✓ 04.10- 6/1/91-00267

REPORT

CORRECTIVE ACTION PLAN
TARAWA TERRACE
MARINE CORPS
BASE
NEW RIVER, NORTH CAROLINA

JUNE 1991

PREPARED BY:

O'BRIEN & GERE ENGINEERS
440 VIKING DRIVE
SUITE 250
VIRGINIA BEACH, VIRGINIA 23452

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

1.01 Purpose and Scope

The purpose of this Corrective Action Plan (CAP) is to present a summary of the hydrogeologic conditions at the site and evaluate the corrective measures necessary to remediate the groundwater in the Tarawa Terrace vicinity.

1.02 Site Description

Marine Corps Base Camp LeJeune is located in Onslow County, North Carolina. The facility covers approximately 170 square miles and is bounded by U.S. Route 17 to the west and State Route 24 to the northeast (Figure 1). Tarawa Terrace Gas Station is located on the corner on Tarawa Blvd. and Iwo Jima Drive at Camp Lejeune. The Site is approximately 300 feet by 300 feet and is comprised of an automobile service station which includes four underground gasoline storage tanks and two pump islands (Figure 2).

In September 1985, a reported 4400 gallons of unleaded gasoline was released from one of the storage tanks. The tank was taken out of service and groundwater monitoring wells were established. In January 1986 a recovery system was installed by Specialized Marine, Inc. of Wrightsville Beach, N.C. This abatement method consisted of a purge well and a groundwater treatment system. Testing of the product recovered during July 1986 revealed the presence of lead, suggesting a second tank of leaded gas was leaking. A 3000 gallon leaded gasoline tank was

confirmed to be leaking and was taken out of service in July 1986. The total combined loss from the two sources is estimated at 10,000 gallons.

SECTION 2 - SITE ASSESSMENT

2.01 Hydrogeology

2.01.1 Regional Geology

The geologic units beneath the Tarawa Terrace area are comprised of surficial aquifers, the Yorktown Formation, the Castle Hayne Formation and the Peedee Formation. The Yorktown and Castle Hayne Formations are composed of shelly limestones that are semi- to completely consolidated. The Peedee formation is composed of sand, interbedded with clay and consolidated calcareous beds (LeGrand,1960). The unit that is most widely used for water supply is the Castle Hayne Formation which exceeds a thickness of 1,100 feet in some areas of Eastern North Carolina.

2.01.2 Site Geology

Soil surveys of the Tarawa Terrace area indicate that the upper 3 feet of subsurface material is characterized by sandy loams consisting of at least 45% silts and clays (Juney et al.,1923). The surficial aquifer is found underlying approximately 8 feet of sandy clay. The surficial sand has been classified as a light gray, medium to fine grained, well sorted, quartz sand and extends to a depth of about 60 feet below grade (Industrial Marine Service, Inc.,1985).

2.01.3 Groundwater Data

In June 1989 an OBG geologist gauged each well to measure groundwater elevations and product thickness. Table 1 summarizes groundwater elevations. Due to hydrostatic pressure, a product layer tends to depress the water table. Groundwater elevations must

be corrected, using the following equation, to give elevations that would be representative of the aquifer without the effects of the product layer. The equation $Ec = E + (0.73 \times T)$ takes into consideration the thickness of the product layer (T), the density of the product (0.73), and the water elevation under the influence of the product layer (E). An illustration of the groundwater contours and flow direction for the site is presented on Figure 4 and indicates that groundwater is flowing in a southerly direction. The hydraulic gradient across the site is estimated to be 0.01 ft/ft. Based on the corrected ground water elevations, the site's effective porosity of 0.40 and average hydraulic conductivity of 3800 ft/day^2. The groundwater velocity is calculated at 90 ft/day.

2.01.4 Aquifer Testing

On June 7 1989 an OBG geologist performed an 8 hour pump test. The results of the pump test help to determine the hydraulic characteristics of the aquifer including transmissivity, hydraulic conductivity and the pumping well's radius of influence. The test was performed with the constant discharge rate of 20 gallons per minute (gpm) for a duration of 8 hours. The pumping rate was maintained by using a submersible pump. Water levels in the pumping well and nearby monitoring wells were measured and recorded at various intervals during, and directly following the test. Following the pump test, groundwater recovery of the test well was measured until the aquifer had recovered to within 95% of its static level.

Aquifer coefficients can be calculated by using the Cooper and Jacob Straight Line Method and Horslov's formula. The Cooper and Jacob (1946) straight line method involves plotting the drawdown of the groundwater versus elapsed time and the drawdown versus distance from the well on semi-logarithmic paper. Horslov's formula is based on the change in water level versus the change in time for the recovery of the well. From these calculations the average transmissivity was found to be approximately 91000 ft^2/day and a hydraulic conductivity of approximately 3800 ft/day. The average storage coefficient is calculated to be 0.03. Table 2 is a summary of the pump test results. According to the distance/ drawdown plot the radius of influence is estimated to be approximately 130 feet. Appendix C contains data generated from the pump test.

2.02 Environmental Assessment

2.02.1 Free Product Characterization

A small amount of free product was detected in only well OB-4 which contained 0.07 feet of free phased product. Figure 5 illustrates the approximately location of the free product layer. Between January 1986 and October 1988 approximately 6600 gallons of free product was effectively recovered. Exhibit A contains information received from Specialized Marine, Inc. concerning their recovery efforts.

2.02.2 Groundwater Characterization

Between June 6 and 9 1989 groundwater samples were collected from 6 wells in accordance with sampling procedures outlined in Appendix A. Samples were sent to OBG Laboratories, Inc. in

Syracuse New York for analysis by modified USEPA method 503.1. The results of this analysis are contained in Appendix B.

Wells OB-1, OB-2, OB-4, OB-6, OB-11, and the recovery well (RW) were sampled. Benzene concentrations ranged from below detection limits in OB-11 to 22 mg/l in OB-4. Toluene concentrations varied from 7.9 mg/l in RW to 44 mg/l in OB-1. Ethylbenzene ranged from 0.44 mg/l in RW to 3.0 mg/l in OB-2. Xylene levels varied between 3.0 mg/l in RW to 17.0 mg/l in OB-1. Total Petroleum Hydrocarbons (TPH) concentrations ranged from 39 mg/l in OB-11 to 250 mg/l in OB-6. Figure 5 illustrates the approximate extent of dissolved TPH at the site.

SECTION 3 - CORRECTIVE ACTION PLAN

3.01 General

Based on the results of the site investigations and the evaluation of remedial technologies a petroleum hydrocarbon recovery system was designed to remove dissolved phase product from the groundwater. Figure 6 illustrates the location of the proposed recovery system. Final design plans and specifications will be submitted to the U.S. Navy in June 1991.

3.02 Designed Recovery System

The designed system consists of two recovery wells and a product treatment system. The recovery wells will be constructed of 6" I.D. Schedule 40 flush jointed PVC and extend to a depth of 45 feet below grade. Each well will contain a drawdown pump to advance the removal of petroleum hydrocarbons. The product treatment system will be comprised of an oil/water separator, an above ground storage tank to hold recovered petroleum, an air 7474 stripper tower and carbon contactors. Groundwater from the drawdown pump will enter the oil/water separator. If free product is present it will be decanted and deposited into the storage tank while the remaining recovered groundwater is drained into a surge tank to be fed to an air stripper tower. The air stripper will volatilize hydrocarbon constituents in the groundwater. The groundwater will then be filtered through the carbon contactors for organic adsorption to complete the treatment. Treated groundwater will then be discharged into a nearby sanitary sewer. Figure 7 is a remediation system schematic.

3.03 Treatment Requirements/Effectiveness

As discussed in Section 3.01, recovered groundwater will be passed through an oil/water separator, an air stripper and carbon contactors before discharging to a nearby sanitary sewer. The pretreatment requirement of Naval Facilities Engineering Command, Atlantic Division (LANTDIV) is 2 mg/l of Total Toxic Organics (TTO) (Christina Wallace Memo, 15 May 1990).

Recovered groundwater will be sampled and analyzed for USEPA 602 parameters upon system start-up, and then monthly. If effluent concentrations are consistently below the 2 mg/l TTO concentration for a period of six consecutive months, sampling frequency will be decreased to quarterly.

The recovery system will operate until groundwater meets North Carolina Groundwater Quality Standards for petroleum related components (NC Admin. Code Title 15 Subchapter 2L).. Ground water samples will be collected from the five monitoring wells quarterly for one year and analyzed by Method 602. If ground water concentrations of these parameters has been consistently low over this period, the Site will be considered remediated.

3.04 Maintenance and Reports

Maintenance of the product recovery system equipment will be performed per manufacturer's recommendations. In addition, the following activities will be conducted monthly:

- Inspect and adjust all systems to ensure optimum operational efficiency.
- Collect groundwater discharge flow meter readings.
- Measure product recovery tank.

The following reports shall be prepared quarterly:

- Recovered Product/Discharged Groundwater Report - A tabulation of measurements of the product recovery tank and a tabulation of groundwater discharge flow meter readings.

- Well report - A tabulation of liquid level measurements (product and groundwater) in all the recovery wells.

- Analytical Report - Summary of analytical results with laboratory data sheet.

In addition to the quarterly reports, an annual report will be submitted and will summarize the data collected over the previous year. The annual report will present conclusions on how the system is working and recommendations for any changes to the program, as necessary, to enhance recovery.

Prepared By:

F.D. Hale, P.E., Managing Engineer
T. Bickerstaff, Geologist
S. Mogilnicki, Geologist

Tables

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TABLE 1
GROUNDWATER ELEVATIONS
TARAWA TERRACE, CAMP LEJEUNE
JUNE 7 1989

WELL #	TOC ELEVATION (AMSL)	DTW (IN FEET)	PRODUCT THICKNESS (IN FEET)	CORRECTED GROUNDWATER ELEVATION (AMSL)
OB-1	27.96	21.13	0.00	6.83
OB-2	26.90	20.26	0.00	6.64
OB-3	27.25	20.87	0.00	6.36
OB-4	26.48	19.22	0.07	7.31
OB-6*		19.54	0.00	
OB-7	22.49	20.58	0.00	1.91
OB-8	27.02	20.51	0.00	6.51
OB-9	26.40	19.81	0.00	6.59
OB-10	24.66	18.33	0.00	6.33
OB-11	27.06	19.65	0.00	7.41
A-1	26.76	18.39	0.00	8.37
A-2	26.89	20.30	0.00	6.59
A-3	25.42	18.82	0.00	6.60
A-4	26.66	19.08	0.00	7.58
A-5	24.73	17.35	0.00	7.38
A-6	26.65	20.28	0.00	6.37
A-7	26.70	19.97	0.00	6.73
A-8	26.30	19.78	0.00	6.52
A-9	26.10	19.36	0.00	6.74
RW**	27.98	21.19	0.00	6.79

DTW = Depth to Water
TOC = Top of Casing
AMSL = Above Mean Sea Level
* = Well Not Surveyed

TABLE 2
PUMP TEST RESULTS
TARAWA TERRACE, CAMP LEJEUNE
JUNE 7 1989

METHOD	TRANSMISSIVITY (SQ.FT/DAY)	STORATIVITY
RECOVERY/HORSELOV'S FORMULA	87,765	------
DISTANCE/DRAWDOWN	64,745	0.047
JACOB PLOT OF OB-3	121,520	0.038
JACOB PLOT OF OB-9	91,847	0.002

