

SUMMARY REPORT: A GROUNDWATER INVESTIGATION
TO DEFINE THE SOURCE(S) OF TETRACHLOROETHYLENE THAT HAVE CONTAMINATED THREE
COMMUNITY WATER SUPPLY WELLS AT TARAWA TERRACE I
CAMP LEJEUNE MARINE CORPS MARINE BASE (MCB)
ONslow COUNTY

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INTRODUCTION

From April to September 1985, the North Carolina Department of Natural Resources and Community Development (DNRCD) conducted a groundwater pollution study to define the source of tetrachloroethylene (TCE) contamination in three of eight wells that are part of the Tarawa Terrace (TT) well-field. This report present the findings of this study.

This report was written in December 1985 by Rick Shiver, Hydrogeological Regional Supervisor, Wilmington Regional Office, 7225 Wrightsville Avenue, Wilmington, NC 28403, telephone number (919) 256-4161.

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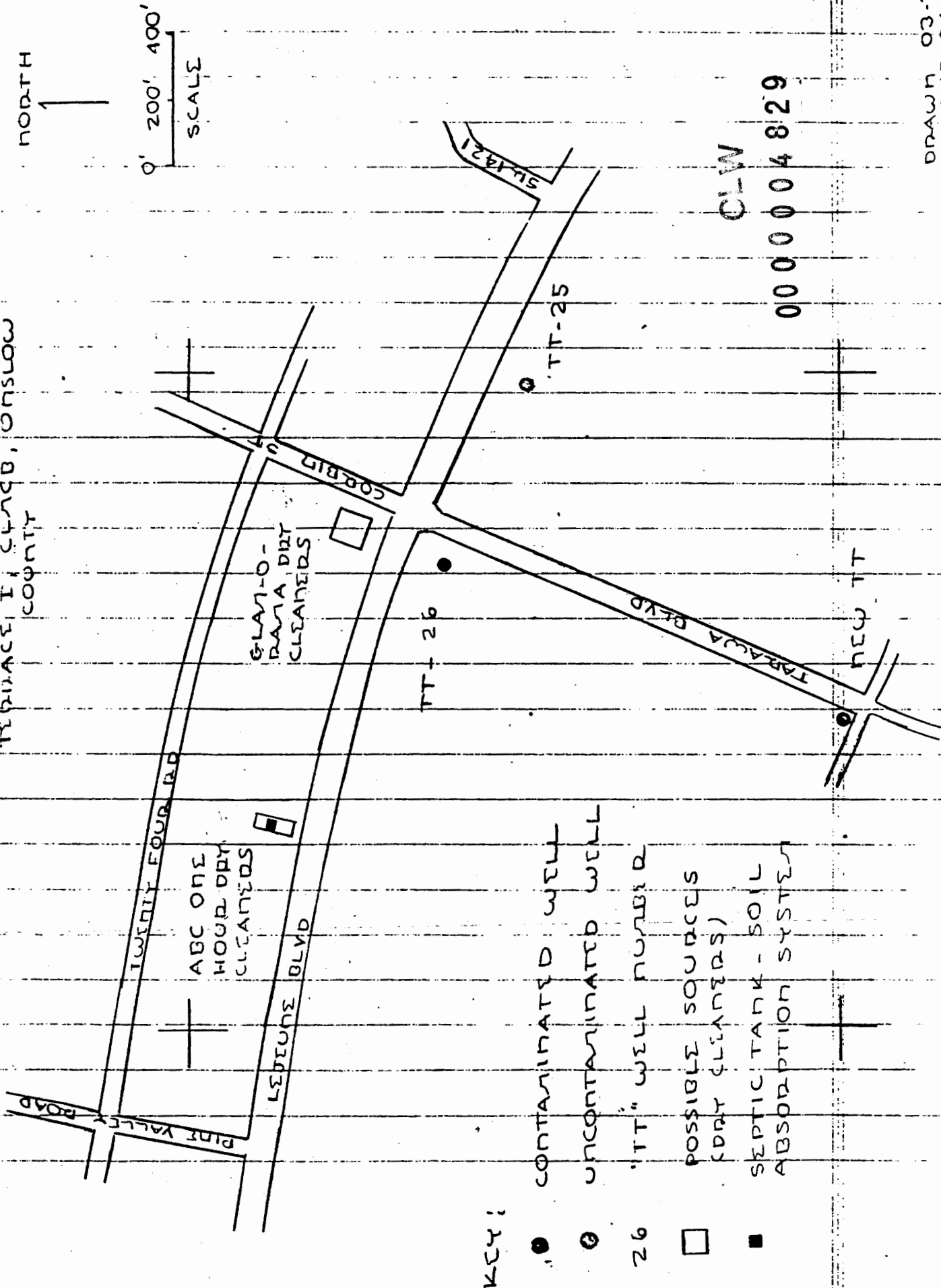
BACKGROUND

Having discovered organic contaminants present in water from well HP-602 during July 1984, the Marine Corps deemed it prudent to collect samples from 40 of its total 100 community water supply wells. Completed in March 1985, the analytical results showed the presence of volatile organic compounds (VOCs) in 10 of the 40 wells. The organic contaminants, moreover, consisted mostly of organic solvents that included tetrachloroethylene (PCE), trichloroethylene (TCE), and dichloroethylene (DCE).

