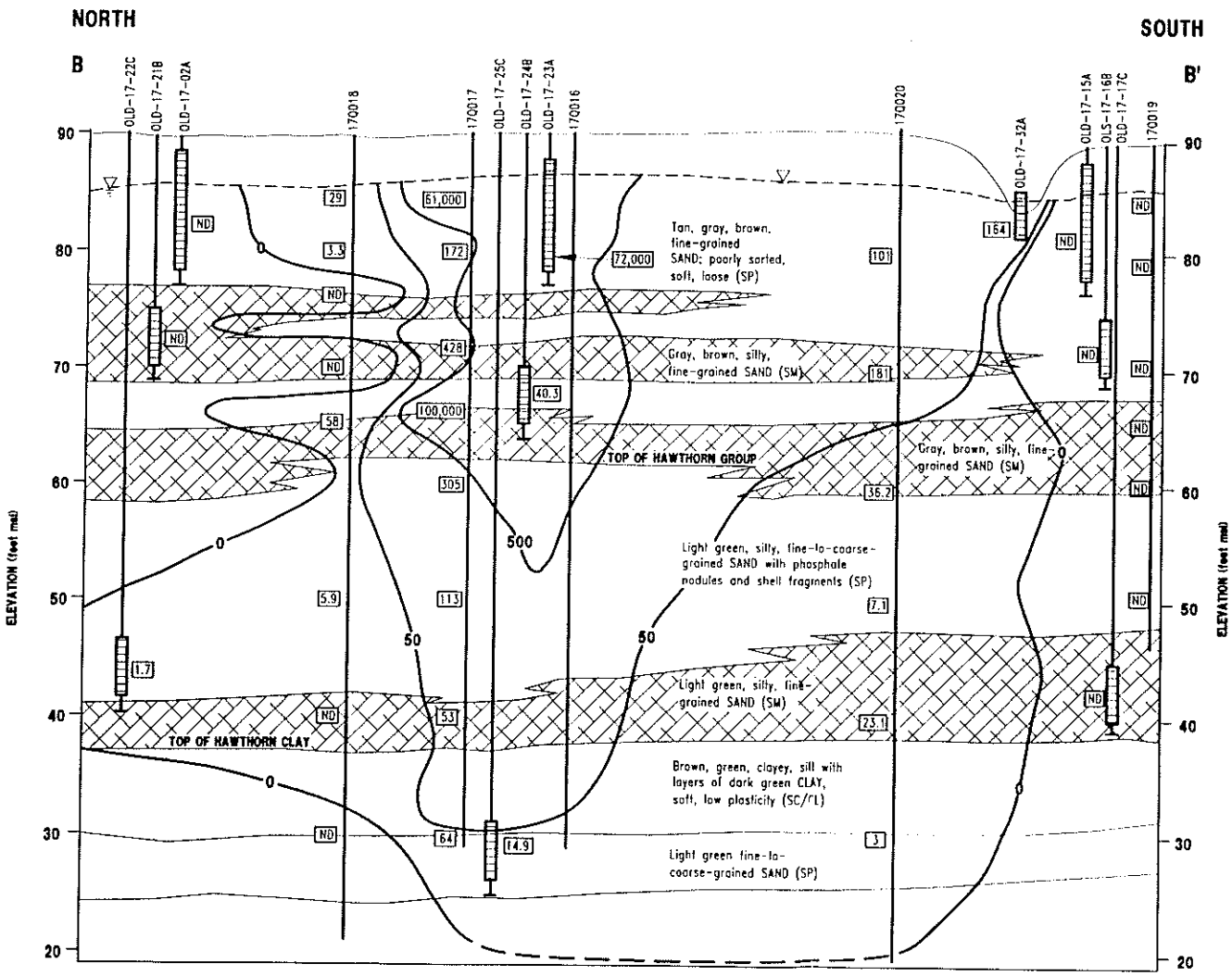


FIGURE 4-8
LITHOLOGIC AND TOTAL CHLORINATED HYDROCARBON CONCENTRATION PLUME CROSS SECTION A-A'

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA



LEGEND

- 50 — Total chlorinated hydrocarbon concentration isopleth (dashed where inferred)
- 101 — Chlorinated hydrocarbon concentration (µg/l)
- ND — Not detected
- µg/l — Micrograms per liter
- BRAC — Base Realignment and Closure
- DPT — Direct-push technology
- msl — Mean sea level
- Water table surface
- (SP) — Unified Soil Classification System symbol
- OLD-17-18A — Monitoring well; Screen; Total depth of boring
- 170022 — DPT well
- (SM) — Silty SANDS, SAND and silt mixture
- (SC/CL) — Clayey SANDS, SAND and CLAY mixtures/inorganic CLAYS of low to medium plasticity

VERTICAL SCALE: 1 INCH = 10 FEET

HORIZONTAL SCALE: 1 INCH = 50 FEET

FIGURE 4-9
LITHOLOGIC AND TOTAL CHLORINATED HYDROCARBON CONCENTRATION PLUME CROSS SECTION B-B'