Figures

O'BRIEN & GERE

063357

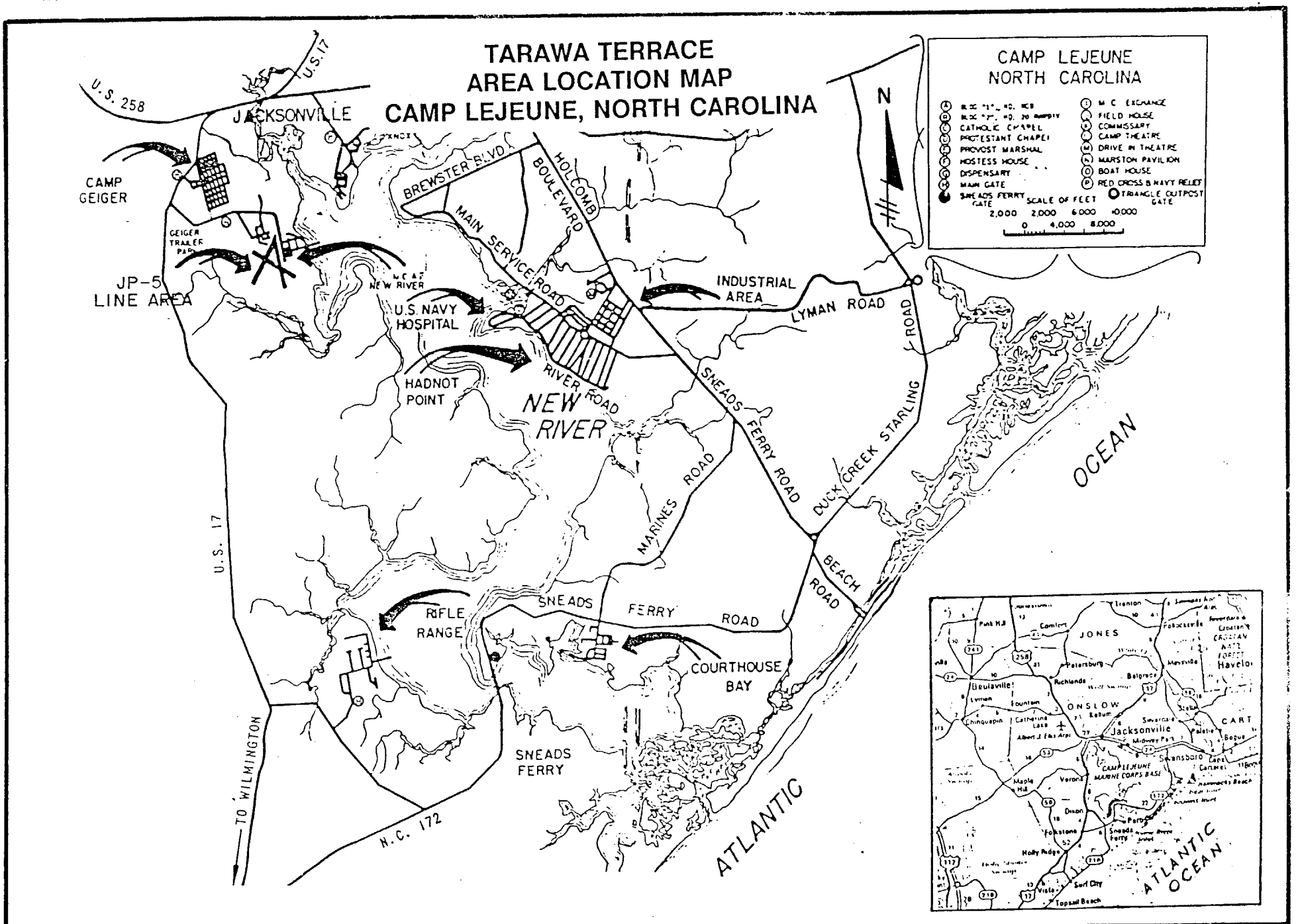

FIGURE 1

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TARAWA TERRACE
SITE LOCATION MAP
CAMP LEJEUNE, NORTH CAROLINA

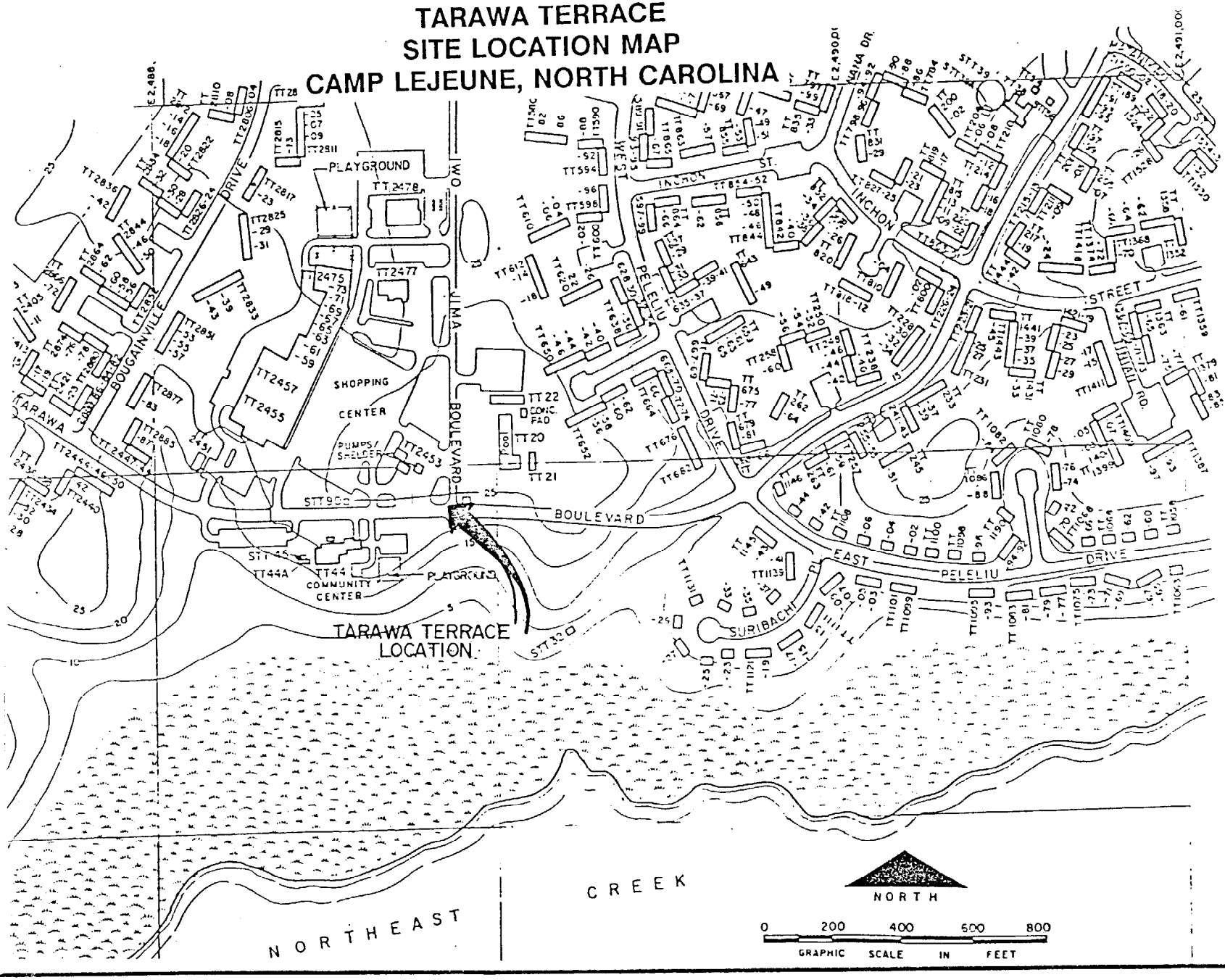

FIGURE 2

O'BRIEN & GERE

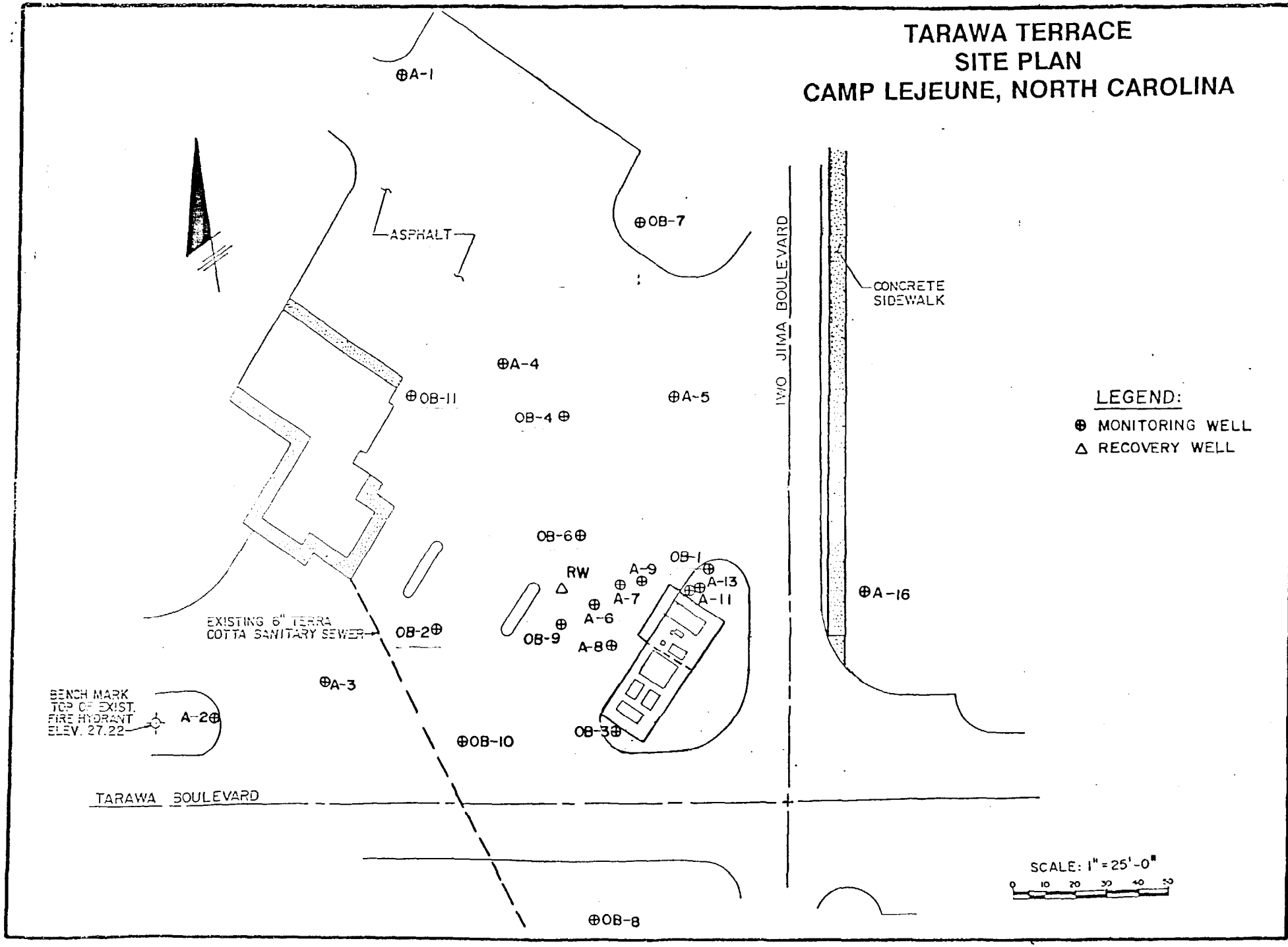

FIGURE 3

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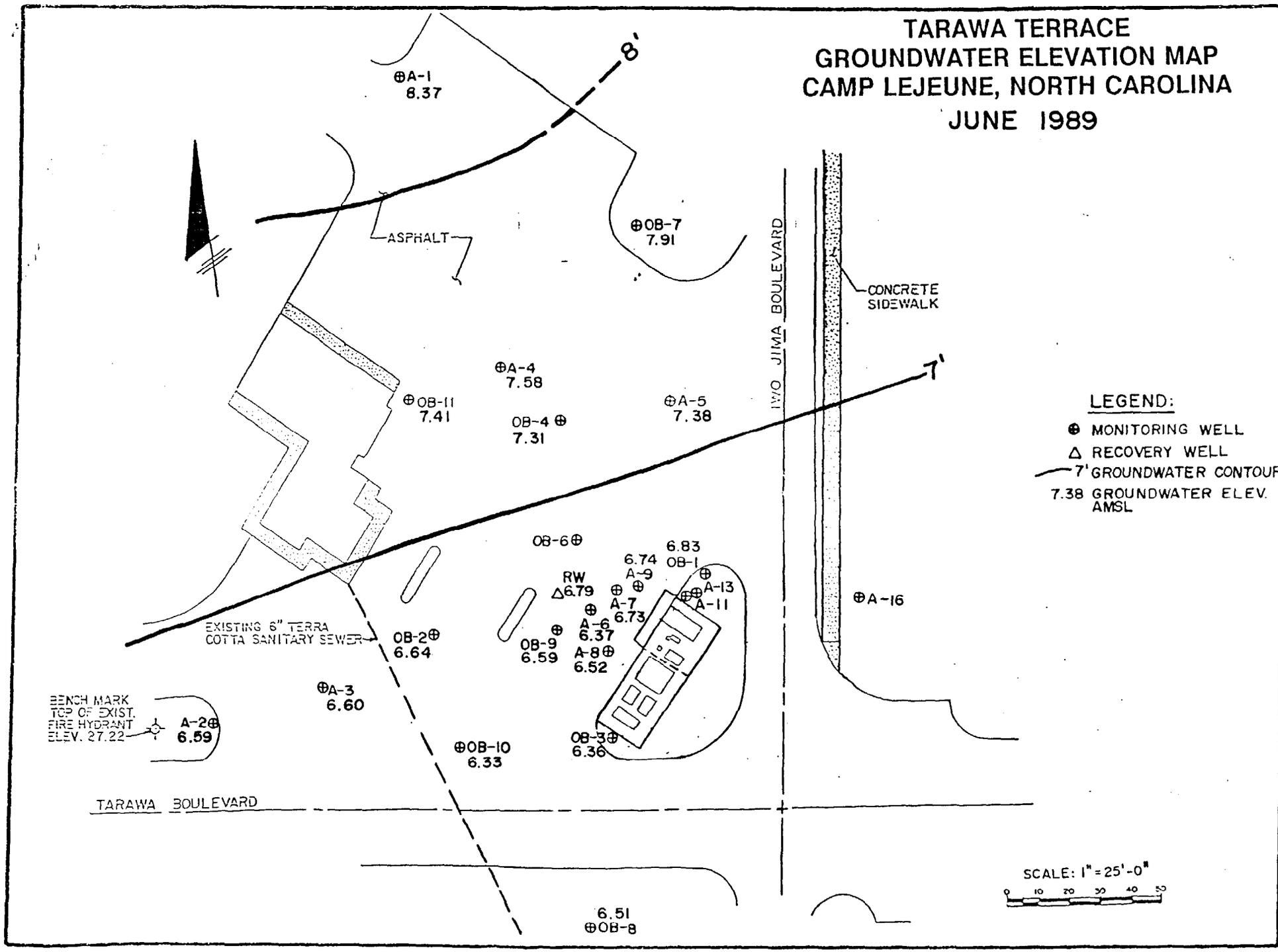