Eight of the 10 contaminated wells obviously had been impacted by sources located on the Marine Corps Base (MCB). However, the other two contaminated wells, wells TT-26 and new TT were located near two off-base, commercial dry cleaning facilities (see Figure 1).

Since both dry cleaners were potential sources of the PCE contaminants, since GA standards obviously had been violated, and since the Marine Corps requested DNRCD's assistance in identifying the source of the pollution problem, the Groundwater Section began its investigation during April 1985.

FIGURE 1: MAP THAT SHOWS LOCATION OF POSSIBLE SOURCES TO CONTAMINATED WELLS, TARAWA TRIPACE I, CLWB, ONSLOW COUNTY



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HYDROGEOLOGY

Figure 2 shows the hydrogeology underneath Tarawa Terrace. Here the Tertiary Sand System appears unconfined. The semi-confined Tertiary Limestone System is composed primarily of calcareous sand.

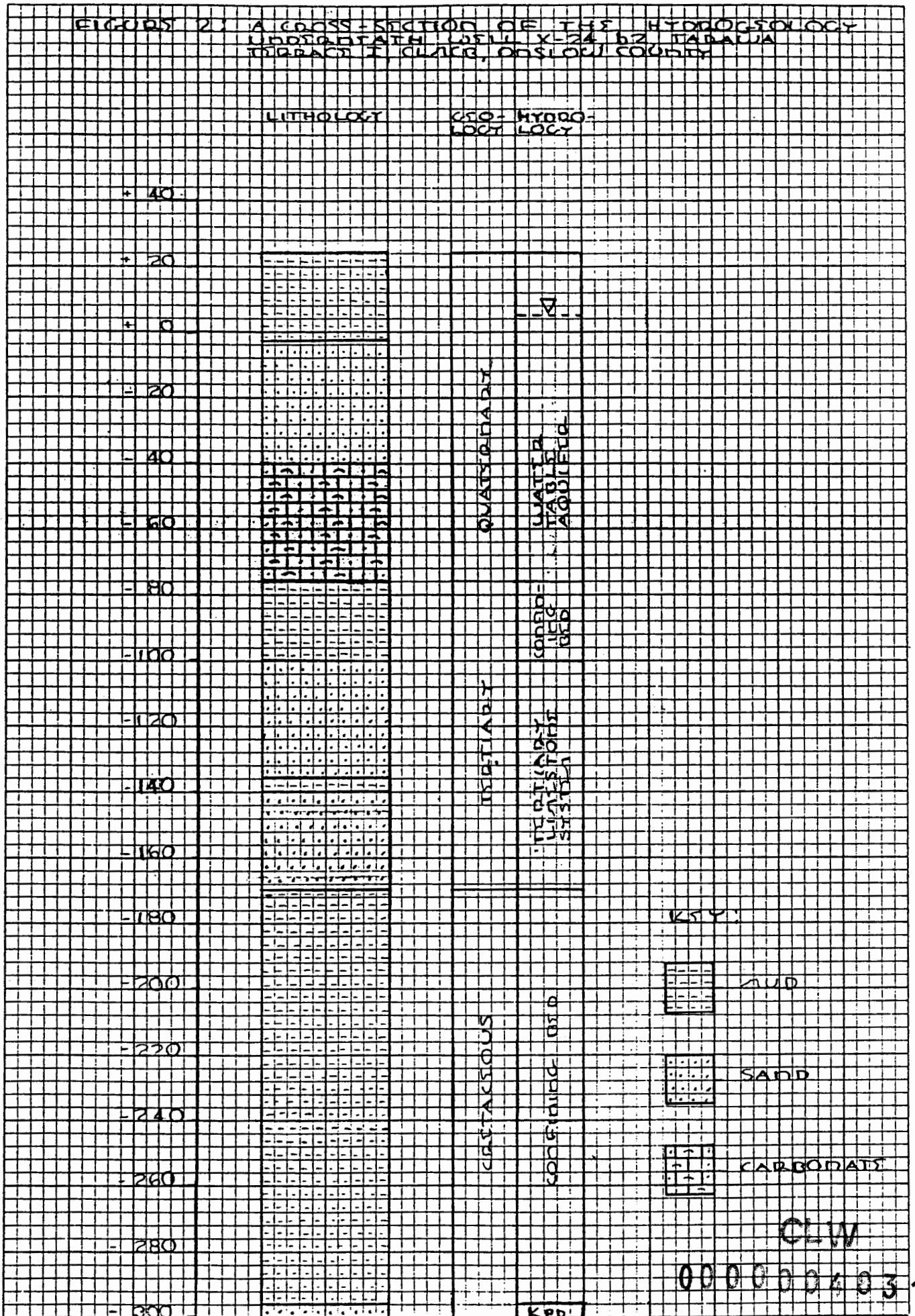
Large diameter wells screened opposite both aquifers typically yield 150 to 200 gallons per minute (GPM) of water. Specific capacity is about five (5) gallons per minute per foot of drawdown. Transmissivity averages about 1000 ft²/day.