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA

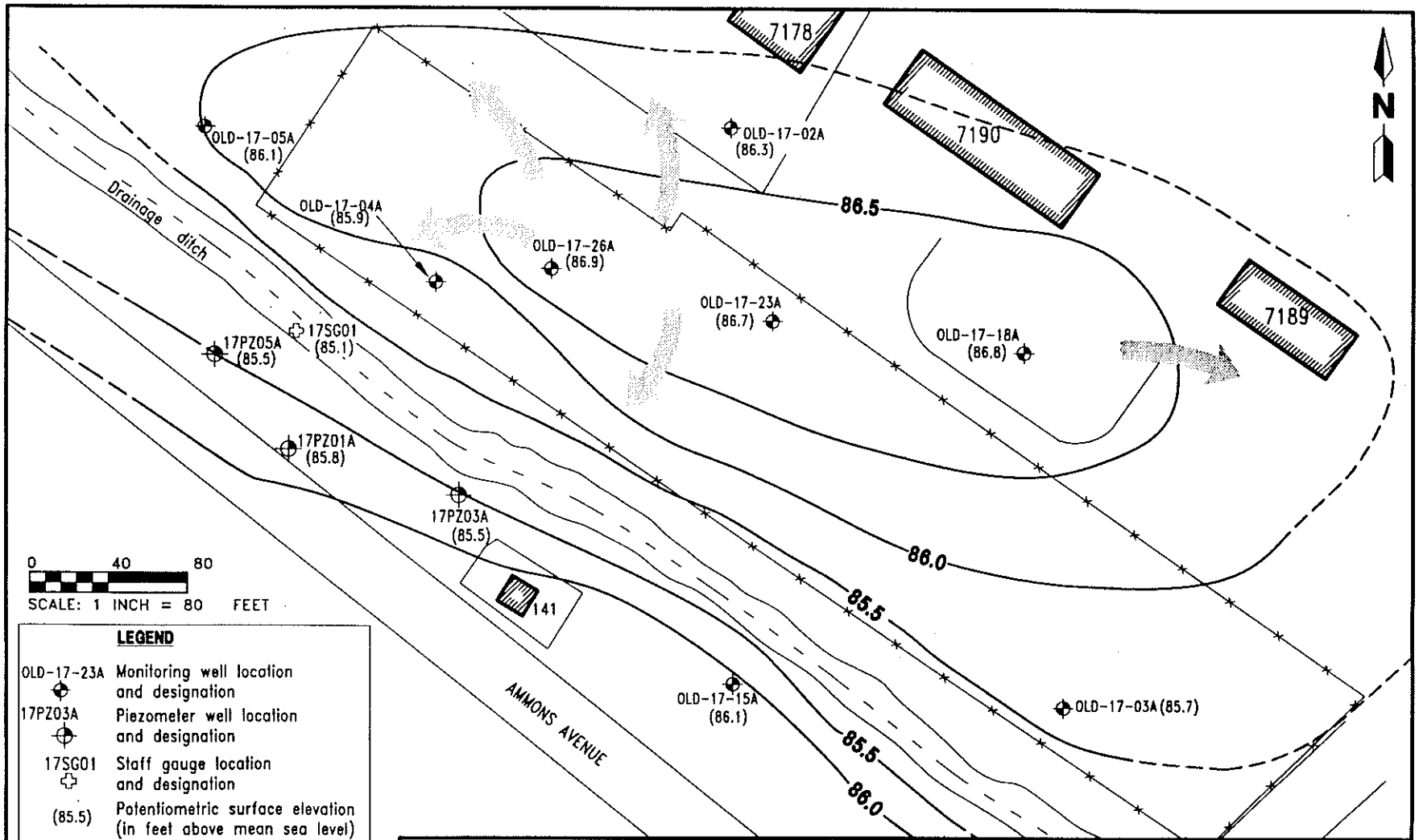
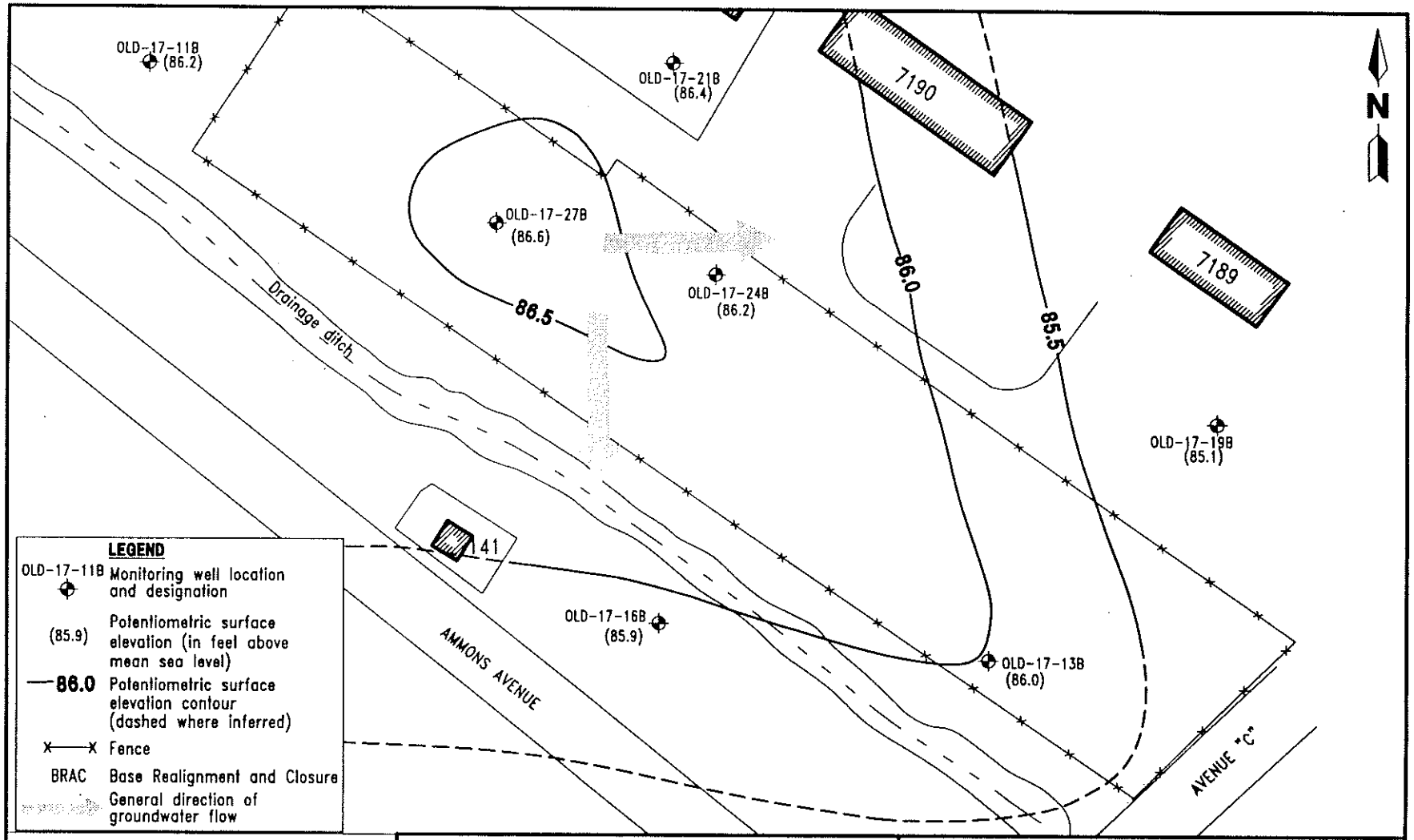


FIGURE 4-10
POTENTIOMETRIC SURFACE CONTOUR MAP
WATER TABLE SURFACE

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA



0 40 80
SCALE: 1 INCH = 80 FEET

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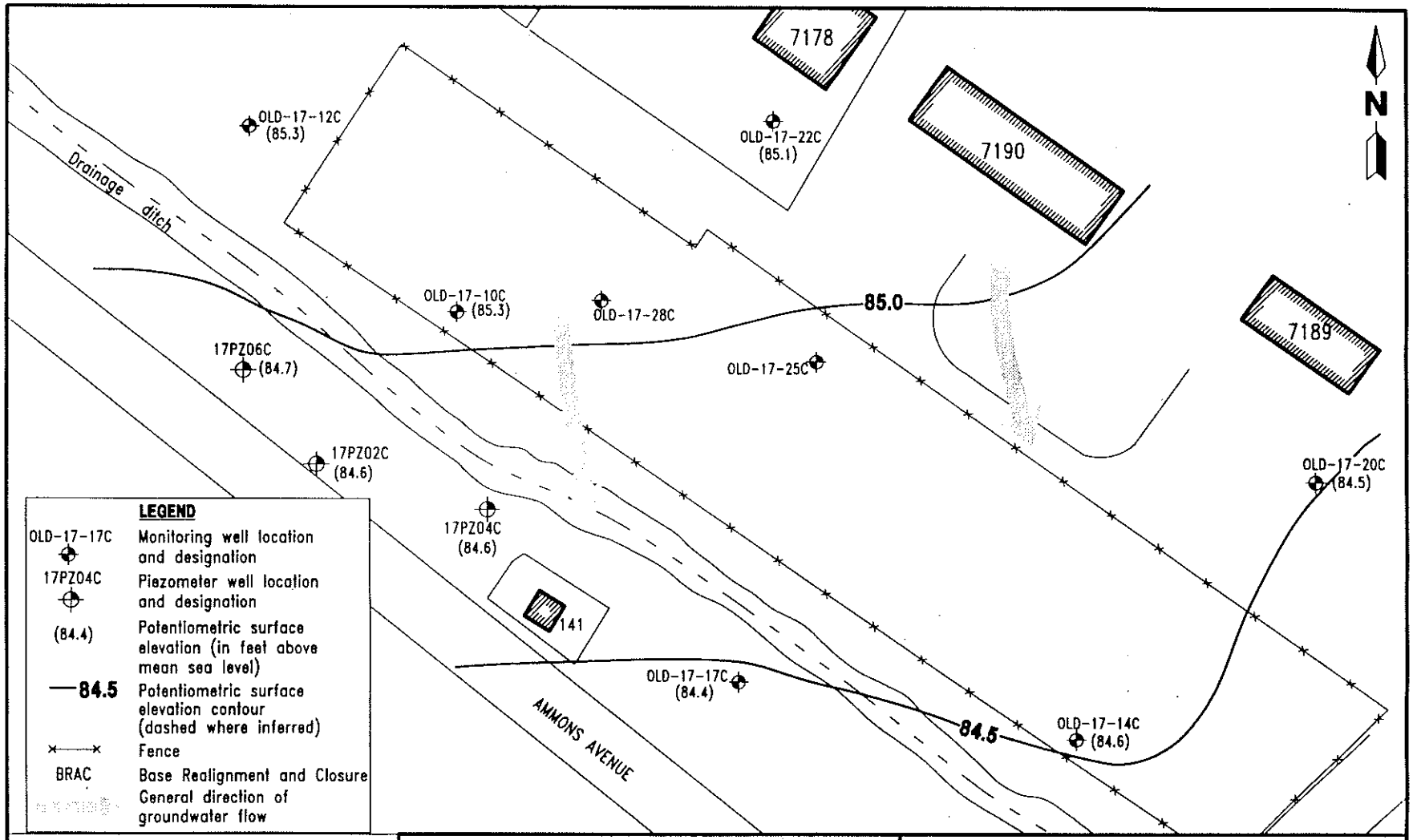
FIGURE 4-11
POTENTIOMETRIC SURFACE CONTOUR MAP
INTERMEDIATE ZONE