FIGURE 4

O'BRIEN&GERE

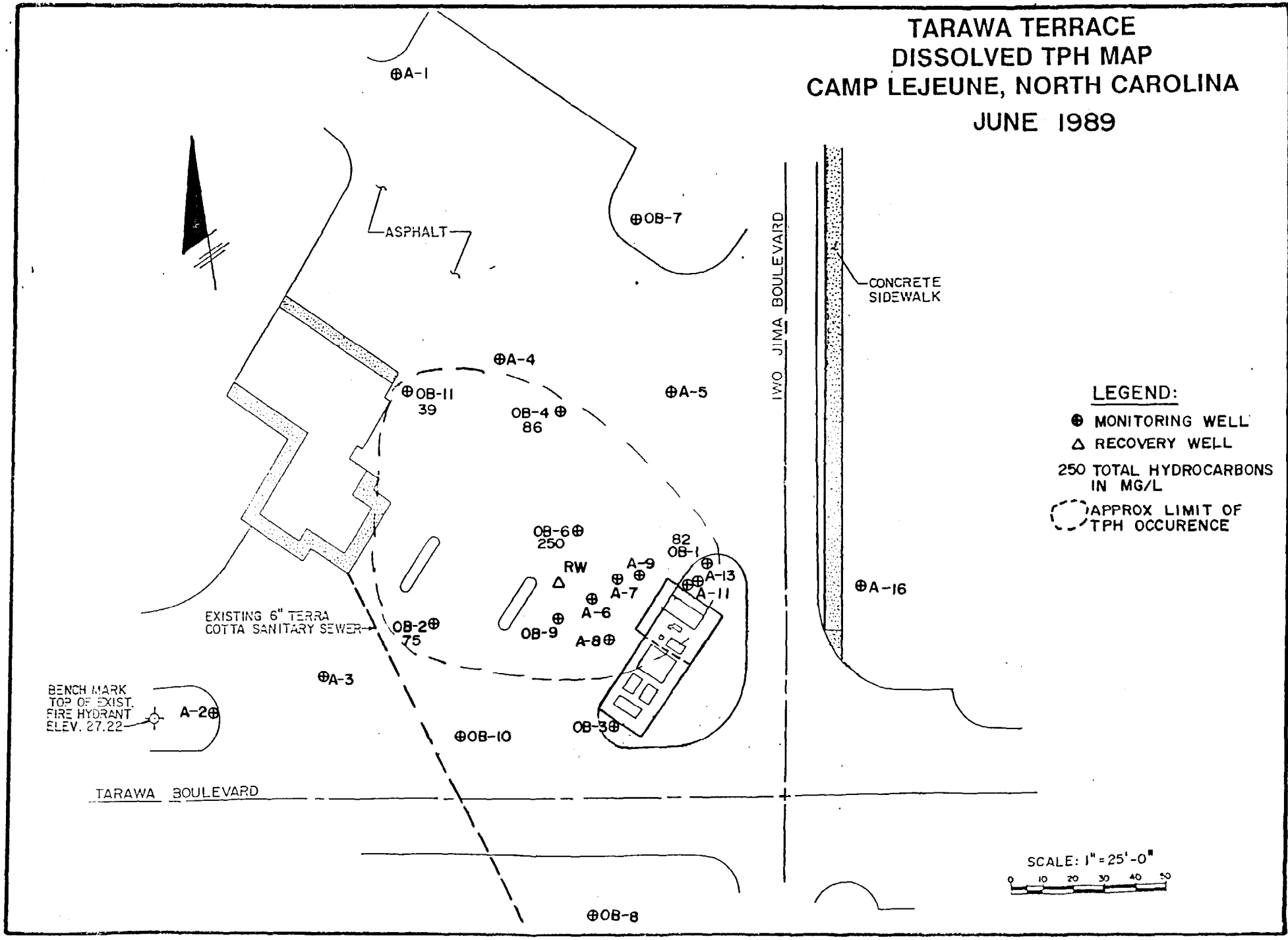

FIGURE 5

O'BRIEN & GERE

TARAWA TERRACE
FREE PRODUCT MAP
CAMP LEJEUNE, NORTH CAROLINA
6-7-89

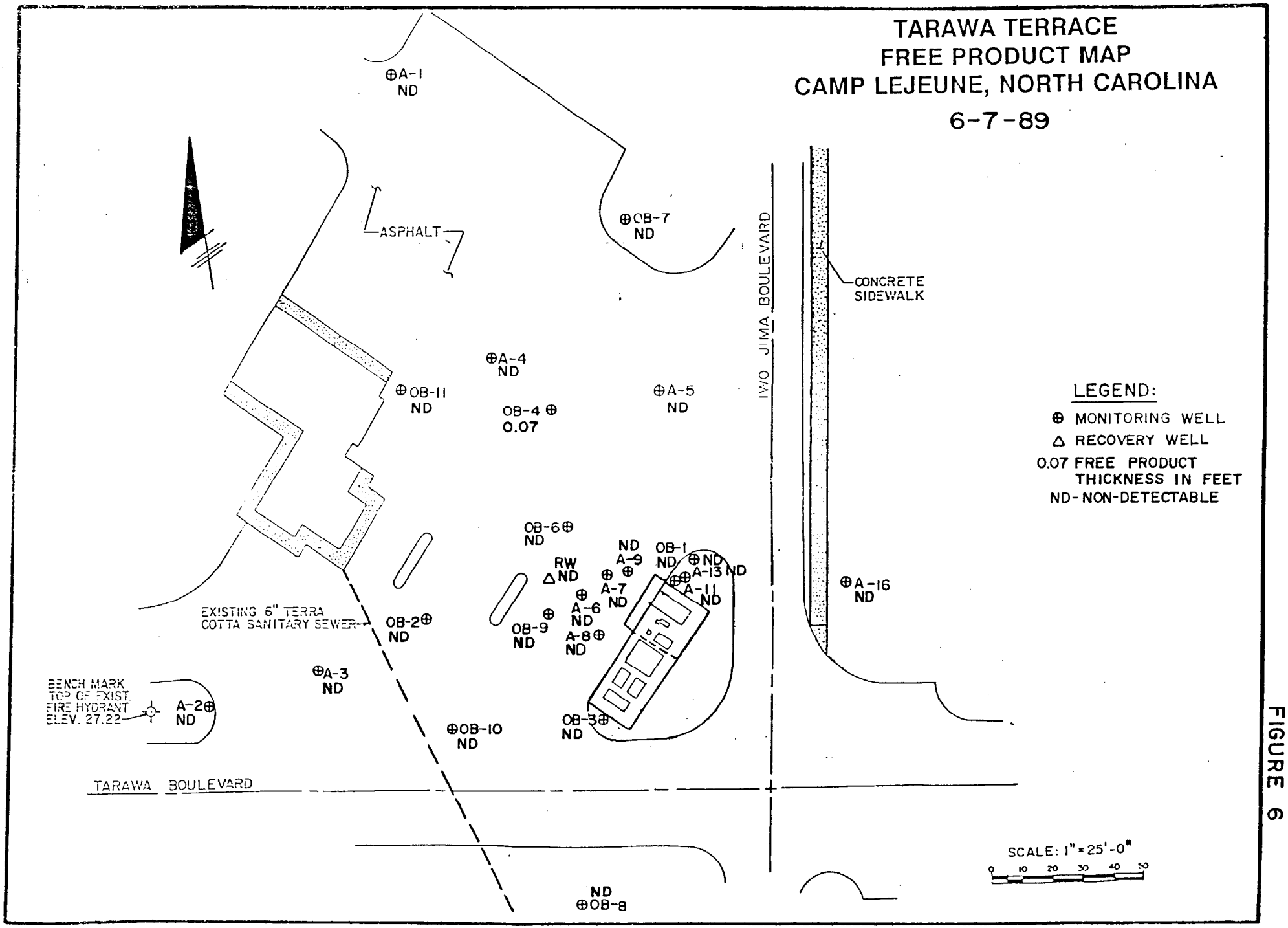

FIGURE 6

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TARAWA TERRACE
REMEDIATION SYSTEM LOCATION
CAMP LEJEUNE, NORTH CAROLINA

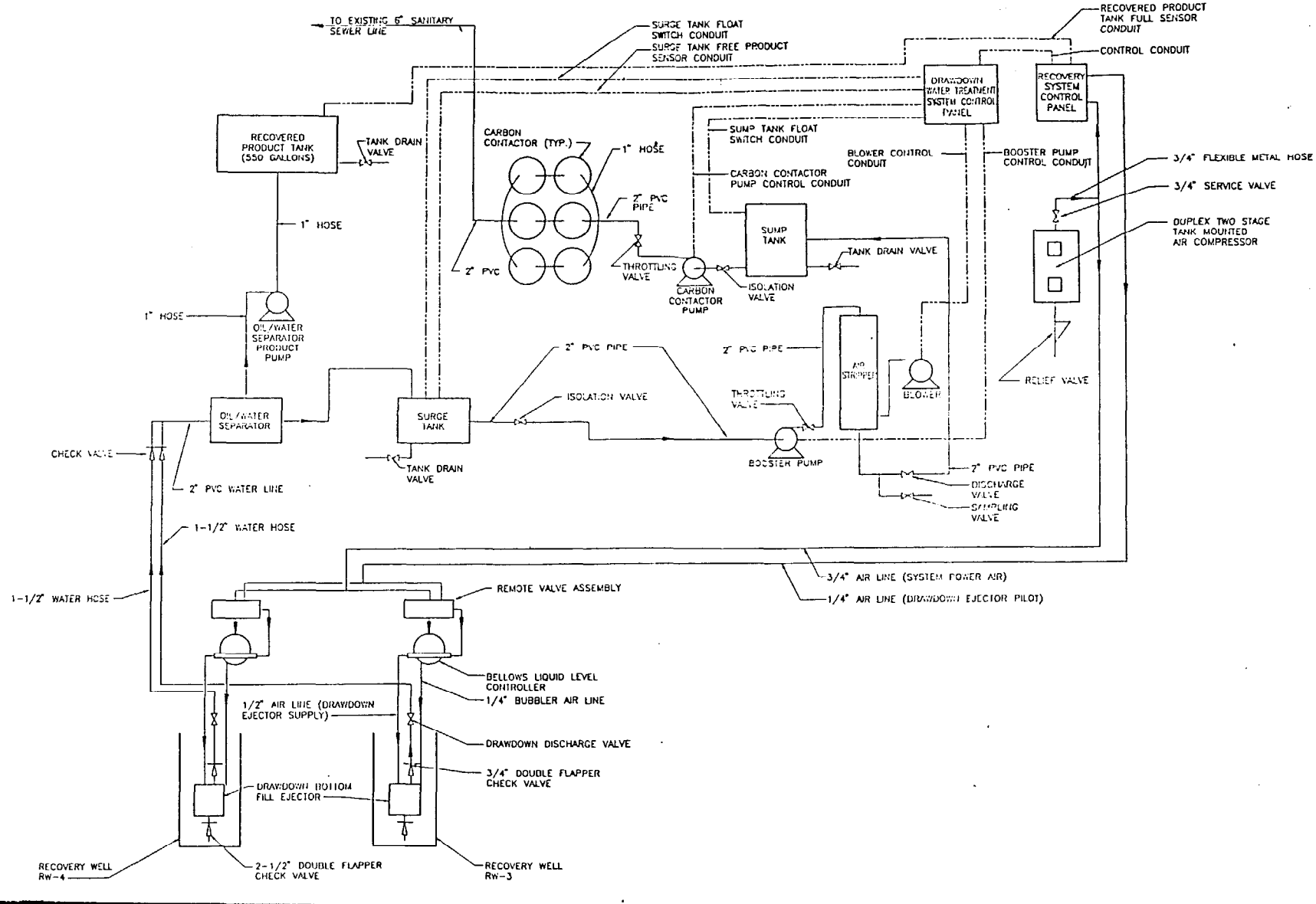

FIGURE 7

O'BRIEN&GERE ENGINEERS INC

Appendices

APPENDIX A

GROUNDWATER SAMPLING PROTOCOL

Use of the following procedures for sampling cf ground water observation wells is dependent upon the size and depth of the well to be sampled and the presence of immiscible petroleum product in the well. To obtain representative ground water samples from wells containing only a few gallons of ground water and no product present, the bailing procedures is preferred. To obtain representative ground water samples from wells containing more than a few gallons if an immiscible product layer is apparent, the pumping procedure generally facilitates more representative sampling. Each of these procedures is explained in detail below.

1. Identify the well and record the location on the Ground Water Sampling Field Log, Attachment A.

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of the plastic sheet, and slip it over the well creating clean surface onto which the sampling equipment can be positioned.

4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.

5. Using an electric well probe, measure the depth of the water tube and the bottom of the well. Record this information in the Ground Water Sampling Field Log.

6. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.

7. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.

8. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

9. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the ground water from the bailer into a glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water only.

10. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.

11. Lower the bailer to the bottom of the well and agitate the bailer up and down to resuspend any material settled in the well.

12. Initiate bailing the well from the well bottom. All groundwater should be dumped from the bailer into a graduated pail to measure the quantity of water removed from the well.

13. Continue bailing the well throughout the water column and from the bottom until three times the volume of groundwater in the well has been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time (several hours to overnight) for the well to recover before proceeding with Step 13. Record this information on the Groundwater Sampling Field Log.

14. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

15. To minimize agitation of the water in the well, initiate sampling by lowering the bailer slowly into the well making certain to submerged it only far enough to fill it completely. Fill each sample container following the instructions listed in the Sample Containerization Procedures, Attachment B. Return each sample bottle to its proper transport container.

16. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. The vials (3) labeled purgeable priority pollutant analysis should be filled from one bailer than securely capped. NOTE: Samples must not be allowed to freeze

17. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

18. After the last sample has been coliected, record the data and time, and, and if required, empty one baiier of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH , conductivity and temperature of the ground water following the procedures outlined in the equipment operation manuals. Record this information on the Ground Water Sampling Field Log. The 200 ml beaker must then be rinsed with distilled water prior to reuse.

19. Begin the Chain of Custody Record.

20. Replace the well cap, and lock the well protection assembly before leaving the well location.

21. Place the polypropylene rope, gloves, rags and plastic sheeting into a plastic bag for disposal.

22. Clean the bailer by rinsing with control water and then distilled water. Store the clean bailer in a fresh plastic bag.

Sampling Procedures (PUMP)

1. Identify the well and record the location on the Ground Water Sampling Field Log.

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of the plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned.

4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.

5. Using an electric well probe, measure the depth of the water tube and the bottom of the well. Record this information in the Ground Water Sampling Field Log.

6. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.

7. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.

8. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fiil one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

9. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the ground water from the bailer into a glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water only.

10. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.

11. Prepare the submersible pump for operation. A pump with a packer inflated above the screened interval is preferred.

12. Lower the bailer to just below the top of the water column and pump the ground water into a graduated pail. Pumping should continue until sufficient well volumes have been removed or the well is pumped dry. If the well is pumped dry, allow sufficient time for the well to recover before proceeding with Step 16. Record this information on the Ground Water Sampling Field Log.

13. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

14. With submersible pump raised to a level just below the surface of the water in the well, fill each sample container following the instructions listed in the Sample Containerization Procedures. Return each sampling bottle to its proper transport container. NOTE: A clean bottom loading stainless steel or Teflon bailer should be used to collect the sample used to fill the sample vials labeled purgeable priority pollutant analysis. Gently lower the bailer into the water to minimize agitation of the water. The vials (2) should be filled from one bailer.

15. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. The vials (3) labeled purgeable priority pollutant analysis should be filled from one bailer than securely capped. NOTE: Samples must not be allowed to freeze.

16. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

17. After the last sample has been collected, record the data and time, and, and if required, empty one bailer of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH, conductivity and temperature of the ground water following the procedures outlined in the equipment operation manuals. Record this information on the Ground Water Sampling Field Log. The 200 ml beaker must then be rinsed with distilled water prior to reuse.

18. Begin the Chain of Custody Record. A separate form is required for each well with the required analysis listed individually.

19. Remove the submersible pump from the well and clean the pump and necessary tubing both internally and externally. Cleaning is comprised of rinses with a source water and acetone or methanol mixture, and distilled water using disposable towers and separate wash basins. The pump should then be returned to its covered storage box.

20. Replace the well cap, and lock the well protection assembly before leaving the well location.

21. Place the gloves, towels, disposable shoe covers and plastic sheet into a plastic bag for disposal.

APPENDIX B

OBG LABORATORIES, INC.

Laboratory Report

CLIENT NAVY JOB NO. 3543.004.517

DESCRIPTION Camp Lejeune, Tarawa Terrace - Waters

DATE COLLECTED 6-9-89 DATE REC'D. 6-12-89 DATE ANALYZED 6-21-89

Description	OB 2	OB 11	OB 1	OB 4
Sample #	I6328	I6329	I6330	I6331
Volatile Petroleum Hydrocarbons and Solvents by Purge & Trap/GC:				
BENZENE	12000.	<1000.	13000.	22000.
TOLUENE	39000.	17000.	44000.	38000.
ETHYLBENZENE	3000.	1600.	2700.	2300.
XYLENES	16000.	11000.	17000.	14000.
TRICHLOROETHENE	<1000.	<1000.	<1000.	<1000.
TETRACHLOROETHENE	↓	↓	↓	↓
MTBE	<10000.	<10000.	<10000.	<10000.
TOTAL HYDROCARBONS	75000.	39000.	82000.	86000.
COMMENTS	gasoline	gasoline	gasoline	gasoline
			UNITS:	µg/l

Methodology: Federal Register — 40 CFR, Part 136, October 26, 1984

Units: mg/ℓ (ppm) unless otherwise noted

Comments:

Authorized: Thomas A. Vellenden

Date: June 29, 1989

OBG Laboratories, Inc.
Box 4942 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 457-1494

OBG LABORATORIES, INC.

Laboratory Report

CLIENT NAVY JOB NO. 3543.004.517

DESCRIPTION Camp Lejeune/Tarawa Terrace
Waters

DATE COLLECTED 6-6/7-89 DATE REC'D. 6-8-89 DATE ANALYZED 6-16,20/21-89

Description	OB-6	Recovery Well	Bailer Blank	QC Trip Blank
Sample #	I6203	I6204	I6205	I6206
Volatile Petroleum Hydrocarbons and Solvents by Purge & Trap/GC				
BENZENE	4000.	5300.	<1.	<1.
TOLUENE	**20000.**	**7900.**	↓	↓
ETHYLBENZENE	2600.	440.		
XYLENES	**16000.**	**3000.**	↓	↓
TRICHLOROETHENE	**<1000.**	**<100.**	**<1.**	**<1.**
TETRACHLOROETHENE	↓	↓	↓	↓
MTBE	<10000.	<1000.	<10.	<10.
TOTAL HYDROCARBONS	250000.	61000.	<10.	<10.
COMMENTS	fuel	fuel	-	-

UNITS: µg/l

Methodology: Federal Register — 40 CFR, Part 136, October 26, 1984

Units: mg/ℓ (ppm) unless otherwise noted

Comments:

Authorized: Thomas C. Alexander

Date: June 28, 1989

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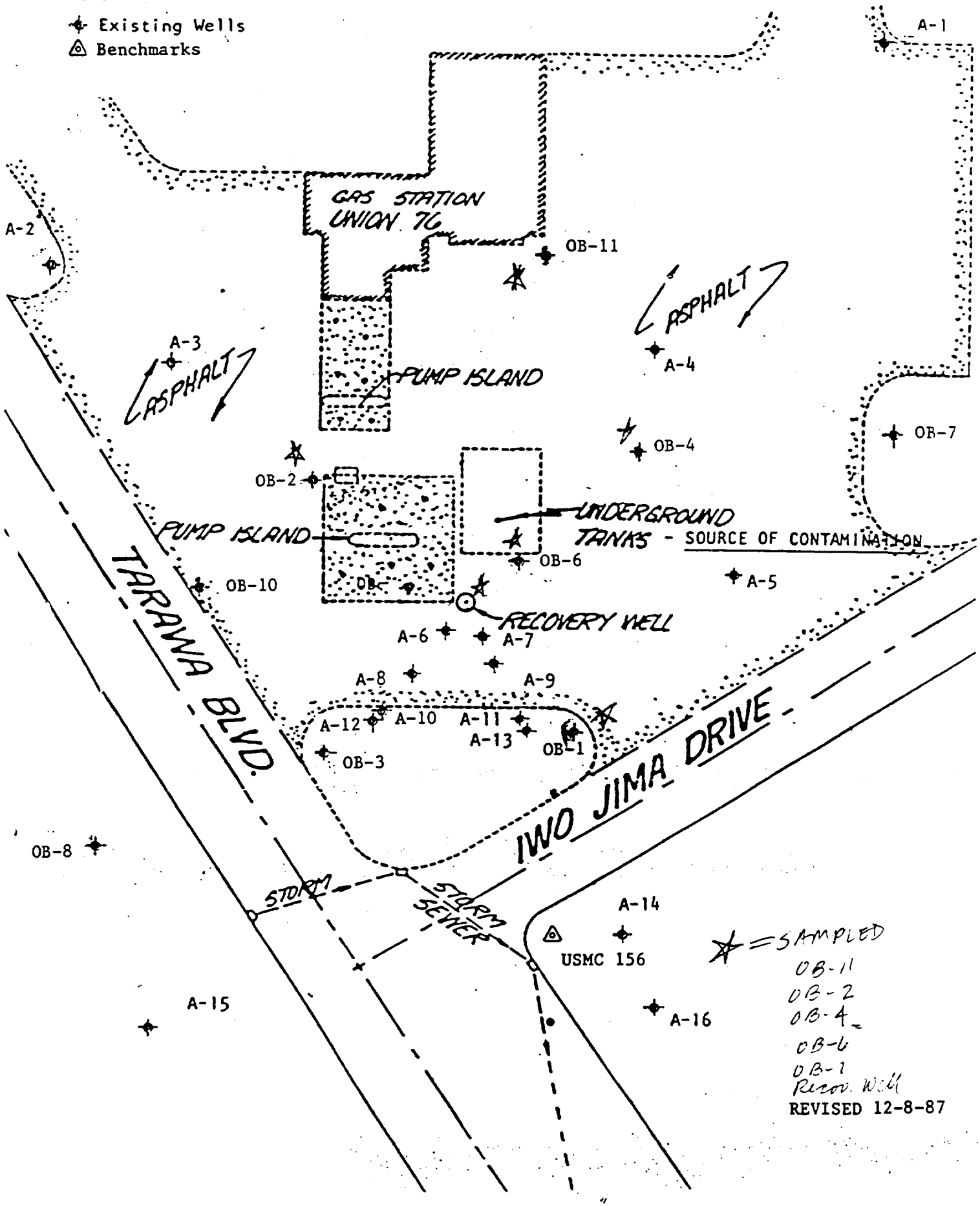
Box 4942 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 457-1494