Presuming an aquifer storativity that ranges from 0.1-0.25, and assuming a pumping time equal to 182.5 days, the cone of depression from a well in the TT well field attains a radius that is 900-1500 feet.

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FIGURE 2. A CROSS-SECTION OF THE HYDROGEOLOGY
 UNDERGATH WELL, X-24 62 TADAWA
 TERRACE, CLACK, OSLOUT COUNTY



WATER USE SITUATION

Wells TT-26 and new TT were two of a total eight base community water supply wells that comprised the Tarawa Terrace (TT) Water System. These wells are exposed to the Water Table Aquifer and/or Teritary Limestone System. Water use averages 1.00 million gallons per day (MGD) and ranges from a minimum of 0.72 MGD to a maximum of 1.50 MGD.

Use of contaminated wells TT-26 and new TT was discontinued during February 1985. Without these wells, demand exceeded supply, so it was necessary to impose water conservation measures on the users. These restrictions were lifted during June 1985, when an emergency water line from the Holcomb Boulevard System became operational.

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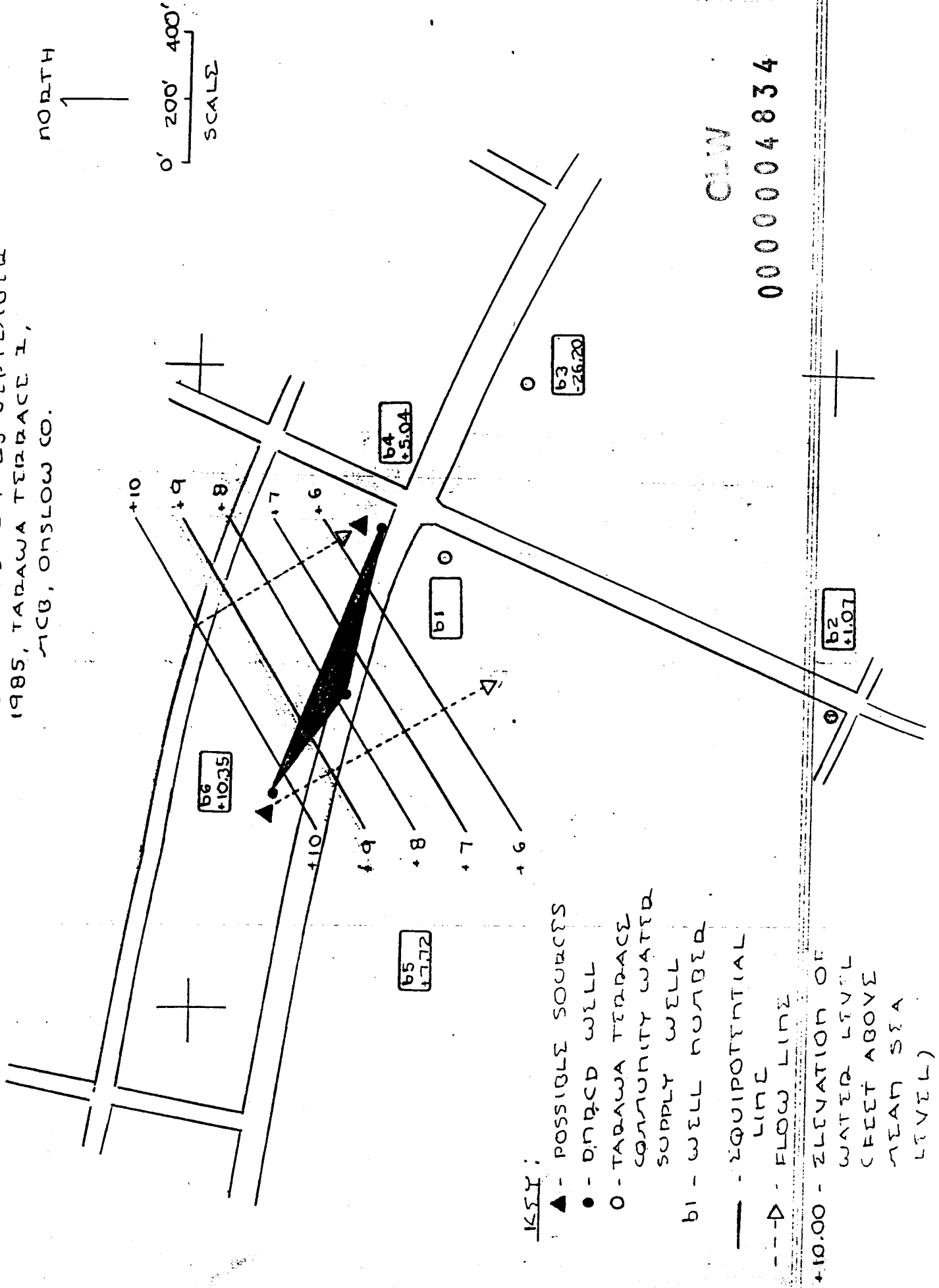
WATER LEVEL DATA

Table 2 summarizes the attributes of the wells from which water level data was collected on 25 September 1985 (Table 3). The static water level in the Water Table Aquifer was encountered at about 23 feet below land surface datum. Figure 3 shows that the generalized direction of flow within the Water Table Aquifer is to the southeast.