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA



0 40 80
SCALE: 1 INCH = 80 FEET

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FIGURE 4-12
POTENTIOMETRIC SURFACE CONTOUR MAP
DEEP ZONE

BRAC ENVIRONMENTAL SITE SCREENING REPORT STUDY AREA 17

NAVAL TRAINING CENTER ORLANDO, FLORIDA

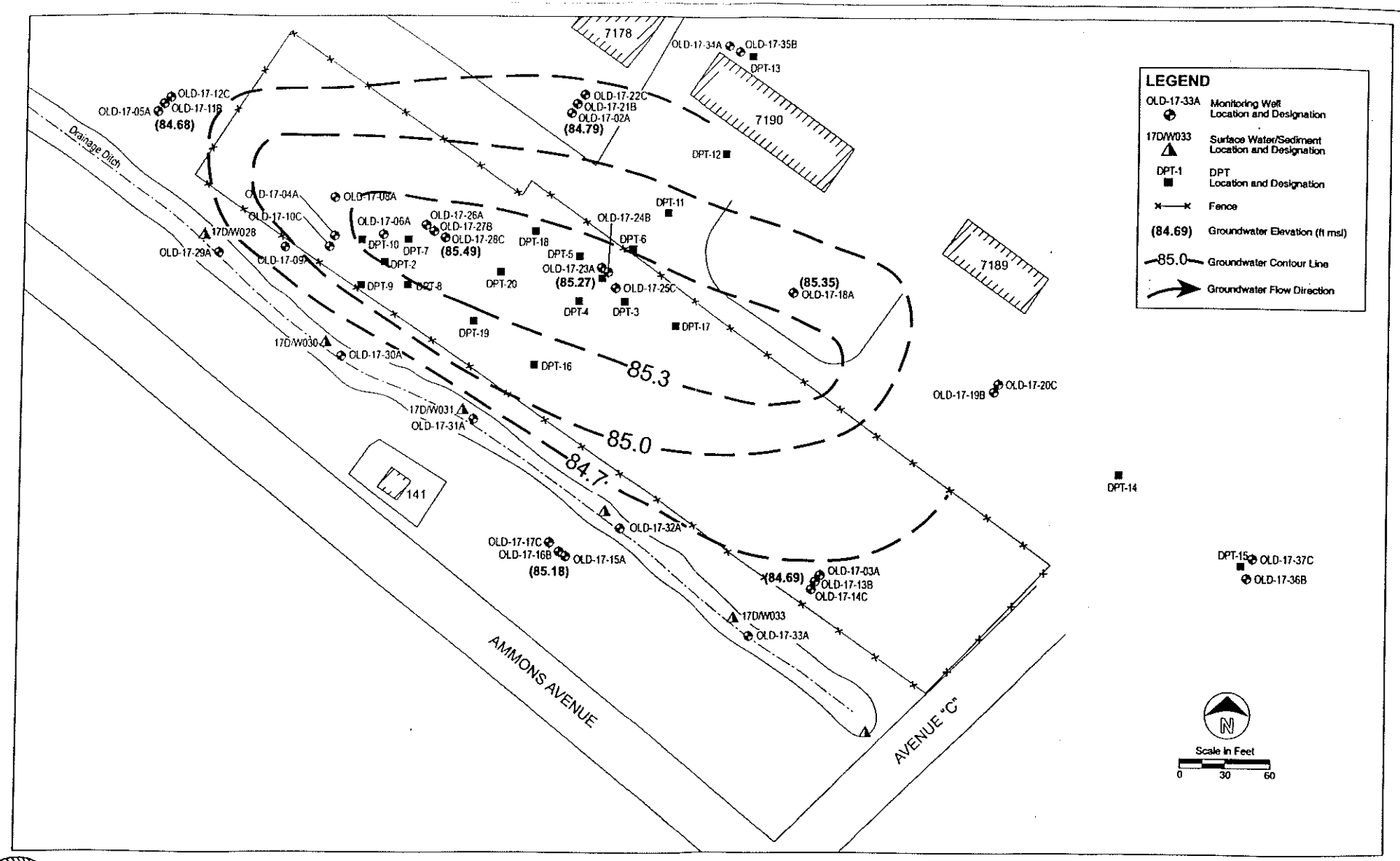


FIGURE 6
Shallow Groundwater Contour Map, SA17
April 28, 2000
Study Area 17, Naval Training Center, Orlando, Florida