APPENDIX C

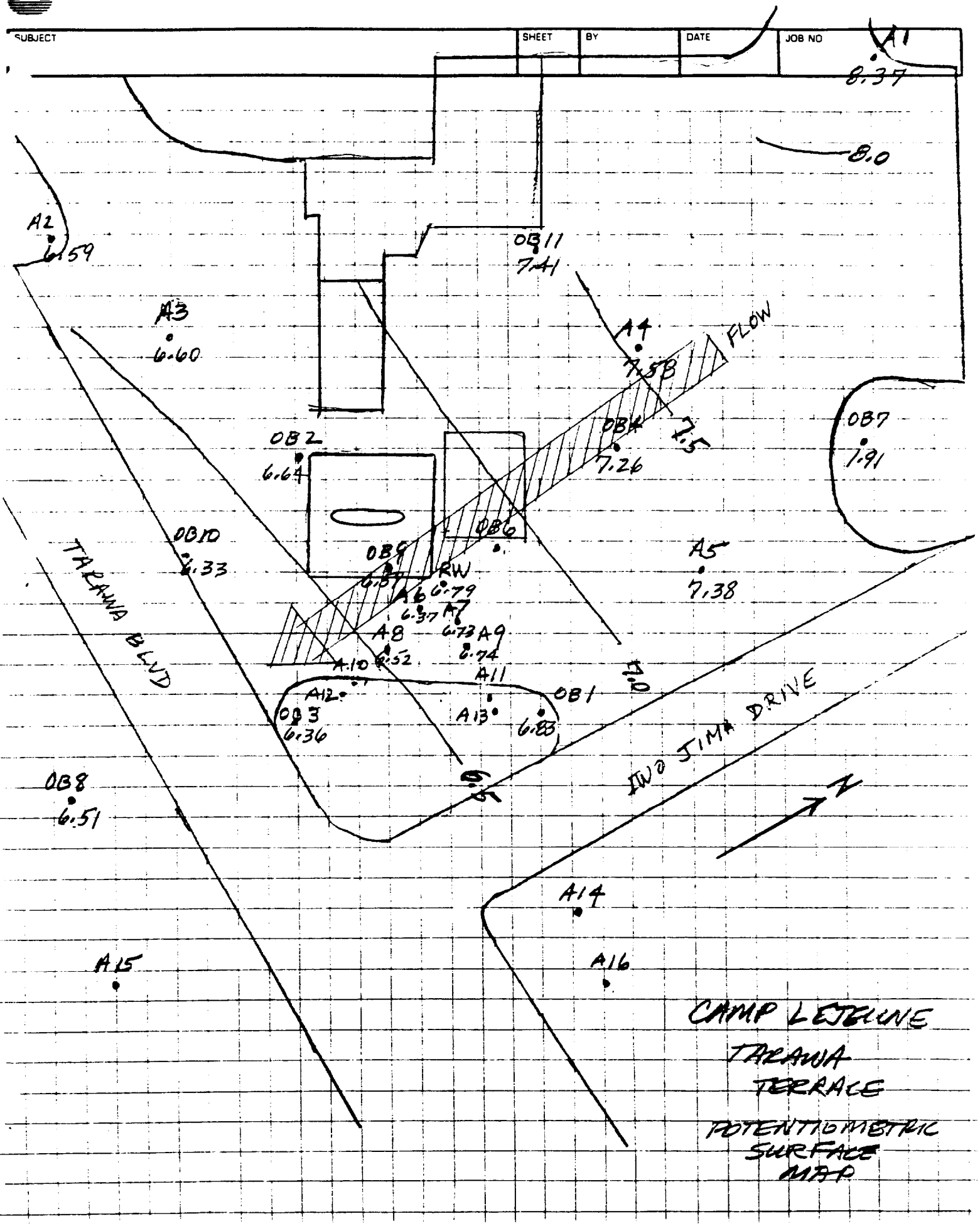
LOCATION MAP OF EXISTING MONITORING WELLS

TARAWA TERRACE SITE, CAMP LEJEUNE, NC



OBRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO



Summary of T and S values

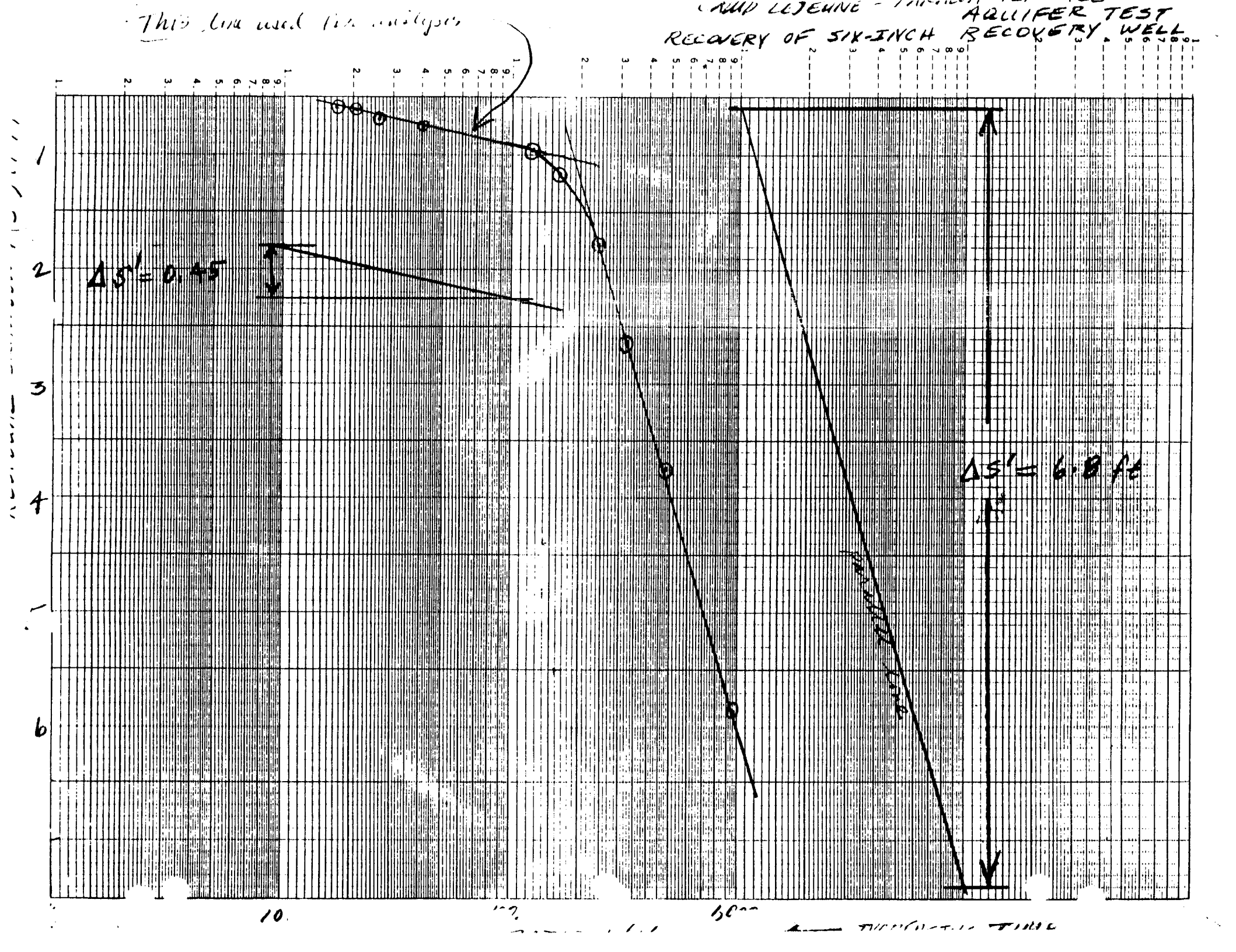
Tarawa Terrace, Camp Lejeune

Method	Transmissivity (sq.ft/day)	Storage Coefficient
Recovery using t/t'	87,765	-
Distance-drawdown	64,745	0.047
Jacob plot of 08-3	121,520	0.038
Jacob plot of 08-9	91,847	0.002

DISTANCE-DRAWDOWN DATA

TARAWA TERRACE PUMP TEST

OBSERVATION WELL	DISTANCE FROM PUMPED WELL (FT)	DRAWDOWN AFTER 8 HOURS (FT)
OB-1	41	0.39
OB-2	47	0.20
OB-3	49	0.39
OB-4	53	0.08
OB-6	15	1.05
OB-7	116	0.34
OB-9	15	1.18
A-6	9	0.80
A-7	10	2.19


AQUIFER TEST
RECOVERY OF SIX-INCH RECOVERY WELL
$\Delta s' = 0.45$
$\Delta s' = 6.8$ ft
1
2
3
4
6
10

DISTANCE DRAWDOWN ANALYSIS
TARAWA TERRACE TEST
CAMP LEJEUNE

$Q = 20$ gpm

Pumping period = 8 hrs

$T = \frac{528\,Q}{\Delta s} = \frac{528\,(20\ \text{gpm})}{1.22\ \text{ft}}$

$T = 8655.7$ gpd/ft

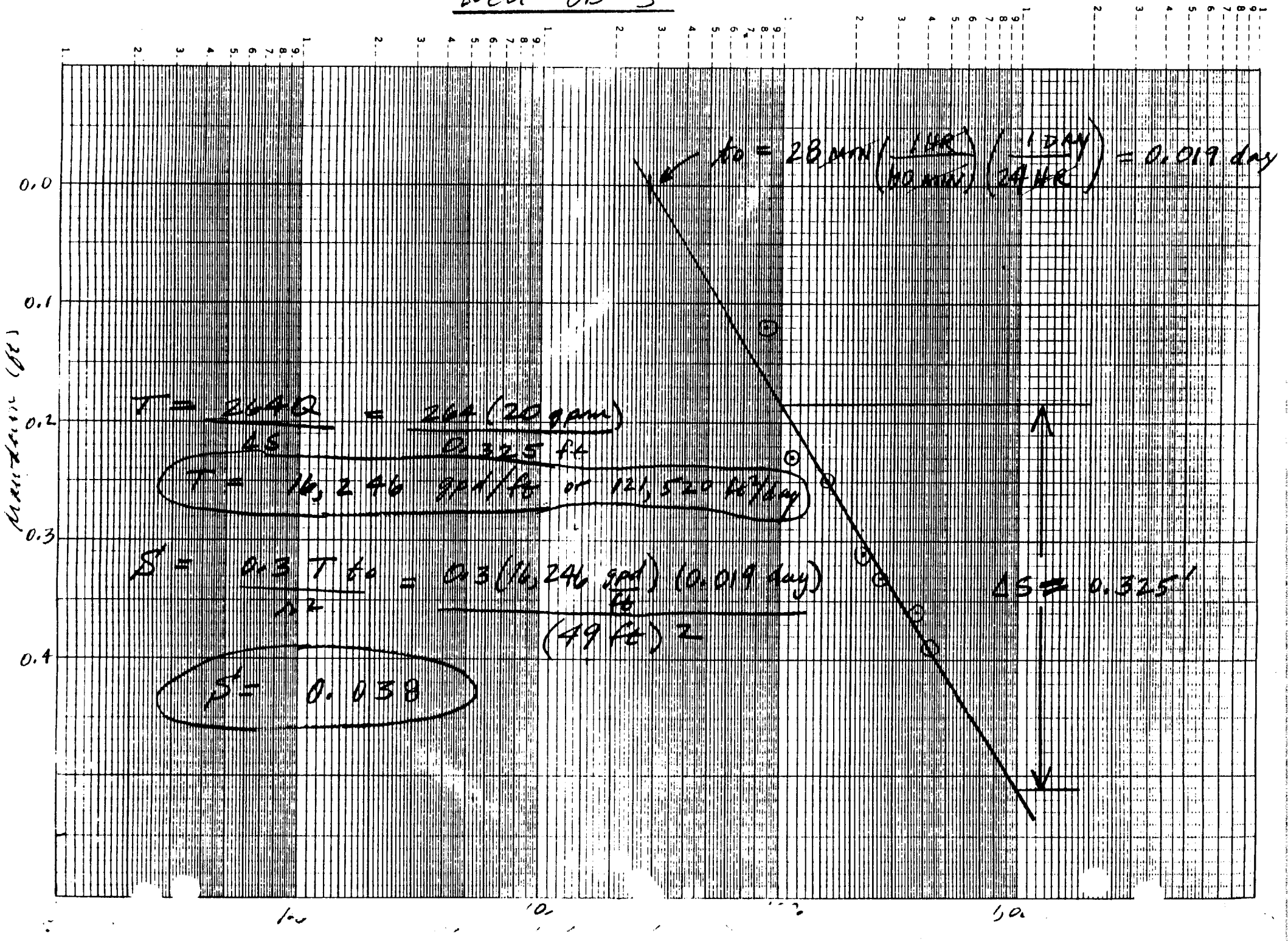
(or 64744.6 ft²/day)