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FIGURE 3: FLOWNET MAP CONSTRUCTED FOR WATER LEVEL DATA COLLECTED ON 25 SEPTEMBER 1985, TABAWA TERRACE I, MCB, ONSLOW CO.



- KEY:
- ▲ - POSSIBLE SOURCES
 - - DINED WELL
 - - TABAWA TERRACE COMMUNITY WATER SUPPLY WELL
 - b1 - WELL NUMBER
 - - EQUIPOTENTIAL LINE
 - - - Δ - FLOW LINE
 - +10.00 - ELEVATION OF WATER LEVEL (FEET ABOVE MEAN SEA LEVEL)

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TABLE 2: A SUMMARY OF THE WELL ATTRIBUTES, TARAWA TERRACE I, CLACK, ONSLOW COUNTY

WELL NO.	WELL OWN-ER	TOTAL DEPTH (FT)	DIAM-ETER (IN)	SCREENED INTER-VAL (FT-FT)	GRAV-EL IN-TERVAL (FT-FT)	CEMENT GROUT (FT-FT)	MUD GROUT (FT-FT)	IQ (GPM)	Q/S (GPM/FT-DD)	RES. MAP
X-24,b1	USMC	100	-	-	60-100	11-	1-	128		TT-
X-24,b2	USMC	147	10	70-95	0-155	0-50	-	252	4.77	NSC
-	-	-	-	132-142	-	-	-	-		-
X-24,b3	USMC	180	8	70-75	0-185	0-40	-	130	5.04	TT-
-	-	-	-	85-95	-	-	-	-		-
-	-	-	-	150-175	-	-	-	-		-
X-24,b4	DDBCD	59	2	42-52	32-59	-	0-32	1	-	NO.
X-24,b5	DDBCD	59	2	42-52	32-59	-	0-32	5	-	NO.
X-24,b6	DDBCD	59	2	42-52	32-59	-	0-32	5	-	NO.

TABLE 3: A SUMMARY OF THE WATER LEVEL INFORMATION COLLECTED ON 25 SEPT 1985, TARAWA TERRACE I, ONSLOW COUNTY

WELL NO.	MP- (LSD) (FT)	WL- (MP) (FT)	FWL- (LSD) (FT)	ELSV (LSD) (FEET AMSL)	ELV (MP) (FEET AMSL)	ELV- (WL) (FEET AMSL)	AQUIFER
b1	-	-	-	-	35.48	-	
b2	1.64	25.55	23.91	24.98	26.62	11.07	
b3	0.39	58.56	58.17	31.97	32.36	-26.20	
b4	-0.07	28.31	28.38	33.28	33.35	5.04	
b5	0.10	23.29	23.19	31.36	31.01	7.72	
b6	0.18	22.84	22.61	33.37	33.19	10.35	

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WATER QUALITY DATA

Table 4 lists the VOCs that have been encountered in the six wells. Appendix I contains the results of the standard complete and standard pollution analyses performed on wells b1, b2, and b3.

This data shows that the principal contaminants are tetrachloroethylene, trichloroethylene, and dichloroethylene. Figure 4 shows the 25 September 1985 extent of the tetrachloroethylene plume over the study area.

Significantly, the 25 September 1985 data show that water from a third well in the TT well field system, well TT-25, contains a measurable concentration of tetrachloroethylene. Before the September 1985 study, only two of the wells in the TT system contained organic solvents.

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TABLE 4: ORGANIC ANALYSES RESULTS
ON WATER SAMPLES COLLECTED
FROM WELLS X-24, b1-b6, TARAWA
TERRACE I, CLACB, ONSLOW COUNTY