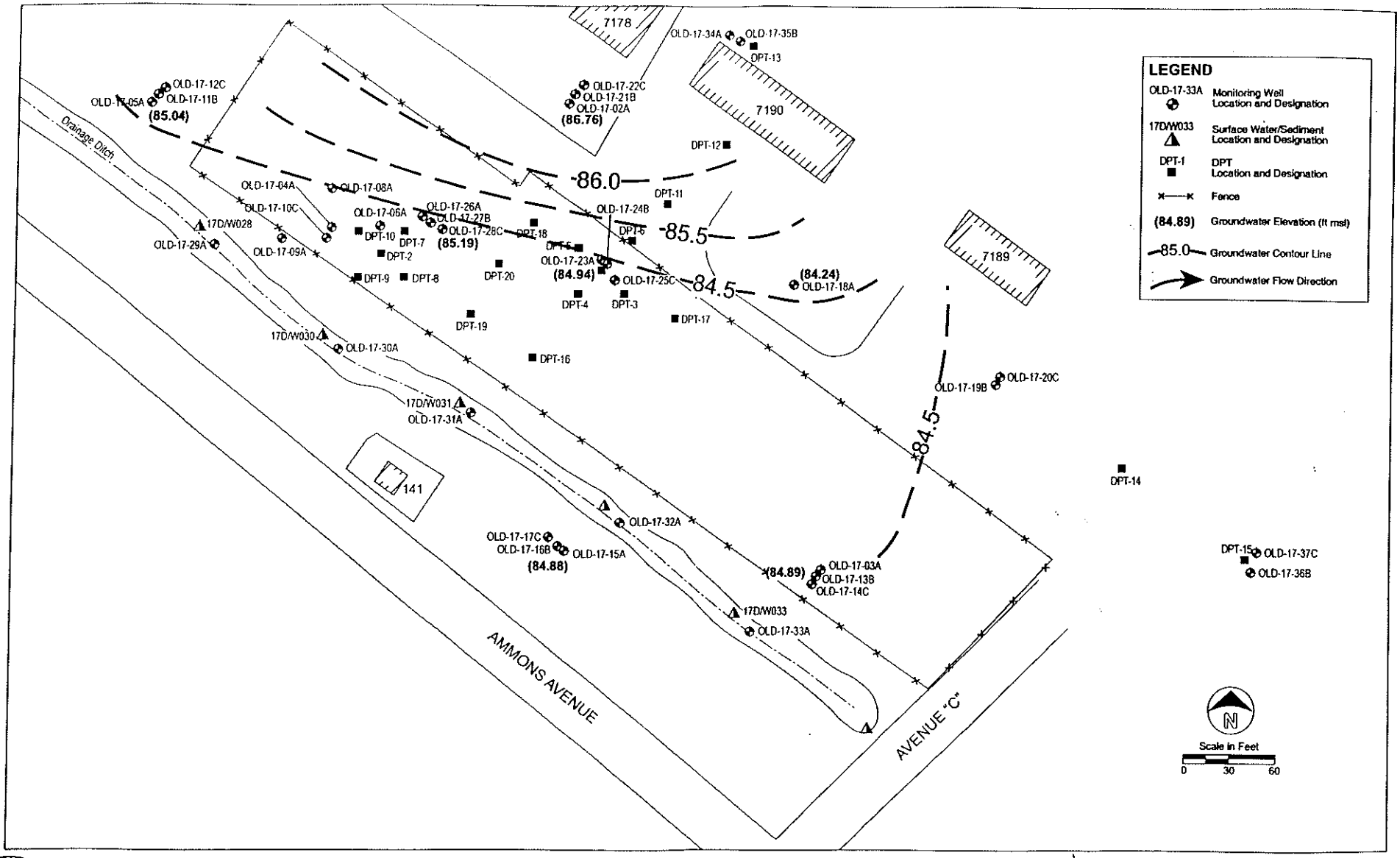


FIGURE 7
Intermediate Groundwater Contour Map, SA17
April 28, 2000
Study Area 17, Naval Training Center, Orlando, Florida

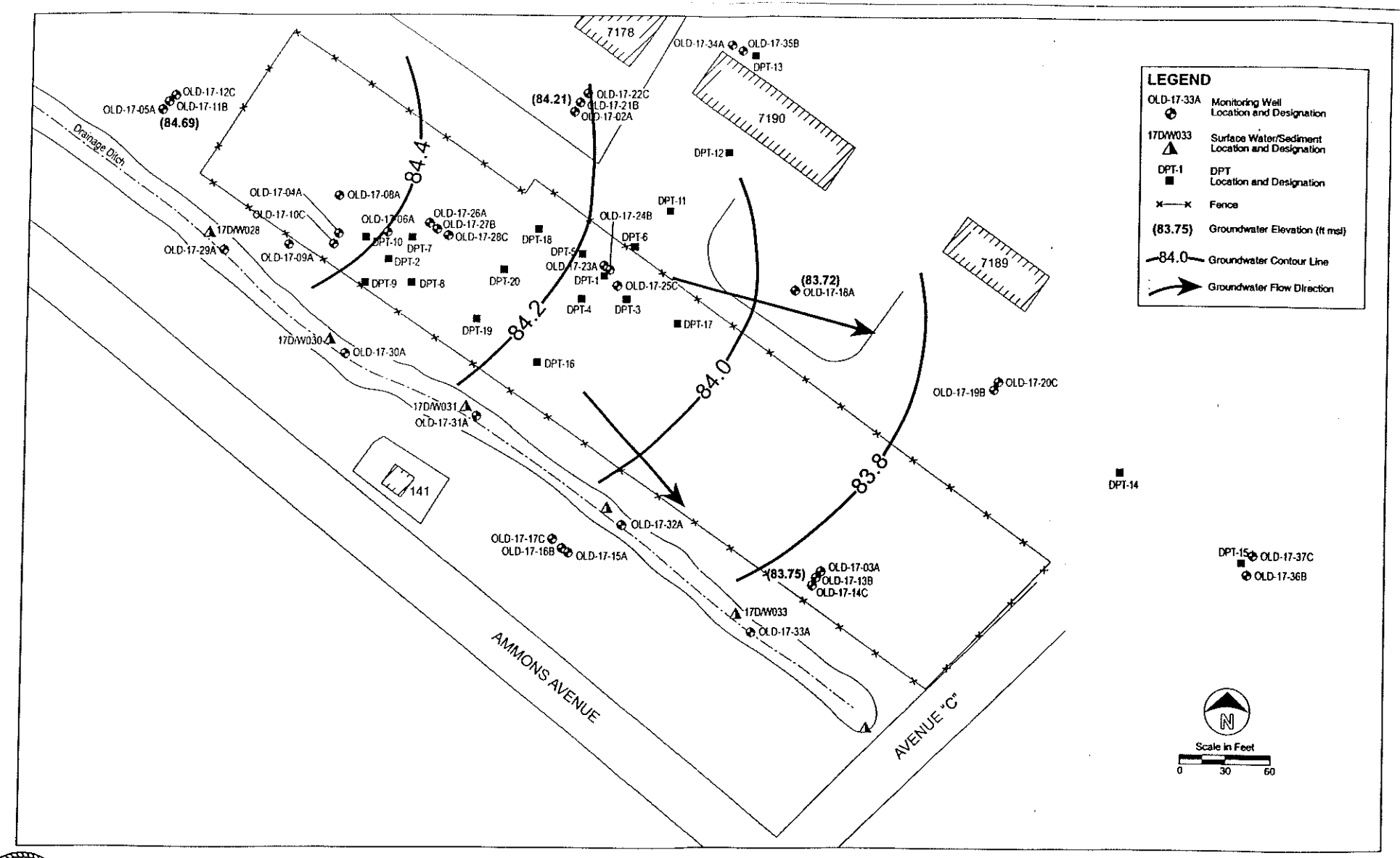


FIGURE 8
Deep Groundwater Contour Map, SA17
April 28, 2000
Study Area 17, Naval Training Center, Orlando, Florida

APPENDIX B

CALCULATION OF GROUNDWATER AND CONTAMINANT FLOW VELOCITY

CLIENT NTC Orlando, Study Area 17		JOB NUMBER N4206
SUBJECT Groundwater and Contaminant Velocity Calculations		
BASED ON See Below		DRAWING NUMBER
BY A. Jenkins	CHECKED BY P. Juriasingani	DATE 05/06/02

Problem: Determine the groundwater seepage velocity and contaminant velocity for the A, B, and C aquifer zones at SA-17.

Solution: The following formulas may be used to calculate the desired velocities.

GW Seepage Velocity, Vs = Ki/Ne

Where K = hydraulic conductivity
i = hydraulic gradient
Ne = aquifer effective porosity

Contaminant Velocity, Vc = Vs/R

Where R, coefficient of retardation = 1 + (Db)(Kd)/N

Where Db = aquifer dry bulk density
Kd = partition coefficient
N = aquifer total porosity

The above formulas are based on advection and adsorption/desorption of contaminants, but ignore the potential effects of dispersion and biodegradation.