$S = \frac{0.3\,Tt}{ro^2} = \frac{(0.3)(8655.7)(0.3)}{(135')^2}$

$S = 0.047$

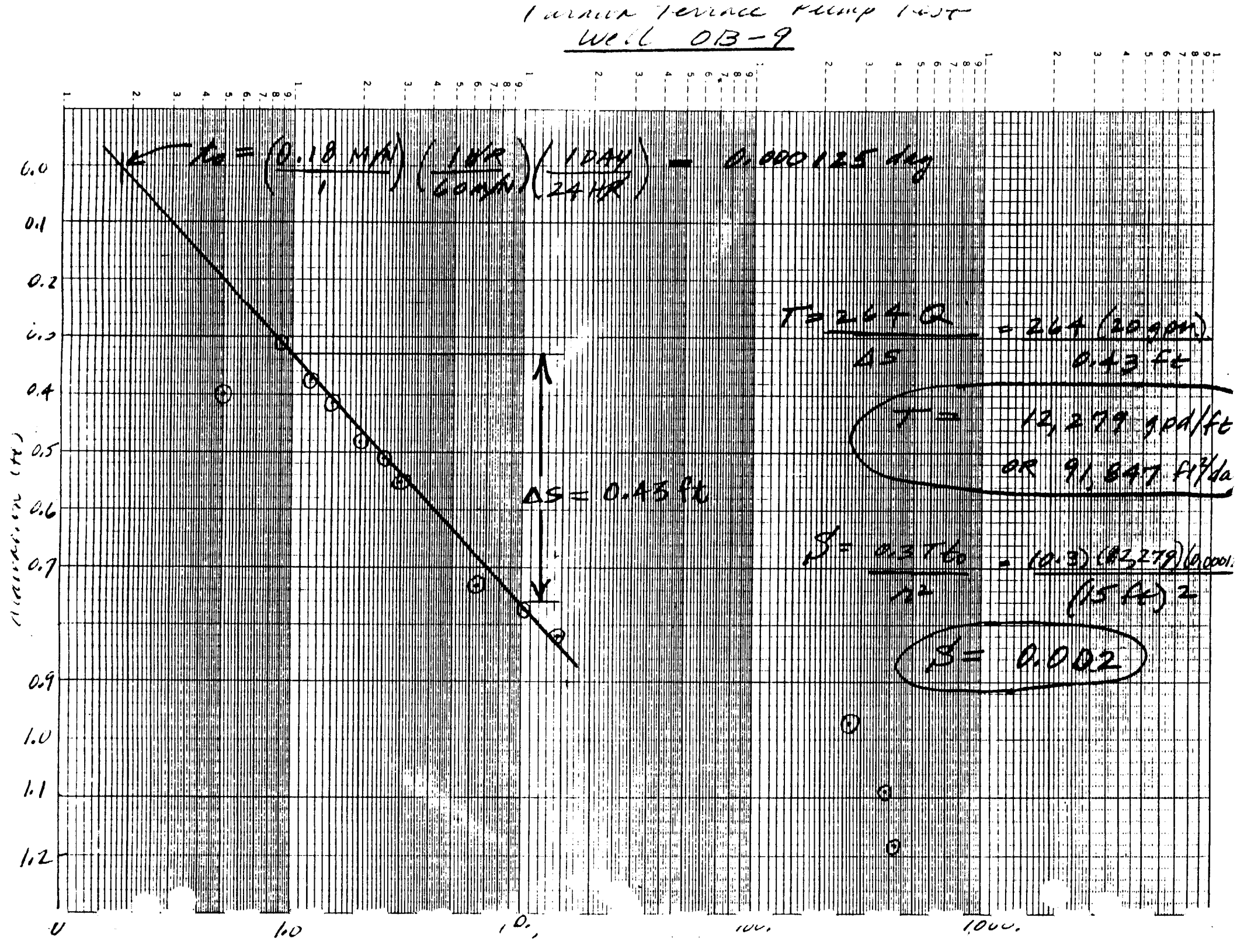
Tarana Terrace Aquifer Test

Well OB-3



Farmin Terrace Pump Test

Well OB-9



GROUND WATER QUALITY RESULTS

TARAWA TERRACE

CAMP LEJEUNE, NORTH CAROLINA

WELL	BENZENE	TOLUENE	ETHYL-BENZENE	XYLENES	TRICHLORO-ETHENE	TETRACHLORO-ETHENE	MTBE	TOTAL HYDROCARBONS
OB-1	13,000.	44,000.	2,700.	17,000.	<1,000.	<1,000.	<10,000.	82,000.
OB-2	12,000.	39,000.	3,000.	16,000.	<1,000.	<1,000.	<10,000.	75,000.
OB-4	22,000.	38,000.	2,300.	14,000.	<1,000.	<1,000.	<10,000.	86,000.
OB-6	4,000.	20,000.	2,600.	16,000.	<1,000.	<1,000.	<10,000.	250,000.
OB-11	<1,000.	17,000.	1,600.	11,000.	<1,000.	<1,000.	<10,000.	39,000.
RECOVERY WELL	5,300.	7,900.	440.	3,000.	<100.	<100.	<1,000.	61,000.

RESULTS IN PPB.

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

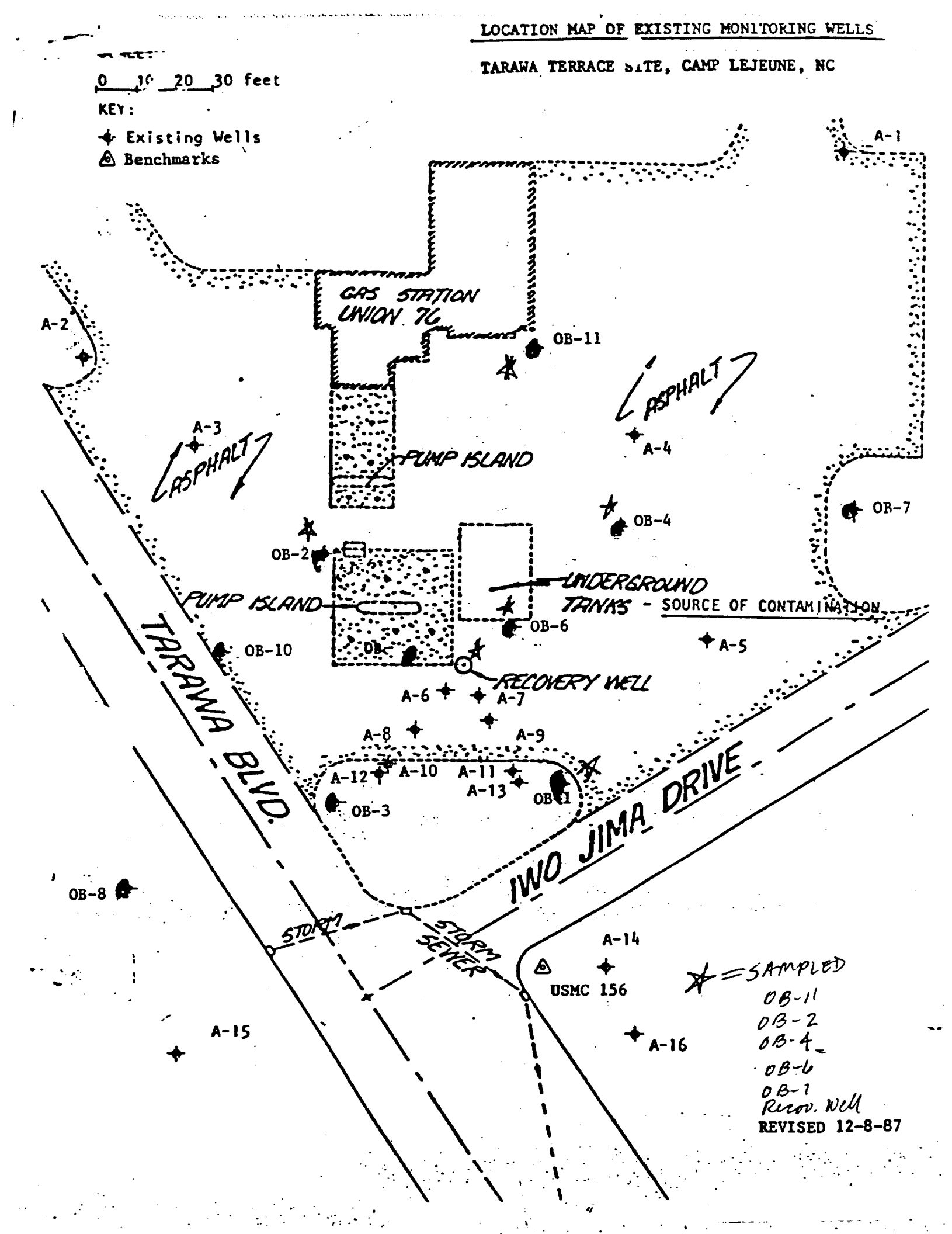
WELL: SIX-INCH DIAMETER RECOVERY WELL

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 21.17

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 50 0	-215.00	21.19		0.02	NO FLOATING
	13 0 0	-25.00	21.17		0.00	PRODUCT
	13 25 30	0.50	28.50	7.33	7.33	OBSERVED
	13 26 0	1.00	27.05	-1.45	5.88	AT ANY TIME
	13 26 30	1.50	26.20	-0.85	5.03	
	13 27 0	2.00	25.15	-1.05	3.98	
	13 28 0	3.00	24.10	-1.05	2.93	DISCHARGE AT
	13 33 0	8.00	31.50	7.40	10.33	20 GPM FOR
	13 35 0	10.00	31.98	0.48	10.81	8 HOURS
	13 40 0	15.00	32.18	0.20	11.01	
	13 45 0	20.00	32.26	0.08	11.09	
	13 50 0	25.00	32.32	0.06	11.15	
	13 55 0	30.00	32.35	0.03	11.18	
	14 0 0	35.00	32.40	0.05	11.23	
	14 30 0	65.00	33.05	0.65	11.88	
	15 7 0	102.00	32.40	-0.65	11.23	
	15 33 0	128.00	32.48	0.08	11.31	
	16 1 0	156.00	32.28	-0.20	11.11	
	16 31 0	186.00	32.36	0.08	11.19	
	17 0 0	215.00	32.41	0.05	11.24	
	17 36 0	251.00	32.50	0.09	11.33	
	19 40 0	375.00	32.58	0.08	11.41	
	20 27 0	422.00	32.70	0.12	11.53	
	21 0 0	455.00	32.70	0.00	11.53	


LOCATION MAP OF EXISTING MONITORING WELLS
TARAWA TERRACE SITE, CAMP LEJEUNE, NC
0 10 20 30 feet
KEY:
Existing Wells
Benchmarks
A-1
A-2
A-3
A-4
A-5
A-6
A-7
A-8
A-9
A-10
A-11
A-12
A-13
A-14
A-15
A-16
OB-1
OB-2
OB-3
OB-4
OB-6
OB-7
OB-8
OB-10
OB-11
GAS STATION UNION 76
ASPHALT
ASPHALT
PUMP ISLAND
PUMP ISLAND
UNDERGROUND TANKS - SOURCE OF CONTAMINATION
RECOVERY WELL
TARAWA BLVD.
IWO JIMA DRIVE
STORM
STORM SEWER
USMC 156
=SAMPLED
OB-11
OB-2
OB-4
OB-6
OB-1
Recov. Well
REVISED 12-8-87

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: OB-1

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 21.13

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 10 0	-255.00	21.13		0.00	
	14 38 0	73.00	21.28	0.15	0.15	
	15 12 0	107.00	21.32	0.04	0.19	
	15 41 0	136.00	21.35	0.03	0.22	
	16 6 0	161.00	21.38	0.03	0.25	
	16 39 0	194.00	21.40	0.02	0.27	
	17 3 0	218.00	21.42	0.02	0.29	
	17 44 0	259.00	21.47	0.05	0.34	
	19 44 0	379.00	21.52	0.05	0.39	
	21 55 0	510.00	21.52	0.00	0.39	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: OB-2

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 20.26

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 15 0	-250.00	20.26		0.00	
	14 47 0	82.00	20.36	0.10	0.10	
	15 14 0	109.00	20.38	0.02	0.12	
	15 43 0	138.00	20.40	0.02	0.14	
	16 8 0	163.00	20.41	0.01	0.15	
	16 41 0	196.00	20.44	0.03	0.18	
	17 5 0	220.00	20.46	0.02	0.20	
	17 45 0	260.00	20.50	0.04	0.24	
	20 46 0	441.00	20.56	0.06	0.30	
	22 0 0	515.00	20.46	-0.10	0.20	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: OB-4

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 19.22

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	DEPTH TO PRODUCT	PRODUCT THICKNESS
6/7/89	10 0 0	-205.00	19.22		0.00	19.15	0.07
	14 44 0	79.00	19.35	0.13	0.13	not measured	not measured
	15 12 0	107.00	19.35	0.00	0.13	19.28	0.07
	15 54 0	149.00	19.36	0.01	0.14	19.30	0.06
	17 2 0	217.00	19.40	0.04	0.18	19.34	0.06
	17 57 0	272.00	19.44	0.04	0.22	19.40	0.04
	19 56 0	391.00	19.46	0.02	0.24	19.41	0.05
	20 50 0	445.00	19.50	0.04	0.28	19.46	0.04
	22 6 0	521.00	19.45	-0.05	0.23	19.37	0.08

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: 08-6

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 19.41

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 0 0	-265.00	19.41	0.00	0.00	
	13 41 0	16.00	19.67	0.26	0.26	
	13 47 0	22.00	19.73	0.06	0.32	
	13 52 0	27.00	19.78	0.05	0.37	
	13 56 0	31.00	19.79	0.01	0.38	
	14 2 0	37.00	19.82	0.03	0.41	
	14 32 0	67.00	19.99	0.17	0.58	
	15 8 0	103.00	20.02	0.03	0.61	
	15 38 0	133.00	20.08	0.06	0.67	
	16 2 0	157.00	20.13	0.05	0.72	
	16 35 0	190.00	20.17	0.04	0.76	
	17 1 0	216.00	20.21	0.04	0.80	
	17 41 0	256.00	20.27	0.06	0.86	
	19 41 0	376.00	21.05	0.78	1.64	
	20 40 0	435.00	20.46	-0.59	1.05	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: OB-7

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 20.58

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 30 0	-235.00	20.58		0.00	
	14 10 0	45.00	20.57	-0.01	-0.01	
	15 21 0	116.00	20.57	0.00	-0.01	
	15 58 0	153.00	20.55	-0.02	-0.03	
	16 55 0	210.00	20.58	0.03	0.00	
	17 55 0	270.00	20.58	0.00	0.00	
	19 45 0	380.00	20.59	0.01	0.01	
	20 42 0	437.00	20.59	0.00	0.01	
	21 54 0	509.00	20.92	0.33	0.34	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: A-6

TIME PUMP ON: 13 25 0

STOP PUMPING: 21 25 0 STATIC DTW: 20.28

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 45 0	-220.00	20.28		0.00	
	13 20 0	-5.00	20.20	-0.08	-0.08	
	13 29 0	4.00	20.20	0.00	-0.08	
	13 35 0	10.00	20.21	0.01	-0.07	
	13 38 0	13.00	20.21	0.00	-0.07	
	13 41 0	16.00	20.21	0.00	-0.07	
	13 46 0	21.00	20.22	0.01	-0.06	
	13 51 0	26.00	20.28	0.06	0.00	
	13 56 0	31.00	20.33	0.05	0.05	
	14 30 0	65.00	20.47	0.14	0.19	
	15 9 0	104.00	20.55	0.08	0.27	
	15 50 0	145.00	20.69	0.14	0.41	
	16 48 0	203.00	20.77	0.08	0.49	
	17 50 0	265.00	20.93	0.16	0.65	
	19 51 0	386.00	21.06	0.13	0.78	
	20 30 0	425.00	21.08	0.02	0.80	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: A-7

TIME PUMP ON:13 25 0

STOP PUMPING:21 25 0 STATIC DTW: 20.01

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 5 0	-260.00	20.60	0.59	0.59	
	13 32 0	7.00	21.19	0.59	1.18	
	13 42 0	17.00	21.45	0.26	1.44	
	13 49 0	24.00	21.59	0.14	1.58	
	13 54 0	29.00	21.63	0.04	1.62	
	13 57 0	32.00	21.65	0.02	1.64	
	14 3 0	38.00	21.69	0.04	1.68	
	14 34 0	69.00	21.91	0.22	1.90	
	15 10 0	105.00	21.91	0.00	1.90	
	15 40 0	135.00	21.91	0.00	1.90	
	16 5 0	160.00	21.91	0.00	1.90	
	16 37 0	192.00	21.96	0.05	1.95	
	17 2 0	217.00	21.99	0.03	1.98	
	17 40 0	255.00	22.07	0.08	2.06	
	19 42 0	377.00	22.12	0.05	2.11	
	20 37 0	432.00	22.20	0.08	2.19	

AQUIFER TEST DATA

RECOVERY

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: SIX-INCH DIAMETER RECOVERY WELL

STOP PUMPING:21 25 0 FINAL PUMPING STATIC

TIME PUMP ON:13 25 0 D.T.W.: 32.72 D.T.W.: 21.17

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	RESIDUAL* DRAWDOWN	CUMULATIVE RECOVERY	% TOTAL RECOVERY
6/7/89	21 25 0	0.00	32.72	11.55	0.00	0.00
	21 25 30	0.50	27.00	5.83	5.72	49.52
	21 26 0	1.00	24.90	3.73	7.82	67.71
	21 26 30	1.50	23.80	2.63	8.92	77.23
	21 27 0	2.00	22.95	1.78	9.77	84.59
	21 28 0	3.00	22.35	1.18	10.37	89.78
	21 29 0	4.00	22.11	0.94	10.61	91.86
	21 37 0	12.00	21.91	0.74	10.81	93.59
	21 44 0	19.00	21.85	0.68	10.87	94.11
	21 50 0	25.00	21.78	0.61	10.94	94.72
	21 55 0	30.00	21.76	0.59	10.96	94.89

NOTE: NO FLOATING PRODUCT WAS OBSERVED AT ANY TIME.