PARAMETER	UNIT	RESULTS FOR WELL b1				
		1-16-85	2-19-85	4-9-85	9-25-85	
TETRACHLOROSTHYLENE	MG/L	1580	64	630	1100	
TRICHLOROSTHYLENE	MG/L	57	-	18	27	
1,2-TRANS-DICHLOROSTHYLENE	MG/L	92	-	1.4	1.6	
VINYL CHLORIDE	MG/L	27	-	-	-	
METHYL CYCLOPENTANE	MG/L	-	-	-	0.42	
	MG/L	-	-	-	-	
	MG/L	-	-	-	-	
PARAMETER	UNIT	RESULTS FOR WELL b2				
		1-16-85	2-19-85	7-11-85	4-9-85	9-25-85
TETRACHLOROSTHYLENE	MG/L	132	26	41	ND	4
TRICHLOROSTHYLENE	MG/L	-	53	-	ND	0
1,2-TRANS-DICHLOROSTHYLENE	MG/L	-	-	-	ND	-
VINYL CHLORIDE	MG/L	-	-	-	ND	-
	MG/L	-	-	-	-	-
	MG/L	-	-	-	-	-
	MG/L	-	-	-	-	-
PARAMETER	UNIT	RESULTS FOR WELL b3				
		4-9-85	9-25-85			
TETRACHLOROSTHYLENE	MG/L	ND	0.43			
TRICHLOROSTHYLENE	MG/L	ND	-			
1,2-TRANS-DICHLOROSTHYLENE	MG/L	ND	-			
VINYL CHLORIDE	MG/L	ND	-			
	MG/L	-	-			
	MG/L	-	-			
	MG/L	-	-			
PARAMETER	UNIT	RESULTS FOR WELL b4				
		9-25-85				
TETRACHLOROSTHYLENE	MG/L	2.2				
DICHLOROSTHYLENE	MG/L	-				
p-TRANS-DICHLOROSTHYLENE	MG/L	-				
VINYL CHLORIDE	MG/L	-				
METHYL BENZENE	MG/L	2.3				
	MG/L	-				
	MG/L	-				

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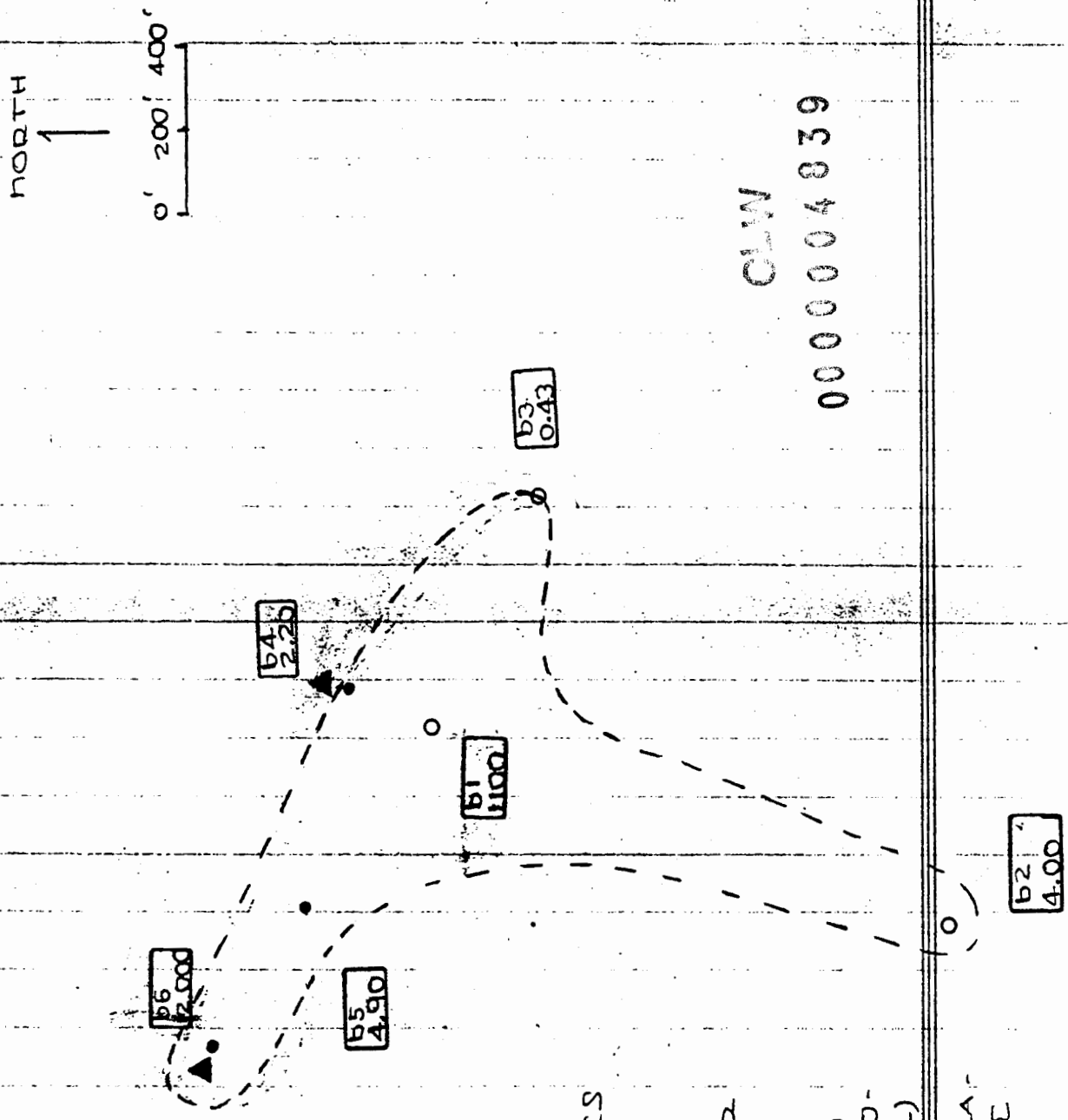
TABLE 4: ORGANIC ANALYSIS RESULTS
 ON WATER SAMPLES COLLECTED
 FROM WELLS X-24, b1-b6, TARAWA
 TERRACE I, CLACB, ONSLOW COUNTY