Given: Water level measurements collected during July 1998 were used to map the potentiometric surfaces for the A, B, and C aquifer zones in the ESSR (HLA, 1999). Based on these contour maps, the following horizontal hydraulic gradients were presented in the ESSR:

Aquifer Zone	July Gradient
A	0.004
B	0.003
C	0.002

Slug tests were presented in the ESSR (HLA, 1999) for four wells in each of the A, B, and C aquifer depths. This data was used to calculate the geometric mean of the test results for each aquifer depth as summarized below:

Aquifer Zone	K, geomean (ft/day)
A	0.9
B	0.4
C	1.5

The total porosity and effective porosity, and the dry bulk density of the aquifer formation at SA-17 have not been determined by site specific testing or analyses of samples. Therefore, the following literature values for fine sand, silty sand, and fine to coarse sand (AFCEE, 1995), which are the predominant aquifer materials for aquifer zones A, B, and C, respectively, will be used for the velocity calculations:

Parameter (Zone A)	Range	Value Used
Total Porosity	0.26 – 0.53	0.35
Effective Porosity	0.1 – 0.3	0.20
Dry Bulk Density	1.37 – 1.81 g/cc	1.7 g/cc

Because aquifer Zone B contains silt mixed with fine sand, the material is assumed to have lower total porosity, lower effective porosity, but a somewhat higher dry bulk density due to tighter grain packing. The following literature values for silt will be used for the Zone B velocity calculations:

Parameter (Zone B)	Range	Value Used
Total Porosity	0.34 – 0.61	0.25
Effective Porosity	0.01 – 0.3	0.15
Dry Bulk Density	1.37 – 1.81 g/cc	1.9 g/cc

Because aquifer Zone C contains fine to coarse sand, the material is assumed to have an overall greater total porosity, greater effective porosity, but a similar dry bulk density as the A zone. The following literature values for coarse sand will be used for the Zone C velocity calculations:

Parameter (Zone C)	Range	Value Used
Total Porosity	0.31 – 0.46	0.40
Effective Porosity	0.2 – 0.35	0.25
Dry Bulk Density	1.37 – 1.81 g/cc	1.7 g/cc

The primary contaminants of concern (COCs) for transport through the aquifer at SA-17 are TCE, DCE, and vinyl chloride. To calculate the velocity of these constituents it is necessary to determine the partition coefficient, Kd, for each. The Kd can be estimated as the octanol-water partitioning coefficient, Koc, for each constituent multiplied by the fraction of organic carbon, foc, in the aquifer. Published values (FDEP 1999) of Koc for the above constituents are as follows:

Constituent	Koc (L/kg)
TCE	1.66 E+02
Cis-1,2-DCE	3.55 E+01
Vinyl chloride	1.86E+01

A site-specific concentration for foc in the aquifer at SA-17 has not been determined. The BioScreen Model documentation (AFCEE, 1996) reports that a typical range is 0.0002 to 0.02. ASTM (1995) states that if the site foc is unknown, a value of 0.001 is often used. This calculation willl use the default value of 0.002 used in F.A.C. 62-777 for calculating the Kd (FDEP, 1999).

CLIENT NTC Orlando, Study Area 17		JOB NUMBER N4206
SUBJECT Groundwater and Contaminant Velocity Calculations		
BASED ON See Below		DRAWING NUMBER
BY A. Jenkins	CHECKED BY P. Juriasingani	DATE 05/06/02

Calculations:

Groundwater Seepage Velocity, Vs:

Aquifer Zone	K (ft/day)	Gradient	Ne	Vs (ft/day)	**Vs (ft/year)**
A	0.9	0.004	0.20	0.018	**6.6**
B	0.4	0.003	0.15	0.008	**2.9**
C	1.5	0.002	0.25	0.012	**4.4**

Contaminant Seepage Velocity, Vc:

Aquifer Zone A	Vs (ft/day)	Db (g/cc)	Kd (L/kg)*	N	R	Vc (ft/day)	**Vc (ft/year)**
TCE	0.018	1.7	0.332	0.35	2.61	0.007	**2.5**
Cis-DCE	0.018	1.7	0.071	0.35	1.34	0.013	**4.9**
Vinyl chloride	0.018	1.7	0.037	0.35	1.18	0.015	**5.6**

Aquifer Zone B	Vs (ft/day)	Db (g/cc)	Kd (L/kg)	N	R	Vc (ft/day)	**Vc (ft/year)**
TCE	0.008	1.9	0.332	0.25	3.52	0.002	**0.8**
Cis-DCE	0.008	1.9	0.071	0.25	1.54	0.005	**1.9**
Vinyl chloride	0.008	1.9	0.037	0.25	1.28	0.006	**2.3**

Aquifer Zone C	Vs (ft/day)	Db (g/cc)	Kd (L/kg)	N	R	Vc (ft/day)	**Vc (ft/year)**
TCE	0.012	1.7	0.332	0.40	2.41	0.005	**1.8**
Cis-DCE	0.012	1.7	0.071	0.40	1.30	0.009	**3.4**
Vinyl chloride	0.012	1.7	0.037	0.40	1.16	0.010	**3.8**

* Kd = Koc X foc

References

AFCEE (Air Force Center for Environmental Excellence), 1996. *Bioscreen Natural Attneuation Decision Support System, User's Manual*, Version 1.3, Books Air Force Base, San Antonio, TX.

AFCEE, 1995. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, Technology Transfer Division, Brooks Air Force Base, San Antonio, TX.

ASTM (American Society for Testing and Materials), 1995. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E-1739-95, Philadelphia, PA.

HLA (Harding Lawson Associates), 1999. *Base Realignment and Closure Environmental Site Screening Report, Study Area 17*, Naval Training Center, Orlando, Florida.

FDEP (Florida Department of Environmental Protection), 1999. *Chapter 62-777, Contaminant Cleanup Target Levels*, Florida Administrative Code, Effective 8-5-99.

APPENDIX C

DATA TABLES FROM PREVIOUS INVESTIGATION REPORTS

Appendix B

Table B-3.1. Summary of Positive Detections in Groundwater Analytical Results

Study Area 17

Naval Training Center, Orlando

Orlando, FL

Well ID							OLD-17-01		OLD-17-02		OLD-17-03		OLD-17-04					
Identifier	Background	FDEPGCTL		FEDMCL	RBC for Tap Water		17G00101		17G00201		17G00301		17G00401		17G00402		17G00403	
Sampling Date							5/31/95		5/31/95		5/31/95		5/31/95		6/17/96		2/12/97	
Volatile Organics, µg/L																		
1,1-Dichloroethane		70	mc/st	ND	810	n												
1,1-Dichloroethene		7	p/c	7	0.044	c							3	J	21	J	[redacted]	
Carbon disulfide		700	mc/st	ND	1000	n												
Chloroform		5.7	mc/c	100	0.15	c			5									
Chloromethane		2.7	mc/c	ND	1.4	c												
cis-1,2-Dichloroethene		70	p/st	70	61	n							[redacted]		[redacted]		[redacted]	D
m-Dichlorobenzene		10	mc/o	ND	540	n												
n-Butylbenzene		ND		ND	61	n												
n-Propylbenzene		ND		ND	61	n												
Tetrachloroethene		3	p/c	5	1.1	c	0.4	J										
Toluene		40	s/st	1000	750	n												
trans-1,2-Dichloroethene		100	p/st	100	120	n							5	J	10	J	6.9	
Trichloroethene		3	p/c	5	1.6	c							[redacted]		[redacted]		[redacted]	D
Vinyl chloride		1	p/c	2	0.019	c							[redacted]		[redacted]	D	[redacted]	D
Semivolatile Organics, µg/L																		
bis(2-Ethylhexyl)phthalate		6	p/c	6	4.8	c							1				NA	

Appendix B

Table B-3.1. Summary of Positive Detections in Groundwater Analytical Results
Study Area 17

Naval Training Center, Orlando
Orlando, FL

Well ID								OLD-17-05						OLD-17-T24		OLD-17-06	
Identifier	Background	FDEPGCTL		FEDMCL	RBC for Tap Water		17G00404		17G00501	17G00501D		17G00502		17G024T1		17G00601	
Sampling Date							19-Jun-98		5/31/95	5/31/95		8-Jun-98		6/2/95		2/12/97	
Volatile Organics, µg/L																	
1,1-Dichloroethane		70	mc/st	ND	810	n											
1,1-Dichloroethene		7	p/c	7	0.044	c	**26**										
Carbon disulfide		700	mc/st	ND	1000	n			1								
Chloroform		5.7	mc/c	100	0.15	c						0.69	J				
Chloromethane		2.7	mc/c	ND	1.4	c						1.2	J				
cis-1,2-Dichloroethene		70	p/st	70	61	n	**420**									11	
m-Dichlorobenzene		10	mc/o	ND	540	n						0.67	J				
n-Butylbenzene		ND		ND	61	n											
n-Propylbenzene		ND		ND	61	n											
Tetrachloroethene		3	p/c	5	1.1	c											
Toluene		40	s/st	1000	750	n											
trans-1,2-Dichloroethene		100	p/st	100	120	n	4.1	J									
Trichloroethene		3	p/c	5	1.6	c	**260**										
Vinyl chloride		1	p/c	2	0.019	c	**360**									**16**	
Semivolatile Organics, µg/L																	
bis(2-Ethylhexyl)phthalate		6	p/c	6	4.8	c	NA			1		NA		1		NA	