*RESIDUAL DRAWDOWN = D.T.W. - STATIC D.T.W.

RECOVERY TEST DATA

TARAWA TERRACE RECOVERY WELL

DURATION OF PUMPING = 8 HRS.

t', min	t, min	t/t'	s', ft
0.50	480.50	961.00	5.83
1.00	481.00	481.00	3.73
1.50	481.50	321.00	2.63
2.00	482.00	241.00	1.78
3.00	483.00	161.00	1.18
4.00	484.00	121.00	0.94
12.00	492.00	41.00	0.74
19.00	499.00	26.26	0.68
25.00	505.00	20.20	0.61
30.00	510.00	17.00	0.59

CALCULATION OF TRANSMISSIVITY

t' = time since pumping stopped

t = time since pumping started

s' = residual drawdown

Q = 20.00 gpm

T = (264 Q)/delta s'

From a semilog plot of s' vs. t/t', delta s' = 0.45 ft

T = 11,733.33 gpd/ft or 87,765.33 sq.ft/day

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA

WELL: OB-3

TIME PUMP ON: 13 25 0

STOP PUMPING: 21 25 0 STATIC DTW: 20.89

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 25 0	-240.00	20.89		0.00	
	14 49 0	84.00	21.01	0.12	0.12	
	15 17 0	112.00	21.12	0.11	0.23	
	16 1 0	156.00	21.14	0.02	0.25	
	17 8 0	223.00	21.20	0.06	0.31	
	17 47 0	262.00	21.22	0.02	0.33	
	19 48 0	383.00	21.25	0.03	0.36	
	20 34 0	429.00	21.28	0.03	0.39	

AQUIFER TEST DATA

PROJECT: TARAWA TERRACE, CAMP LEJEUNE, JACKSONVILLE, NORTH CAROLINA
WELL: OB-9
TIME PUMP ON: 13 25 0
STOP PUMPING: 21 25 0 STATIC DTW: 19.90

MEASUREMENTS IN FEET

DATE	TIME (HR MIN SEC)	ELAPSED TIME (MINUTES)	DEPTH TO WATER	INCREMENTAL DRAWDOWN	CUMULATIVE DRAWDOWN	REMARKS
6/7/89	9 35 0	-230.00	19.81		-0.09	
	13 18 0	-7.00	19.90	0.09	0.00	
	13 30 0	5.00	20.30	0.40	0.40	
	13 34 0	9.00	20.22	-0.08	0.32	
	13 37 0	12.00	20.27	0.05	0.37	
	13 40 0	15.00	20.31	0.04	0.41	
	13 45 0	20.00	20.38	0.07	0.48	
	13 50 0	25.00	20.41	0.03	0.51	
	13 55 0	30.00	20.45	0.04	0.55	
	14 30 0	65.00	20.63	0.18	0.73	
	15 8 0	103.00	20.67	0.04	0.77	
	15 50 0	145.00	20.72	0.05	0.82	
	16 50 0	205.00	20.79	0.07	0.89	
	17 49 0	264.00	20.87	0.08	0.97	
	19 50 0	385.00	20.99	0.12	1.09	
	20 30 0	425.00	21.08	0.09	1.18	

UNC Wells

CAMP LEJEUNE, NORTH CAROLINA

IDENTIFICATION OF WELLS BY TYPE AND DEPTH

AS OF DECEMBER 8, 1987

WELL #	TYPE (SEE ATTACHED TYP. SECTIONS)	TOTAL LENGTH OF CASING (FEET) (DOES NOT INCLUDE SCREEN SECTION)	TOTAL DEPTH OF WELL (FROM GRADE ELEV. TO BOTTOM OF SCREEN (FEET)
A-1	B	23.6	38.7
A-2	A	24.1	37.9
A-3	B	23.4	39.8
A-4	B	25.0	40.3
A-5	B	24.8	39.5
A-6	B	26.1	41.2
A-7	B	26.1	41.8
A-8	B	25.1	40.2
A-9	B	25.4	40.5
A-10	C	50.0	50.3
A-11	C	50.2	51.5
A-12	D	50.0	51.6
A-13	D	50.0	51.7
A-14	A	24.7	37.3
A-15	A	23.1	35.5
A-16	A	23.7	35.9

CAMP LEJEUNE, NORTH-CAROLINA

FIELD ELEVATIONS FOR THE GROUNDWATER MONITORING WELLS

AS SURVEYED SEPTEMBER 19, 1997

WELL #	GRADE ELEVATION (FEET)	TOP OF CASING ELEV (FEET)	COMMENTS
A-1	26.89	26.76	
A-2	25.73	26.69	
A-3	26.52	25.42	
A-4	26.82	26.66	
A-5	25.21	24.73	
A-6	26.73	26.65	
A-7	26.69	26.78	
A-8	26.21	26.38	
A-9	26.45	26.18	
A-10	26.18	29.98	
A-11	25.92	26.36	
A-12	25.69	26.32	
A-13	25.92	29.27	TOC TO TOP OF RISER RIM
A-14	23.66	26.82	
A-15	23.37	25.98	
A-16	23.36	26.12	
OB-1	23.16	27.96	
OB-2	27.18	26.98	TOC TO HIGHEST POINT OF CASING RIM
OB-3	24.78	27.25	TOC TO HIGHEST POINT OF CASING RIM
OB-4	26.59	26.48	TOC TO HIGHEST POINT OF CASING RIM
OB-5	*	*	*WELL HAS BEEN REMOVED
OB-6	**	**	** WELL IS DAMAGED AND WAS NOT SURVEYED

WELL #	GRADE ELEVATION (FEET)	TOP OF CASING ELEV (FEET)	COMMENTS
OB-7	25.42	28.49	
OB-9	23.78	27.02	
OB-7	21.37	24.48	
OB-10	24.6±	24.66	
OB-11	27.31	27.06	TOC TO HIGHEST POINT OF CASING RIM
RECOVERY WELL	26.34	27.98	

CAMP LEJEUNE, NORTH CAROLINA

FIELD ELEVATIONS FOR THE GROUNDWATER MONITORING WELLS

AS SURVEYED SEPTEMBER 19, 1987

NOTE: MAGNETIC DECLINATION @ SITE IS APPROXIMATELY 9 DEGREES

BENCHMARK	DESCRIPTION	LOCATION	ELEVATION
USMC 156	8" X 8" CONCRETE MARKER WITH NAIL IN CENTER	N 3845571.73 E 262752.86 35' @ 296 DEGREES FROM POWER POLE 6-53 (2' N OF TAR. BLVD) 75' @ 334 DEGREES FROM POWER POLE 533 (ON SOUTH SIDE OF TARAWA BLVD.)	23.55 FT MSL

BENCHMAR

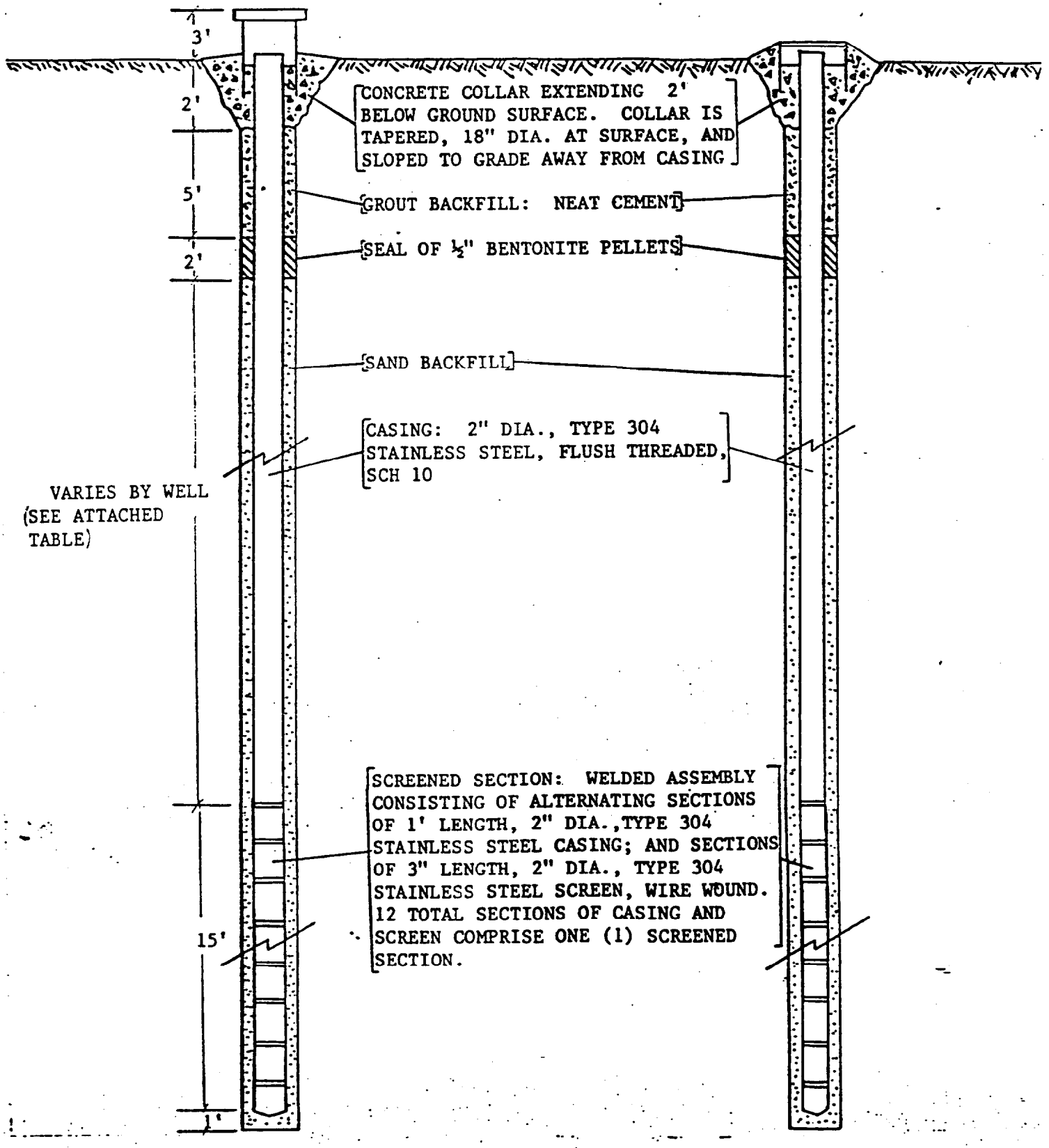
TYPICAL WELL SECTIONS

SECTION A

SECTION B

STEEL RISER: 4" DIA., WITH LOCKING CAP

MANHOLE COVER: CAST IRON, 7" DIA., MOUNTED FLUSH WITH COLLAR



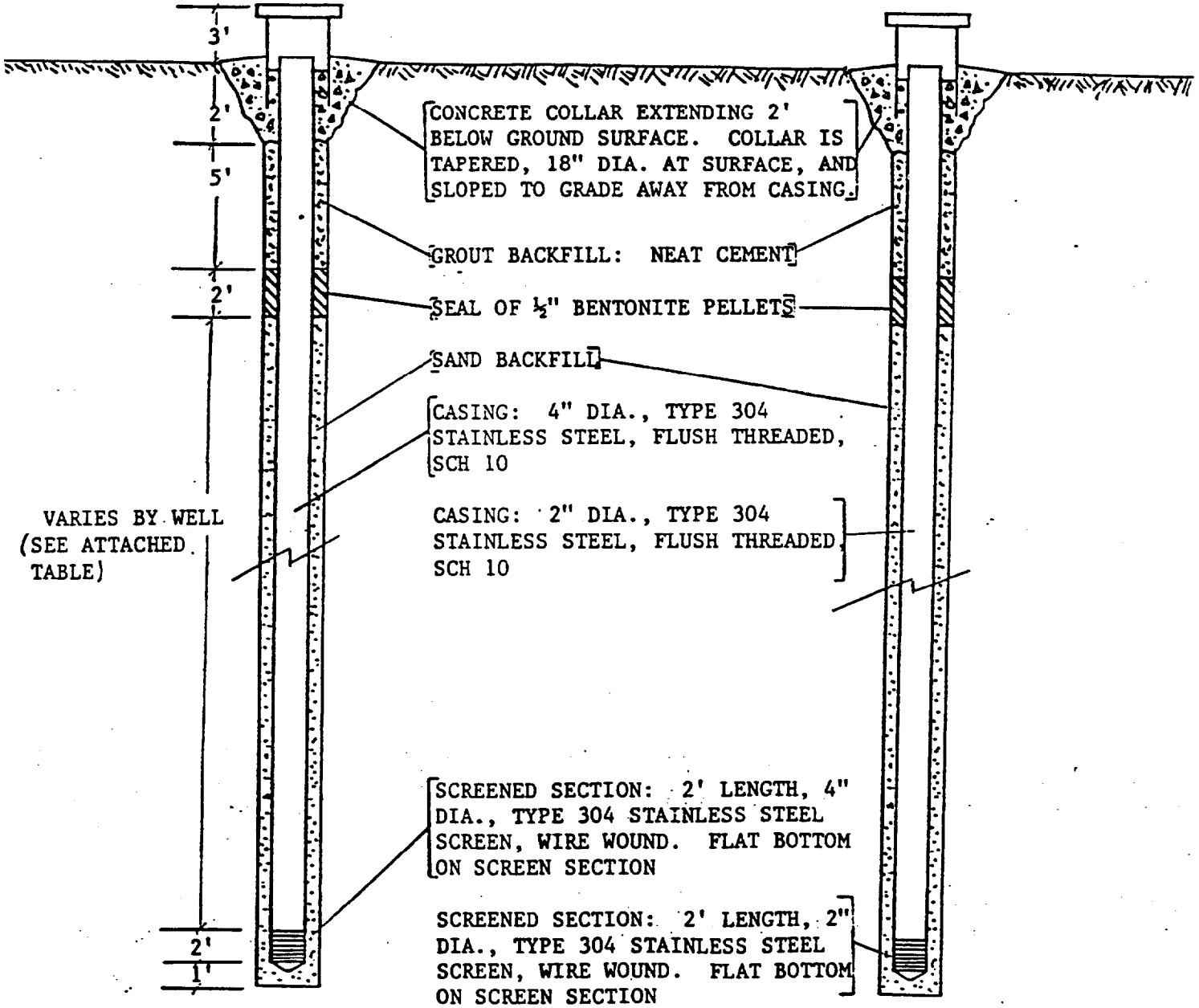
TYPICAL WELL SECTIONS

SECTION C

SECTION D

STEEL RISER: 6" DIA. WITH LOCKING CAP

STEEL RISER: 4" DIA. WITH LOCKING CAP



Exhibits

O'BRIEN & GERE

EXHIBIT A

Richard Catlin & Associates, Inc.