PARAMETER	UNIT	RESULTS FOR WELL	b5
		9-25-85	
TETRACHLOROETHYLENE	MG/L	4.9	
TRICHLOROETHYLENE	MG/L	0.98	
1,2-TRANS-DICHLOROETHYLENE	MG/L	-	
VINYL CHLORIDE	MG/L	-	
BENZENE	MG/L	2.3	
	MG/L	-	
	MG/L	-	
PARAMETER	UNIT	RESULTS FOR WELL	b6
		9-25-85	
TETRACHLOROETHYLENE	MG/L	12,000	
TRICHLOROETHYLENE	MG/L	2.7	
1,2-TRANS-DICHLOROETHYLENE	MG/L	-	
VINYL CHLORIDE	MG/L	-	
	MG/L	-	
	MG/L	-	
	MG/L	-	

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FIGURE 4: MAP THAT SHOWS THE CONCENTRATION OF TETRA-
 CHLOROETHYLENE ON 25 SEPTEMBER, 1985, TADAWA
 TERRACE I, CLACO, ONSLOW



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- KEY:
- ▲ - POSSIBLE SOURCES
 - - DNRCD WELLS
 - - TADAWA TERRACE COMMUNITY WATER SUPPLY WELLS
 - b1 - WELL NUMBER 1100 - CONCENTRATION OF TETRACHLOROETHYLENE (MG/L)
 - - - EXTENT OF TETRACHLOROETHYLENE PLUME

CONCLUSIONS

Interpretation of the data suggests that the PCE plume originates from the septic tank-soil absorption system (ST-SAS) at the ABC One Hour Cleaners (see Figure 1). ABC One Hour Cleaners (hereafter ABC) began business in 1954.

The reasons for identifying the ST-SAS at ABC as the principal source are as follows:

1. ABC uses, and has always used, PCE to dry clean clothes;
2. ABC uses, and has always used, a ST-SAS for the disposal of its wastewater;
3. Inspection of the area where PCE is stored, used and recycled shows that PCE releases can and do enter the septic tank (ST);
4. The formation from 0-15 feet at b6 possessed an obvious PCE odor: this finding infers a PCE release to the subsurface;
5. Figure 3 shows that the direction of flow within the Water Table Aquifer is from ABC to the three impacted wells;
6. Compensating for the disparity in depths between wells b1-b3 and b4-b6, and considering that PCE is a "sinker" (i.e., PCE is about 50% denser than the native groundwater), Figure 4 indeed shows a concentration gradient from the source (ST-SAS at ABC) to the impacted wells.

Not incidentally, Glam-O-Rama also stores-uses-and-recycles PCE, but the study results do not implicate Glam-O-Rama as a (significant) source of PCE contamination.

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CLOSING STATEMENT

Through telephone conversations, the following persons have been made aware of the extent and magnitude of this problem:

Colonel R. A. Tiebout
Assistant Chief of Staff, Facilities
Marine Corps Base
Camp Lejeune, NC 28542-5001
(919) 451-3034

Mr. Victor Melts, Manager
ABC One Hour Cleaners
2127 Lejeune Boulevard
Jacksonville, NC 28540
(919) 353-1800

Ms. Cherylle Deal
Secretary to Dr. Lynn Muchmore
NC-DNRCD
Post Office Box 27687
Raleigh, NC 27611
(919) 733-4984

Mr. Mike Bell
DHR-DHS
Water Supply Branch
404 St. Andrews Street
Greenville, NC 27834
(919) 756-1343

Mr. Grover Nicholson
DHR-DHS
Solid and Hazardous Waste Management Branch
Post Office Box 2091
Raleigh, NC 27602
(919) 733-2178

All but Mr. Mike Bell have requested a copy of this report when it is approved for general circulation.

Furthermore, Mr. Grover Nicholson has begun the process to involve the EPA in this case. Since a military installation is the victim of a serious pollution problem, and since the EPA can assist in a resolution of this

problem under CERCLA, it is not known how and to what extent the EPA may wish to become involved in this matter. Therefore, the recommendations in this report are independent of any other agencies input, and simply reflect what DEM feels must be done to bring the ABC facility into compliance with 2L regulations.