Appendix B

Table B-3.1. Summary of Positive Detections in Groundwater Analytical Results

Study Area 17

Naval Training Center, Orlando

Orlando, FL

Well ID							OLD-17-07	OLD-17-08	OLD-17-09	OLD-17-10		
Identifier	Background	FDEPGCTL		FEDMCL	RBC for Tap Water		17G00701	17G00801	17G00901	17G01001	17G01001D	17G01003
Sampling Date							2/12/97	2/12/97	2/12/97	2/12/97	2/12/97	19-Jun-98
Volatile Organics, µg/L												
1,1-Dichloroethane		70	mc/st	ND	810	n						
1,1-Dichloroethene		7	p/c	7	0.044	c						
Carbon disulfide		700	mc/st	ND	1000	n						
Chloroform		5.7	mc/c	100	0.15	c						
Chloromethane		2.7	mc/c	ND	1.4	c						
cis-1,2-Dichloroethene		70	p/st	70	61	n	7.2	40	3.6	3.4	3.2	30
m-Dichlorobenzene		10	mc/o	ND	540	n						
n-Butylbenzene		ND		ND	61	n						
n-Propylbenzene		ND		ND	61	n						
Tetrachloroethene		3	p/c	5	1.1	c						
Toluene		40	s/st	1000	750	n						
trans-1,2-Dichloroethene		100	p/st	100	120	n						
Trichloroethene		3	p/c	5	1.6	c				2.3	2.2	[illegible]
Vinyl chloride		1	p/c	2	0.019	c	67	2.9	2.6	[illegible]	[illegible]	[illegible]
Semivolatile Organics, µg/L												
bis(2-Ethylhexyl)phthalate		6	p/c	6	4.8	c	NA	NA	NA	NA	NA	NA

Appendix B

Table B-3 1 Summary of Positive Detections in Groundwater Analytical Results

Study Area 17

Naval Training Center, Orlando

Orlando, FL

Well ID							OLD-17-20		OLD-17-22		OLD-17-23				OLD-17-24			
Identifier	Background		FDEPGCTL		FEDMCL	RBC for Tap Water												
							17G02001		17G02201		17G02301		17G02301D		17G02401		17G02401D	
Sampling Date							11-Jun-98		16-Jun-98		18-Jun-98		18-Jun-98		18-Jun-98		18-Jun-98	
Volatile Organics, µg/L																		
1,1-Dichloroethane			70	mc/st	ND	810 n	3.4	J										
1,1-Dichloroethene			7	p/c	7	0.044 c	1	J										
Carbon disulfide			700	mc/st	ND	1000 n												
Chloroform			5.7	mc/c	100	0.15 c			0.89	J								
Chloromethane			2.7	mc/c	ND	1.4 c			1.6	J								
cis-1,2-Dichloroethene			70	p/st	70	61 n	98		1.7	J	8.8		9.9					
m-Dichlorobenzene			10	mc/o	ND	540 n												
n-Butylbenzene			ND		ND	61 n												
n-Propylbenzene			ND		ND	61 n												
Tetrachloroethene			3	p/c	5	1.1 c												
Toluene			40	s/st	1000	750 n												
trans-1,2-Dichloroethene			100	p/st	100	120 n	0.76	J										
Trichloroethene			3	p/c	5	1.6 c					20		28		65000		72000	
Vinyl chloride			1	p/c	2	0.019 c	140											
Semivolatile Organics, µg/L																		
bis(2-Ethylhexyl)phthalate			6	p/c	6	4.8 c	NA		NA		NA		NA		NA		NA	

Appendix B

Table B-3.1. Summary of Positive Detections in Groundwater Analytical Results

Study Area 17

Naval Training Center, Orlando

Orlando, FL

Well ID							OLD-17-25		OLD-17-26		OLD-17-27		OLD-17-28		OLD-17-29		OLD-17-30	
Identifier	Background	FDEPGCTL		FEDMCL	RBC for Tap Water		17G02501		17G02601		17G02701		17G02801		17G02901		17G03001	
Sampling Date							18-Jun-98		17-Jun-98		17-Jun-98		17-Jun-98		23-Jun-98		23-Jun-98	
Volatile Organics, µg/L																		
1,1-Dichloroethane		70	mc/st	ND	810	n												
1,1-Dichloroethene		7	p/c	7	0.044	c					6.1	J						
Carbon disulfide		700	mc/st	ND	1000	n												
Chloroform		5.7	mc/c	100	0.15	c												
Chloromethane		2.7	mc/c	ND	1.4	c												
cis-1,2-Dichloroethene		70	p/st	70	61	n	0.78	J	1.9	J	360		2.3	J			1.1	J
m-Dichlorobenzene		10	mc/o	ND	540	n												
n-Butylbenzene		ND		ND	61	n											1.5	J
n-Propylbenzene		ND		ND	61	n											0.81	J
Tetrachloroethene		3	p/c	5	1.1	c	0.49	J										
Toluene		40	s/st	1000	750	n					1.8	J						
trans-1,2-Dichloroethene		100	p/st	100	120	n					12							
Trichloroethene		3	p/c	5	1.6	c	39				60		1.4	J	2.5	J		
Vinyl chloride		1	p/c	2	0.019	c			13		360						[illegible]	J
Semivolatile Organics, µg/L																		
bis(2-Ethylhexyl)phthalate		6	p/c	6	4.8	c	NA		NA		NA		NA		NA		NA	

Appendix B

Table B-3.1. Summary of Positive Detections in Groundwater Analytical Results
Study Area 17

Naval Training Center, Orlando
Orlando, FL

Well ID								OLD-17-31		OLD-17-32	
Identifier	Background	FDEPGCTL		FEDMCL		RBC for Tap Water		17G03101		17G03201	
Sampling Date								23-Jun-98		23-Jun-98	
Volatile Organics, µg/L											
1,1-Dichloroethane		70	mc/st	ND		810	n				
1,1-Dichloroethene		7	p/c	7		0.044	c				
Carbon disulfide		700	mc/st	ND		1000	n				
Chloroform		5.7	mc/c	100		0.15	c				
Chloromethane		2.7	mc/c	ND		1.4	c				
cis-1,2-Dichloroethene		70	p/st	70		61	n	220		61	
m-Dichlorobenzene		10	mc/o	ND		540	n				
n-Butylbenzene		ND		ND		61	n				
n-Propylbenzene		ND		ND		61	n				
Tetrachloroethene		3	p/c	5		1.1	c				
Toluene		40	s/st	1000		750	n	1	J		
trans-1,2-Dichloroethene		100	p/st	100		120	n	2.2	J	1.9	J
Trichloroethene		3	p/c	5		1.6	c				
Vinyl chloride		1	p/c	2		0.019	c	130		62	
Semivolatile Organics, µg/L											
bis(2-Ethylhexyl)phthalate		6	p/c	6		4.8	c	NA		NA	

Appendix B

Table B-3.1. Notes to Summary of Positive Detections in Groundwater Analytical Results
Study Area 17