CONSULTING ENGINEERS AND HYDROGEOLOGISTS

RC&A

October 26, 1988

Specialized Marine, Inc.
ATTN: Mr. Burt Lea
P. O. Box 813
Wrightsville Beach, NC 28480

RE: Union 76 Station
Camp Lejeune, NC
RC&A Project #85120

Dear Mr. Lea:

Attached is our monthly monitoring report for the gasoline recovery project at the Union 76 station in Camp Lejeune, NC. Figures 1 and 2 show the water table elevations and apparent gas thickness contours, respectively.

If you require any additional information, please do not hesitate to contact us. We will continue to monitor this project and will report to you again next month.

Sincerely,

D. J. Spahr, P.E. for
Richard G. Catlin, P.E., P.G.
President

Enclosures

MEM/nd

Home Office: P.O. Box 557 7225 Wrightsville Ave., Suite 127 Wrightsville Beach, NC 28480 (919) 256-5878
Atlanta Regional Office: 1777 Phoenix Blvd., Suite 203 Atlanta, GA 30349 (404) 997-9485
Charleston Regional Office: 1051 Hwy. 17 N. By-Pass, Suite C Mt. Pleasant, SC 29464 (803) 881-6000

RICHARD CATLIN & ASSOCIATES, INC.

GROUND WATER MONITORING REPORT

DATE: 10/18/88

SITE: Tarawa Terrace, Camp Lejeune, NC

RC&A PROJECT #: 85120

DATE OF LAST REPORT: 8/26/88

MONITORING INTERVAL: Monthly

1) WATER TABLE SURFACE (See Figure 1):

OBSERVATIONS: Figure 1 illustrates the site water table surface measured during the 9/22/88 site visit. The recovery system was fully operational.

2) CONTAMINATION PLUME (See Figure 2):

OBSERVATIONS: Measureable levels of free floating product were measured in monitoring wells 1, 2, 4, 6 and 9.

With present conditions, the top of the screened intervals in the "A" monitoring wells are below the water table levels. This situation will likely prevent representative accumulation of any surrounding free floating product. Therefore, we will continue to omit any detected contamination levels from the free product plume interpolation.

3) RECOVERY PROGRESS:

OBSERVATIONS: During our 9/22/88 site visit, the system was fully operational. Both temporary ejector pumps have remained installed in well 9 during the past period. To date a total of 6,582 gallons of recovered product has been removed from the separator by Specialized Marine, Inc. personnel.

ENCL: (1)

4) RECOMMENDATIONS:

Since the start of this clean-up project, significant progress has been achieved, although for the past several months, the existing recovery system has had relatively little influence on the remaining contamination. In order to augment existing recovery system, our proposed modifications are as follows:

- o Installation of top entry type ejector pumps (i.e., QED pulse pumps) in wells 1, 2, 4, 6 and 9.
- o Install a 6" recovery well (see attached well detail) at the location shown on Figure 3.

CALCULATED BY: SAT
DATE: 10/18/88

CHECKED BY: JJS
DATE: 10/18/88

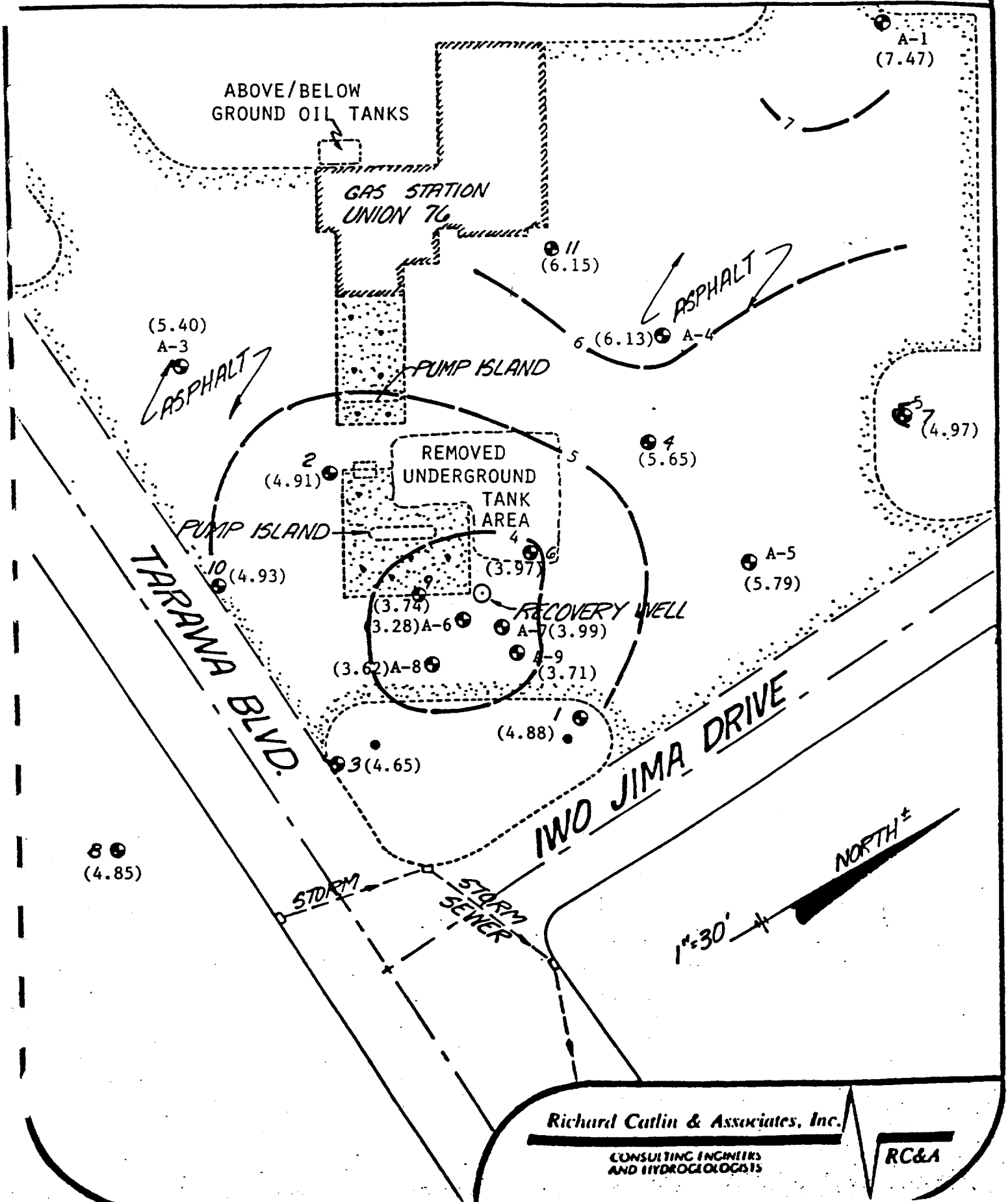
UNION 76, TARAWA TERRACE

CAMP LEJEUNE, N. C.

FIGURE 1

WATER TABLE CONTOURS AS OF 9/22/88

CONTOUR INTERVAL 1.00'



Richard Catlin & Associates, Inc.

CONSULTING ENGINEERS AND HYDROGEOLOGISTS

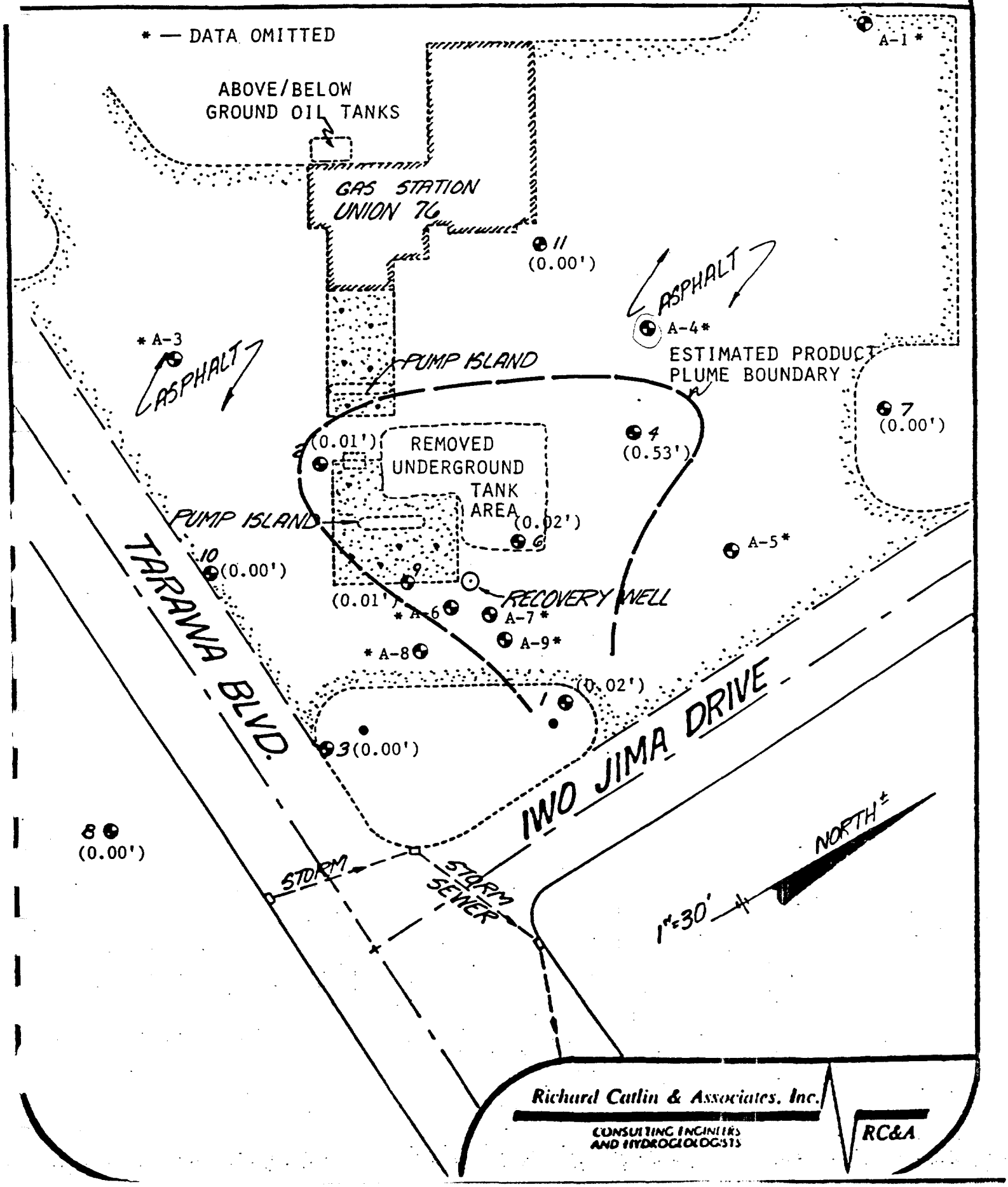
RC&A

UNION 76, TARAWA TERRACE

CAMP LEJEUNE, N. C.