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APPENDIX I

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RECEIVED

DEPARTMENT OF NATURAL RESOURCES
& COMMUNITY DEVELOPMENT

RECEIVED

RECEIVED

COUNTY CONSUMERS
QUAD NO. X-24 SERIAL NO. 14 JUN 6 1985

REPORT TO: (circle one)
XRD, VSD, XRD, TND, VAND,
KIND NO. Absorbance PO,
OTHER

WILMINGTON REGIONAL OFFERGROUNDWATER FIELD/LAB FORM
DEM

JUN 4 1985

PURPOSE: (circle one) baseline, protection monitor other
DATE COLLECTED 04 09 85 Time 10:25 by DAVE

GROUND WATER SECTION I
LOCATION OF RALIGH RD

LAB NUMBER G-182
DATE REC'D 4-10-85
REC'D BY SD
DATA ENTER BY DAVE
DATA REPORTED 6-3-85

DESCRIPTION OF SAMPLING POINT WELL CURB OFF EAST SIDE OF RALIGH RD
Remarks WELL NUMBER NOT KNOWN
(pumping time, air temp, etc.)
FIELD ANALYSIS BY: D. SELLERS Lat. 344422N Long. 772152W

pH 7.10 Spec. Cond. 310 Temp. 19 °C 0 for OCCASIONAL Appearance CLAR Taste 0

Lab Analysis

Alkalinity to pH 4.5	P00410	180	mg/l
Alkalinity, Hydroxide	P1130	41	mg/l
Carbonate	P00445	41	mg/l
Bicarbonate	P00440	220	mg/l
pH value (open analyzed)	P00400	8.2	units
Arsenic (D)	P01000	<10	ug/l
Carbon dioxide	P00405		mg/l
Chloride (D)	P00940	9	mg/l
Color (True)	P00080	24	units
Cyanide	P00720		mg/l
Dissolved solids (D)	P70301	230	mg/l
Fluoride (D)	P00931	0.2	mg/l
Hardness (as CaCO ₃) (D)	P00900	190	mg/l
Hardness (non-carbonate) (D)	P00902	10	mg/l
HAAS (D)	P38260		mg/l
Phenol (D)	P34466	45	ug/l
Sulfide (D)	P00935	6	mg/l
Sulfate (D)	P00946	5	mg/l
Specific Cond.	P00094	420	umhos/cm

Ac-Silver (D)	P01075	<50	ug/l
Ac-Aluminum (D)	P01106	100	ug/l
Barium (D)	P00063	200	ug/l
Ca-Calcium (D)	P00915	80	mg/l
Cd-Cadmium (D)	P01075	<20	ug/l
Cr-Chromium (D)	P01030	<50	ug/l
Cu-Copper (D)	P01040	<20	ug/l
Fe-Iron (D)	P01046	1200	ug/l
Hg-Mercury	P21900	<0.2	ug/l
K-Potassium (D)	P01130	<50	ug/l
Mg-Magnesium (D)	P00925	20	mg/l
Mn-Manganese (D)	P01056	<50	ug/l
Na-Sodium (D)	P00929	54	mg/l
Pb-Lead (D)	P01049	<100	ug/l
Zn-Zinc (D)	P01090	<30	ug/l
K-Potassium (D)	P00935	16	mg/l
SC-Selenium		<50	ug/l

NO ₃	P00310		mg/l
NO ₂	P00341		mg/l
Coliform (Total MP)	P31616		/100ml
Ferrous (total MP)	P31505		/100ml
TOC	P00680	45	mg/l
Turbidity	P82079		NTU
Ammonia (as Nitrogen) (D)	P00612	0.2	mg/l
Nitrate (as Nitrogen) (D)	P00623	0.1	mg/l
Nitrate + Nitrite (as Nitrogen) (D)	P00631	0.0	mg/l
Thiophosphate, total as P (D)	P00666	0.7	mg/l
Dissolved Solids - cond. meter	P70304		mg/l
Other Analytes:			
FLUORIDES		0.2	mg/l

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COUNTY OSLON

QUAD NO. X-24 SERIAL NO. 07-1430

REPORT TO: (circle one)

NO. V&O, M&O, T&O, W&O,
(also) R&O, A&O, P&O,
OTHER

WILMINGTON REGIONAL FIELD LAB FORM

MAY 31 1985

RECEIVED

N. C. DEPARTMENT OF NATURAL RESOURCES
DIVISION OF DEVELOPMENT

REC'D

LAB NUMBER G-181

DATE REC'D 4-10-85

REC'D BY SPD

DATA ENTER BY SPD

DATA REPORTED 5-29-85

GROUND WATER SECTION
DALEIGH, N. C.