Naval Training Center, Orlando
Orlando, FL

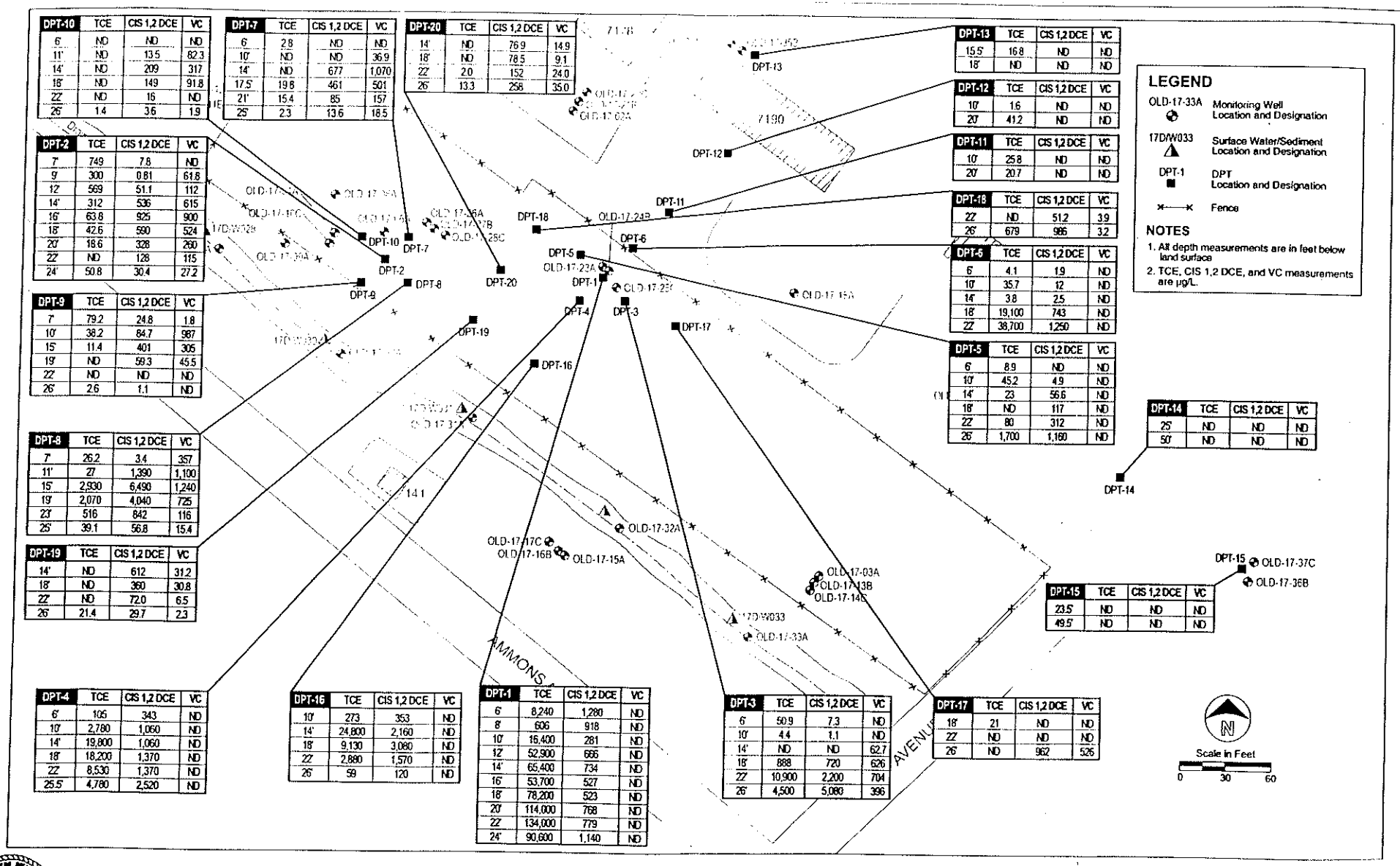
NOTES:

Groundwater background screening value is twice the average of detected concentrations for inorganic analytes.
FDEPGCTL = Florida Department of Environmental Protection, Groundwater Cleanup Target Levels, Chapter 62-785 FAC, April 30, 1998
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996
RBC = Risk-Based Concentration Table, USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995).
For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances

OLD-17-T24 is a temporary well installed during initial site screening. Sample collected from this well on 6/2/95
renamed to 17G024T1 to resolve conflict with sample taken at OLD-17-24 on 6/18/98

s = secondary groundwater standard
st = systemic toxicant
mc = based on minimum criteria
p = primary standard
o = organoleptic
n = noncarcinogenic effects
c = carcinogen (GCTLs) or carcinogenic effects (RBCs)
ND = Not determined
NA = Not analyzed.
USEPA = U.S. Environmental Protection Agency
B = Reported concentration is between the instrument detection limit and the contract required detection limit
J = Reported concentration is an estimated quantity
D = Reported concentrations if from a dilution/reanalysis
µg/L = micrograms per liter
mg/L = miligrams per liter
Bold/shaded numbers indicate exceedance of groundwater guidance and background
Blank space indicates analyte/compound was not detected at the reporting limit

DRAFT



DPT-10	TCE	CIS 1,2 DCE	VC
6'	ND	ND	ND
11'	ND	13.5	82.3
14'	ND	209	317
18'	ND	149	91.8
22'	ND	16	ND
26'	1.4	3.6	1.9

DPT-7	TCE	CIS 1,2 DCE	VC
6'	2.8	ND	ND
10'	ND	ND	36.9
14'	ND	677	1,070
17.5'	19.8	461	501
21'	15.4	85	157
25'	2.3	13.6	18.5

DPT-20	TCE	CIS 1,2 DCE	VC
14'	ND	76.9	14.9
18'	ND	78.5	9.1
22'	2.0	152	24.0
26'	13.3	258	35.0

DPT-13	TCE	CIS 1,2 DCE	VC
15.5'	16.8	ND	ND
18'	ND	ND	ND

DPT-12	TCE	CIS 1,2 DCE	VC
10'	1.6	ND	ND
20'	41.2	ND	ND

DPT-11	TCE	CIS 1,2 DCE	VC
10'	25.8	ND	ND
20'	20.7	ND	ND

DPT-18	TCE	CIS 1,2 DCE	VC
22'	ND	51.2	3.9
26'	679	986	3.2

DPT-6	TCE	CIS 1,2 DCE	VC
6'	4.1	1.9	ND
10'	35.7	12	ND
14'	3.8	2.5	ND
18'	19,100	743	ND
22'	38,700	1,250	ND

DPT-5	TCE	CIS 1,2 DCE	VC
6'	8.9	ND	ND
10'	45.2	4.9	ND
14'	23	56.6	ND
18'	ND	117	ND
22'	80	312	ND
26'	1,700	1,160	ND

DPT-14	TCE	CIS 1,2 DCE	VC
25'	ND	ND	ND
50'	ND	ND	ND

DPT-15	TCE	CIS 1,2 DCE	VC
23.5'	ND	ND	ND
49.5'	ND	ND	ND

DPT-2	TCE	CIS 1,2 DCE	VC
7'	749	7.8	ND
9'	300	0.81	61.8
12'	569	51.1	112
14'	312	536	615
16'	63.8	925	900
18'	42.6	590	524
20'	18.6	328	260
22'	ND	128	115
24'	50.8	30.4	27.2

DPT-9	TCE	CIS 1,2 DCE	VC
7'	79.2	24.8	1.8
10'	38.2	84.7	987
15'	11.4	401	305
19'	ND	59.3	45.5
22'	ND	ND	ND
26'	2.6	1.1	ND

DPT-8	TCE	CIS 1,2 DCE	VC
7'	26.2	3.4	357
11'	27	1,390	1,100
15'	2,930	6,490	1,240
19'	2,070	4,040	725
23'	516	842	116
25'	39.1	56.8	15.4