FIGURE 2

ESTIMATED FREE PRODUCT PLUME BOUNDARY AS OF 9/22/88

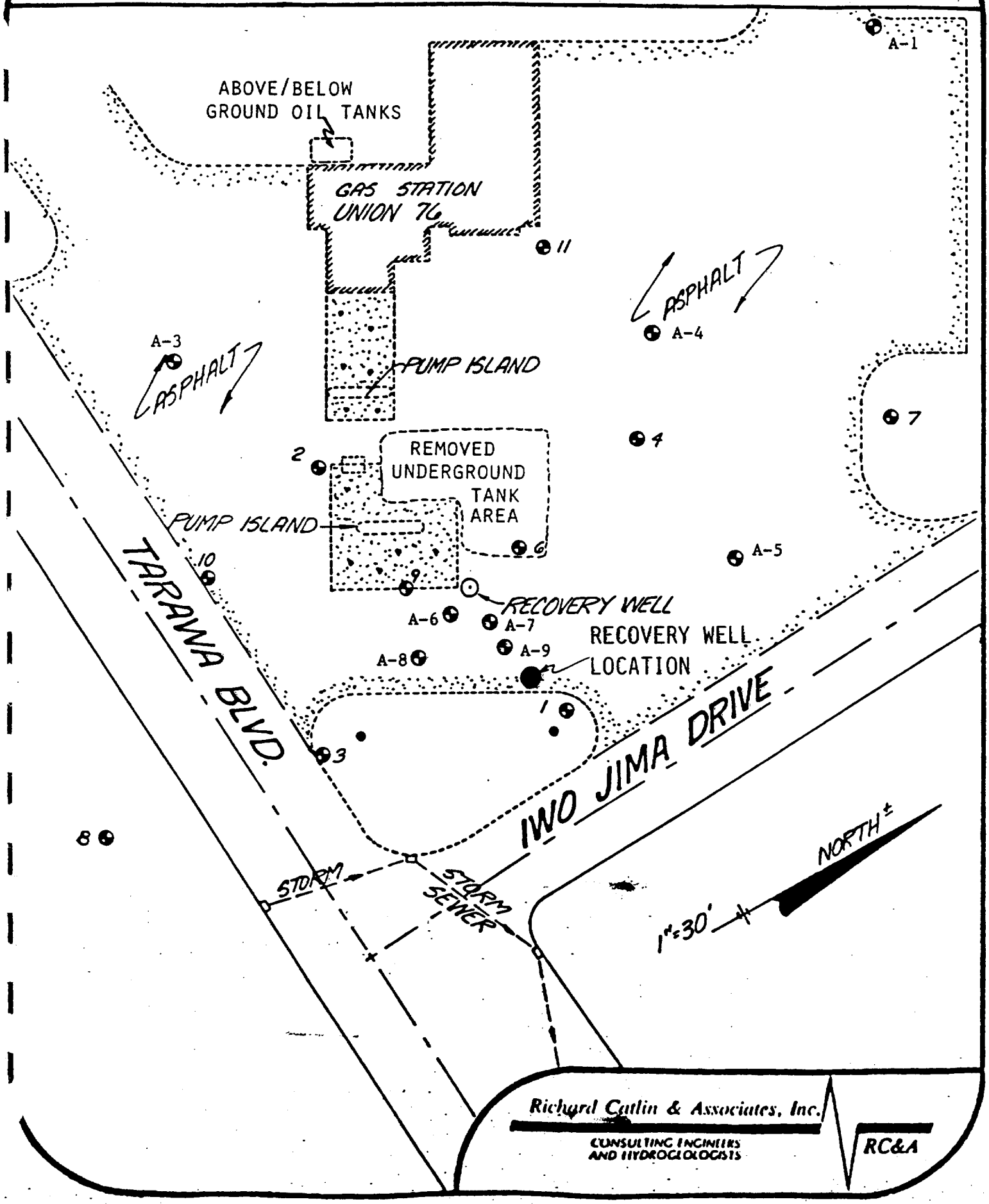


UNION 76, TARAWA TERRACE

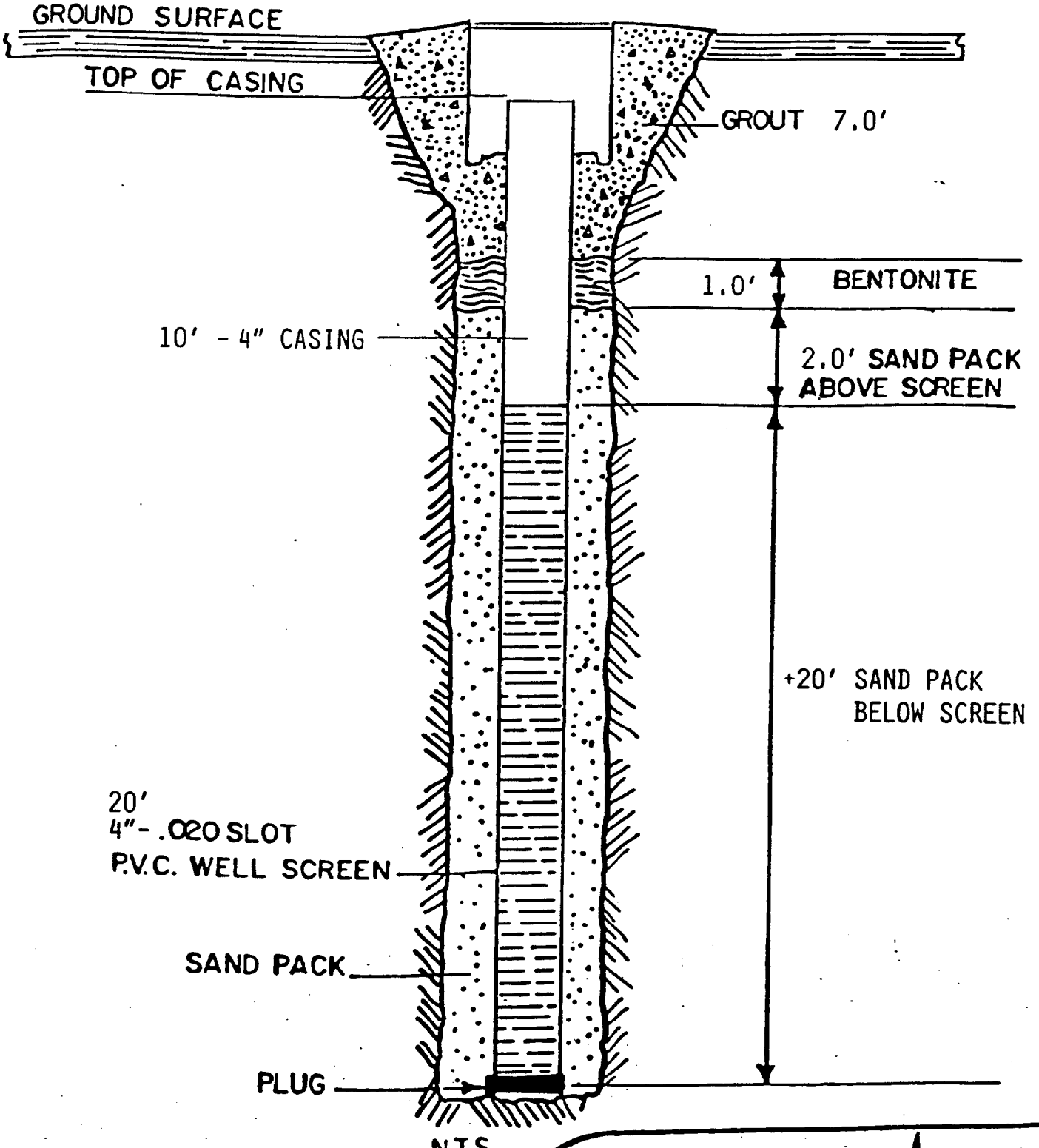
CAMP LEJEUNE, N. C.

FIGURE 3

RECOVERY WELL LOCATION



RECOVERY WELL DETAIL



Richard Catlin & Associates, Inc.
CONSULTING ENGINEERS AND HYDROGEOLOGISTS
RC&A

RICHARD CATLIN & ASSOCIATES, INC.

GROUND WATER MONITORING REPORT

DATE: 10/26/88

SITE: Tarawa Terrace, Camp Lejeune, NC

RC&A PROJECT #: 85120

DATE OF LAST REPORT: 10/18/88

MONITORING INTERVAL: Monthly

1) WATER TABLE SURFACE (See Figure 1):

OBSERVATIONS: Figure 1 illustrates the site water table surface measured during the 10/20/88 site visit. A malfunctioning control box has temporarily halted pumping efforts at well #9. Pumping from the recovery well was continued after the control box had been adjusted.

2) CONTAMINATION PLUME (See Figure 2):

OBSERVATIONS: Only trace levels of free product were detectable in wells 2, 6 and 9. A measurable level of free floating product was found in monitoring well 4.

With present conditions, the top of the screened intervals in the "A" monitoring wells are below the water table levels. This situation will likely prevent representative accumulation of any surrounding free floating product. Therefore, we will continue to omit any detected contamination levels from the free product plume interpolation.

3) RECOVERY PROGRESS:

OBSERVATIONS: During our 10/20/88 site visit, the system was fully operational except for the temporary ejector pumps installed in well 9. To date a total of 6,582 gallons of recovered product has been removed from the separator by Specialized Marine, Inc. personnel.

4) RECOMMENDATIONS:

See 10/18/88 report.

J.J. Spahn, P.E.

CALCULATED BY: SAT
DATE: 10/26/88

CHECKED BY: JJS
DATE: 10/26/88

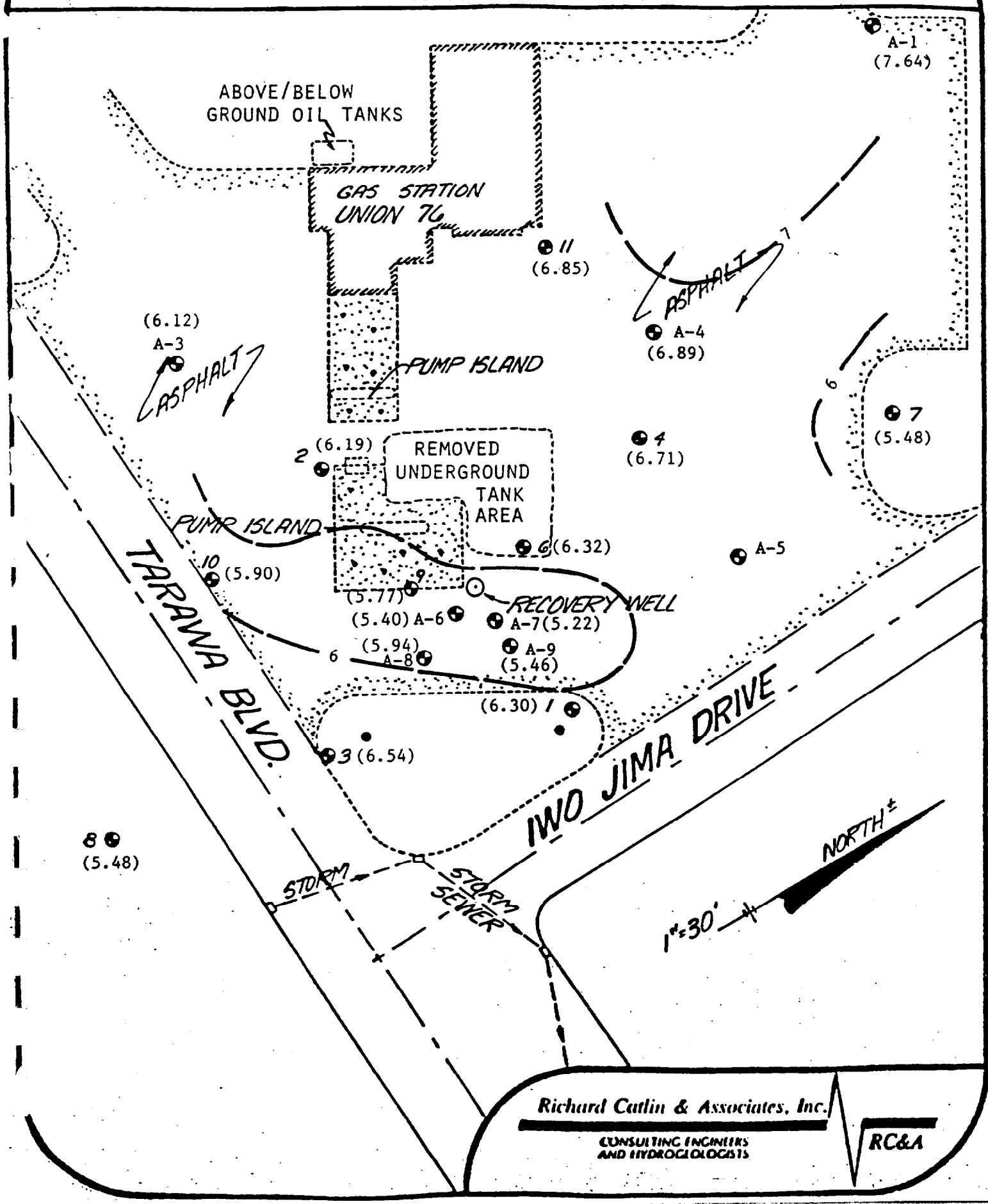
UNION 76, TARAWA TERRACE

CAMP LEJEUNE, N. C.

FIGURE 1

WATER TABLE CONTOURS AS OF 10/20/88

CONTOUR INTERVAL 1.00'

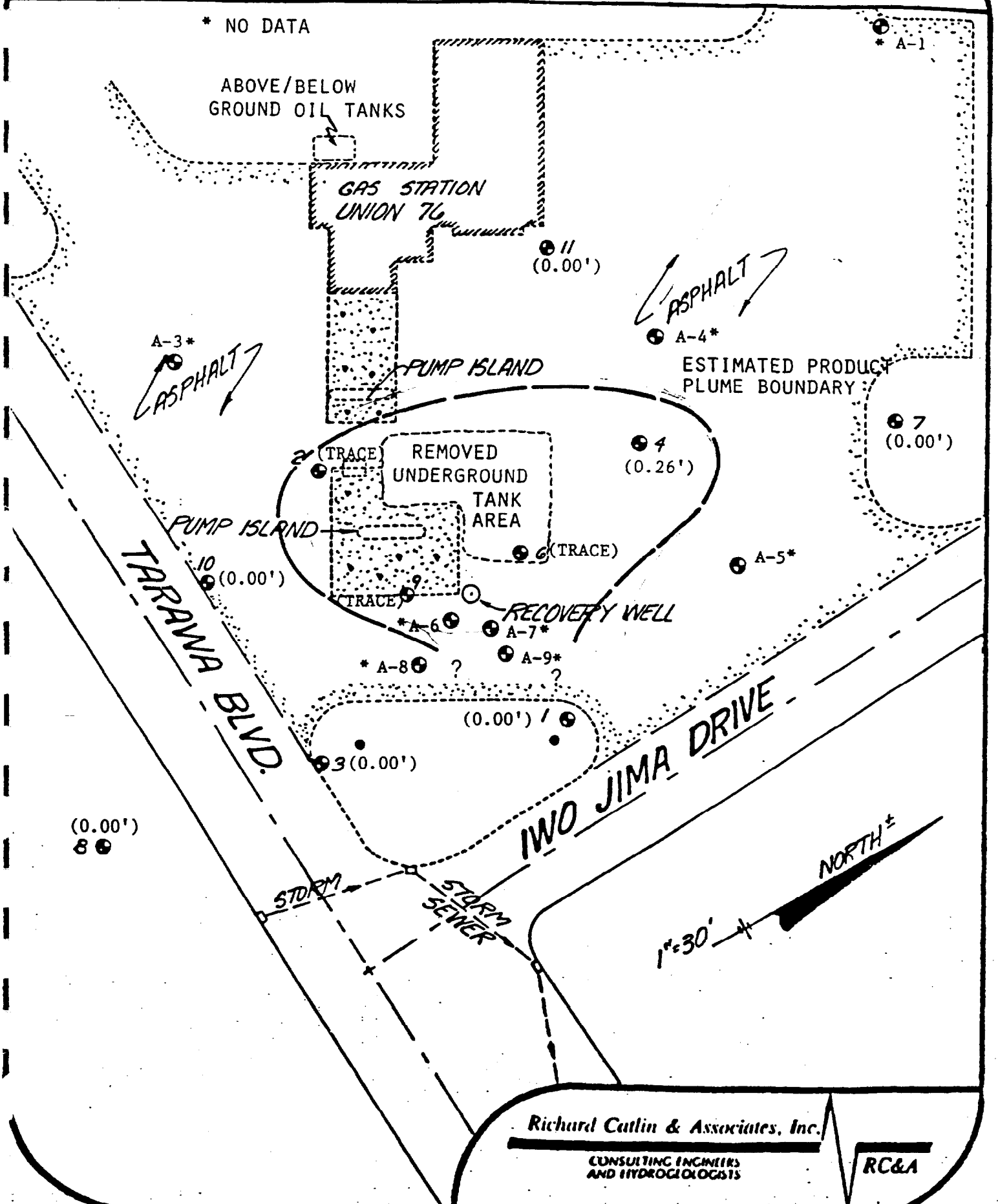


UNION 76, TARAWA TERRACE

CAMP LEJEUNE, N. C.

FIGURE 2

ESTIMATED FREE PRODUCT PLUME BOUNDARY
AS OF 10/20/88



Richard Catlin & Associates, Inc.

CONSULTING ENGINEERS AND HYDROGEOLOGISTS

RC&A

SPECIALIZED MARINE, Inc.

P.O. Box 813 Wrightsville Beach, NC 28480 (919) 256-5780

October 18, 1988

Assistant Chief of Staff-Facilities
ATTN: Mr. Bob Alexander,
Environmental Engineer
Marine Corps Base
Jacksonville, NC 28452-5001

RE: Union 76 Station
Camp Lejeune, NC
RC&A Project #85120

Dear Bob:

Attached is our monthly monitoring report for the Union 76 Station, Camp Lejeune, NC, as prepared by our engineers, Richard Catlin & Associates, Inc. Figures 1 and 2 show the water table elevations and apparent gas thickness contours, respectively. Also enclosed is an extra copy of the monitoring report, which should be forwarded by your office to Mr. Rick Shiver, P.G., of the NC Division of Environmental Management, 7225 Wrightsville Avenue, Wilmington, NC 28403-3696. Please note the recommendation section of the report. I concur with this statement and feel that it is in the best interest of this project.

If you should have any questions, please do not hesitate to contact us. We will continue to monitor this project and will report to you again next month.

Sincerely,

Burt Lea

Burt Lea, Operations Manager

Enclosures

ABL/nd

SPECIALIZED MARINE, Inc.

P.O. Box 813 Wrightsville Beach, NC 28480 (919) 256-5780

October 18, 1988

Assistant Chief of Staff-Facilities
ATTN: Mr. Bob Alexander,
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Marine Corps Base
Jacksonville, NC 28452-5001

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Camp Lejeune, NC
RC&A Project #85120

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If you should have any questions, please do not hesitate to contact us. We will continue to monitor this project and will report to you again next month.

Sincerely,

Burt Lea

Burt Lea, Operations Manager

Enclosures

ABL/nd

Richard Catlin & Associates, Inc.

CONSULTING ENGINEERS AND HYDROGEOLOGISTS

RC&A

October 18, 1988

Specialized Marine, Inc.
ATTN: Mr. Burt Lea
P. O. Box 813
Wrightsville Beach, NC 28480

RE: Union 76 Station
Camp Lejeune, NC
RC&A Project #85120

Dear Mr. Lea:

Attached is our monthly monitoring report for the gasoline recovery project at the Union 76 station in Camp Lejeune, NC. Figures 1 and 2 show the water table elevations and apparent gas thickness contours, respectively.

If you require any additional information, please do not hesitate to contact us. We will continue to monitor this project and will report to you again next month.

Sincerely,

Spalin, P.E. for

Richard G. Catlin, P.E., P.G.
President

Enclosures

MEM/nd

Richard Catlin & Associates, Inc.

CONSULTING ENGINEERS AND HYDROGEOLOGISTS

RC&A

October 26, 1988

Specialized Marine, Inc.
ATTN: Mr. Burt Lea
P. O. Box 813
Wrightsville Beach, NC 28480

RE: Union 76 Station
Camp Lejeune, NC
RC&A Project #85120

Dear Mr. Lea:

Attached is our monthly monitoring report for the gasoline recovery project at the Union 76 station in Camp Lejeune, NC. Figures 1 and 2 show the water table elevations and apparent gas thickness contours, respectively.

If you require any additional information, please do not hesitate to contact us. We will continue to monitor this project and will report to you again next month.

Sincerely,

D. J. Spahr, P.E. for

Richard G. Catlin, P.E., P.G.
President

Enclosures

MEM/nd

Home Office: P.O. Box 557 7225 Wrightsville Ave., Suite 127 Wrightsville Beach, NC 28480 (919) 256-5878
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