DATE COLLECTED 04-09-85 Time 1200 By DIKE Location or site TT-25

Description of sampling point WELL WITH PUMP SAMPLED INTERVAL TO 75'

Remarks WELL HAS BEEN PUMPED CONTINUOUSLY SINCE 02-08-85

Field Analysis By: SHIVERS Lat. 04419N Long. 772143W

PH 7.5 Spec. Cond. 705 Temp. 17 °C Other MS Appearance CLAR

Lab Analysis

Alkalinity to pH 4.5	P00410	170	mg/l
Alkalinity, Hydroxide	P71900	<1	mg/l
Carbonate	P00445	<1	mg/l
Bicarbonate	P00440	200	mg/l
pH value (open analyzed)	P00400	7.5	units
Arsenic (D)	P01000	<1.0	ug/l
Carbon dioxide	P00405		mg/l
Chloride (D)	P00940	9	mg/l
Color (True)	P00080	23	units
Cyanide	P00720		mg/l
Dissolved solids (D)	P70301	220	mg/l
Fluoride (D)	P00951	0.2	mg/l
Hardness (as CaCO ₃) (D)	P00900	180	mg/l
Hardness (non-carbonate) (D)	P00902	10	mg/l
HAMS (D)	P38260		mg/l
Phenol (D)	P34466	<5	ug/l
Silica (D)	P00955	7	mg/l
Sulfate (D)	P00946	7	mg/l
Specific Cond.	P00094	390	UMHOS/cm
Ag-Silver (D)	P01071	<50	ug/l
Al-Aluminum (D)	P01106	180	ug/l
Be-Beryllium (D)	P01005	<100	ug/l
Ca-Calcium (D)	P00915	73	mg/l
Cd-Cadmium (D)	P01025	<20	ug/l
Cr-Chromium (D)	P01030	<50	ug/l
Cu-Copper (D)	P01040	<20	ug/l
Fe-Iron (D)	P01046	700	ug/l
Hg-Mercury	P71900	<0.2	ug/l
K-Lithium (D)	P01130	<50	ug/l
Mg-Magnesium (D)	P00925	14	mg/l
Mn-Manganese (D)	P01056	<50	ug/l
Na-Sodium (D)	P00928	6.1	mg/l
Pb-Lead (D)	P01049	<100	ug/l
Zn-Zinc (D)	P01090	<20	ug/l
K-Potassium (D)	P00935	7.8	mg/l
SELENIUM		<5.0	ug/l
NOB	P00310		mg/l
COF	P00311		mg/l
California (Total H ₂)	P31616		/100ml
California (total H ₂)	P31505		/100ml
TUC	P00660		mg/l
Turbidity	P82079		NTU
Amonia (as Nitrogen) (D)	P00612	.01	mg/l
Kjeldahl (as Nitrogen) (D)	P00623	<0.1	mg/l
Nitrate + Nitrite (as Nitrogen) (D)	P00631	<.01	mg/l
Phosphorus, total as P (D)	P00666	.26	mg/l
Dissolved Solids - cond. meter	P70304		mg/l
Other Analyses:			
NITRITY		<.01	mg/l

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RECOMMENDATIONS

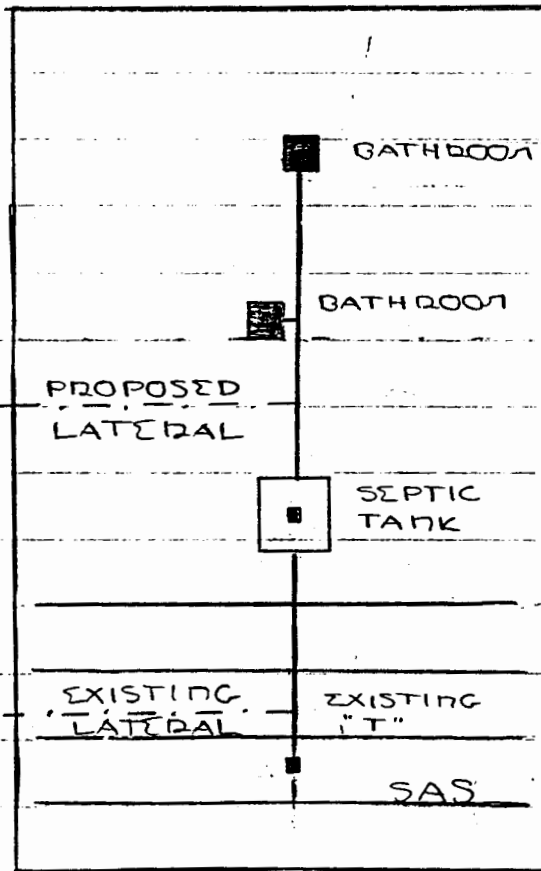
As it is highly probable that ABC One Hour Cleaners is the principal source of the PCE contamination problem, and because this problem has resulted in the violation of standards assigned to GA classified aquifer (s), it is recommended that DEM pursue the following course of action:

1. Require ABC to quit using the source (ST-SAS);
2. Require ABC to analyze the waste in the septic tank for PCE, TCE and DCE concentrations;
3. Require ABC to analyze soil samples around the facility for PCE, TCE and DCE concentrations;
4. If deemed necessary, require ABC to remove PCE contaminated waste and PCE contaminated soils to an authorized disposal site;
5. Require ABC to delineate the horizontal and vertical geometry of the contaminant plume;
6. Require ABC to adequately define the quality attributes of the contaminant plume;
7. Require ABC to predict the future impacts of the contamination problem;
8. Require remediation of the contaminated groundwater to the extent that GA standards can be restored.

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ABC ONE HOUR CLEANERS

LEJEUNE BLVD



LEGEND:

■ - DRAINS

CW

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