DPT-19	TCE	CIS 1,2 DCE	VC
14'	ND	612	31.2
18'	ND	360	30.8
22'	ND	72.0	6.5
26'	21.4	29.7	2.3

DPT-4	TCE	CIS 1,2 DCE	VC
6'	105	343	ND
10'	2,780	1,060	ND
14'	19,800	1,060	ND
18'	18,200	1,370	ND
22'	8,530	1,370	ND
25.5'	4,780	2,520	ND

DPT-16	TCE	CIS 1,2 DCE	VC
10'	273	353	ND
14'	24,800	2,160	ND
18'	9,130	3,080	ND
22'	2,880	1,570	ND
26'	59	120	ND

DPT-1	TCE	CIS 1,2 DCE	VC
6'	8,240	1,280	ND
8'	606	918	ND
10'	16,400	281	ND
12'	52,900	666	ND
14'	65,400	734	ND
16'	53,700	527	ND
18'	78,200	523	ND
20'	114,000	768	ND
22'	134,000	779	ND
24'	90,600	1,140	ND

DPT-3	TCE	CIS 1,2 DCE	VC
6'	50.9	7.3	ND
10'	4.4	1.1	ND
14'	ND	ND	62.7
18'	888	720	626
22'	10,900	2,200	704
26'	4,500	5,080	396

DPT-17	TCE	CIS 1,2 DCE	VC
18'	21	ND	ND
22'	ND	ND	ND
26'	ND	962	526

FIGURE 4
Direct Push Sampling Results
Study Area 17, Naval Training Center, Orlando, Florida

Table 1
Phase I and II Confirmatory Sampling Analytical Results (UNVALIDATED)
Study Area 17

StationID:		OLD-17-03A	OLD-17-05A	OLD-17-11B	OLD-17-12C	OLD-17-13B	OLD-17-14C
Client Sample ID:		017-OLD-17-03A-Q1-00	017-OLD-17-05A-Q1-00	017-OLD-17-11B-Q1-00	017-OLD-17-12C-Q1-00	017-OLD-17-13B-Q1-00	017-OLD-17-14C-Q1-00
Lab Sample ID:		F5963-1	F5933-2	F5925-2	F5925-1	F5963-2	F5963-3
Date Collected:		02/29/2000	02/24/2000	02/23/2000	02/23/2000	02/29/2000	02/29/2000
Parameter	**Units**						
Natural Attenuation Parameters							
Iron	ug/l	14300 =	7790 =	70700 =	6100 =	10900 =	5670 =
Iron, dissolved	ug/l	12600 =	4110 =	74400 =	4830 =	4740 =	5450 =
Turbidity	NTUs	84.6	>1000	>1000	817	84.2	7
Observations		Light grey color	Brown	Brown	Brown	Tan	Clear
Magnesium	ug/l			20200 =	2170 B		
Magnesium, dissolved	ug/l			21000 =			
Manganese	ug/l	22.9 =	24.8 =	121 =	17.7 =	23.2 =	38.2 =
Manganese, dissolved	ug/l			130 =			
Alkalinity, Total	mg/l	87.9 =	72.2 =	111 =	8.6 =	53.2 =	21.8 =
BOD, 5 Day	mg/l	2 U	3 U	9.1 =	3 U	2 U	5.6 =
Chloride	mg/l	3.6 =	8.3 =	7.2 =	5.8 =	2.9 =	33.7 =
Hydrogen Sulfide	mg/l	2.2 =	2 U	40 U	5.4 =	2.7 =	2 U
Nitrogen, Nitrate	mg/l	0.1 U	0.1 U	0.13 =	0.1 U	0.1 U	0.1 U
Nitrogen, Nitrate + Nitrite	mg/l	0.11 U				0.11 U	0.11 U
Nitrogen, Nitrite	mg/l	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Sulfate	mg/l	22.1 =	7.8 =	50 U	5 U	8.6 =	5 U
Dissolved Oxygen	mg/l	0.67	1.09	0.84	1.19	0.67	0.78
Dissolved Hydrogen	nM	0.92	0.96	0.58	4.24	11.8	1.71
ORP	mV	-61.8	-20.2	-68.1	-84.9	-57.7	-97.2
Total Organic Carbon	mg/l	11.4 =	21.2 =	427 =	50 U	11.7 =	21.1 =
VOCs							
1,1,2-Trichloroethane	ug/l						
1,1-Dichloroethane	ug/l						
1,1-Dichloroethylene	ug/l						
Acetone	ug/l						
Bromodichloromethane	ug/l						
Carbon disulfide	ug/l						
Chloroform	ug/l						
cis-1,2-Dichloroethylene	ug/l						
trans-1,2-Dichloroethyler	ug/l						
Trichloroethylene	ug/l						
Vinyl chloride	ug/l						
Methane	ug/l	83.8 =	157.1 =	1204 =	450.3 =	340.4 =	4828 =
Ethane	ng/l	5 U	5	38 =	5 U	5 U	5 U
Ethene	ng/l	5 U	5 U	17 =	16 =	11 U	69 =

Table 1
Phase I and II Confirmatory Sampling Analytical Results (UNVALIDATED)
Study Area 17

	StationID:	OLD-17-27B	OLD-17-28C	OLD-17-34A	OLD-17-35B	OLD-17-36B	OLD-17-37C
	Client Sample ID:	017-OLD-17-27B-Q1-00	017-OLD-17-28C-Q1-00	017-OLD-17-34A-Q1-00	017-OLD-17-35B-Q1-00	017-OLD-17-36B-Q1-00	017-OLD-17-37C-Q1-00
	Lab Sample ID:	F5933-4	F5933-5	F6201-1	F6201-2	F6201-3	F6201-4
	Date Collected:	02/24/2000	02/24/2000	04/04/2000	04/04/2000	04/04/2000	04/04/2000
Parameter	**Units**						
Natural Attenuation Parameters							
Iron	ug/l	9740 =	2500 =	17300	32900	25900	7920
Iron, dissolved	ug/l	2580 =	1200 =				
Turbidity	NTUs	65.1	20.7	7.5	301	>1000	29.9
Observations		Clear	Clear	Clear	Light Brown	Brown	Clear
Magnesium	ug/l						
Magnesium, dissolved	ug/l						
Manganese	ug/l	28.5 =	16.5 =				
Manganese, dissolved	ug/l						
Alkalinity, Total	mg/l	67.9 =	35.6 =				
BOD, 5 Day	mg/l	3 U	3 U				
Chloride	mg/l	24.5 =	15.6 =				
Hydrogen Sulfide	mg/l	2 U	2 U				
Nitrogen, Nitrate	mg/l	0.1 U	0.1 U				
Nitrogen, Nitrate + Nitrite	mg/l						
Nitrogen, Nitrite	mg/l	0.01 U	0.01 U				
Sulfate	mg/l	50 U	5 U				
Dissolved Oxygen	mg/l	0.71	1.27	0.59	0.80	0.50	0.40
Dissolved Hydrogen	nM	0.71	3.07				
ORP	mV	-97.1	30.6	178	81	-95	-63
Total Organic Carbon	mg/l	6 =	9.9 =				
VOCs							
1,1,2-Trichloroethane	ug/l						
1,1-Dichloroethane	ug/l						
1,1-Dichloroethylene	ug/l	2.7 =					
Acetone	ug/l		9.9 J				43
Bromodichloromethane	ug/l						
Carbon disulfide	ug/l						2.4
Chloroform	ug/l			2.3	2.1		7.8
cis-1,2-Dichloroethylene	ug/l	140 =					
trans-1,2-Dichloroethylen	ug/l	9.4 =					
Trichloroethylene	ug/l	12.4 =					
Vinyl chloride	ug/l	160 =					
Methane	ug/l	141.4 =	539.3 =				
Ethane	ng/l	2042 =	5 U				
Ethene	ng/l	14951 =	151 =				