

PRELIMINARY Health Assessment for



ABC ONE HOUR CLEANERS
JACKSONVILLE, ONSLOW COUNTY, NORTH CAROLINA
CERCLIS NO. NCD024644494
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
FEDERAL BUREAU OF INVESTIGATION
Agency for Toxic Substances and Hazardous Waste Registry



THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

The conclusion and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

SUMMARY

ABC One Hour Cleaners (ABC), located in Onslow County, North Carolina, was proposed by Update VII for the National Priorities List. The site is approximately 1 acre and was and is currently occupied by a drycleaning establishment.

According to preliminary investigation results, the primary contaminant of concern is tetrachloroethylene (PCE). Other contaminants found during the course of the investigation were vinyl chloride, trichloroethylene (TCE), benzene, methyl benzene (toluene), 1,2-dichloroethylene (1,2-DCE), and 1,1-dichloroethylene (1,1-DCE).

PCE was found in on- and off-site wells. Several drinking water wells in the Tarawa Terrace community were contaminated by PCE. Two of the highest contaminated wells were disconnected in February 1985, and the water supply was supplemented by an emergency water line connected to the Holcomb Boulevard System. The on-site subsurface soil is contaminated with PCE, 1,2-DCE, and TCE. In addition to these contaminants, the septic tank sludge is contaminated with 1,1-DCE.

Potential human exposure pathways associated with the ABC site are: Inhalation (contaminated ambient air or airborne soil particles, and volatilization of contaminants from groundwater during showering, bathing, etc.); ingestion (contaminated groundwater, soils, consumable plants and animals); and dermal absorption (contact with groundwater, surface water, and soils). Only ground-water and subsurface soil sampling were performed during the preliminary site investigations. Surface soil, deep soil, sediment, surface water, and air were not sampled.

Although two contaminated wells were removed from the Tarawa Terrace water system, past exposure to PCE may have occurred. Past and current sampling data from the water system would be needed to evaluate any exposures.

The Agency for Toxic Substances and Disease Registry does not expect the following to be of current public health concern: inadvertent ingestion of surface soils (unless the soil surface is disturbed by remediation); ingestion of consumable plants and animals; dermal contact with groundwater, surface water, and soils; or inhalation (unless the soil is disturbed by remediation). Past exposures from ingestion, inhalation, and dermal absorption may have occurred from ground-water sources; however, the magnitude and duration of these exposures are not known. On- and off-site groundwater is currently contaminated; and although contaminated wells have been removed from the water system (Tarawa Terrace), human exposure may still occur from the other system wells if the contamination is not contained. ground-water and subsurface soils remain a potential public health concern.

BACKGROUND

A. SITE DESCRIPTION AND HISTORY

ABC One Hour Cleaners (ABC) is a drycleaning establishment proposed by Update VII for the National Priorities List (NPL). The business, which is located at 2127 Lejeune Boulevard, Jacksonville, North Carolina, in Onslow County (see Appendix, Figure 1), has been operating since 1954. The site covers approximately 1 acre. The facilities previously consisted of three buildings, but two of the buildings were joined to form one complex. A smaller building, which has been demolished, was located 25 feet behind the complex. This building housed the septic tank system, drycleaning machines, a 250-gallon tank containing tetrachloroethylene (PCE), and PCE recycling equipment.

PCE was used as a solvent at the facility to dryclean clothes. This solvent was stored in the 250-gallon above-ground tank. The PCE was reclaimed by a filtration-distillation process. Still bottoms from the process were used to fill pot holes or were disposed of on-site until 1985. After that time, the still bottoms were disposed of off-site. PCE is believed to have entered the environment from past usage of the septic-tank or soil absorption system. This system is no longer used.

In July 1984, Camp Lejeune Marine Corps Base--located about 500 feet from the site--discovered organic chemical contamination in three of eight wells that were part of the Tarawa Terrace community wellfield. The discovery came about as part of an ongoing investigation by the Marine Corps into ground-water contamination on the base. The base itself was proposed for the National Priorities List. Two drycleaners, ABC One Hour Cleaners and Glam-O-Rama Dry Cleaners, were potential sources of contamination. The Marine Corps requested assistance from the North Carolina Department of Natural Resources and Community Development (NRCD), which drilled monitoring wells to investigate the sources of the organic contamination. Monitoring wells at the ABC site contained significantly higher concentrations of PCE than monitoring wells at the Glam-O-Rama site. NRCD concluded that the ABC site was the major source of PCE contamination in the groundwater affecting the Tarawa Terrace community wellfield.

In February 1985, two of the most contaminated wells supplying Tarawa Terrace were disconnected from the water system. In June 1985, a water line was connected from the Holcomb Boulevard System to supplement the Tarawa Terrace water system.

B. SITE VISIT

A site visit was performed by representatives of the Agency for Toxic Substances and Disease Registry (ATSDR) on March 13, 1989. Photographs were taken of the site and surrounding areas. The land use in the site

vicinity is strip commercial along Lejeune Boulevard, with Tarawa Terrace (residential) located across from the site. In the back of the drycleaning facility, the concrete foundation of the PCE recycling building remains. The remainder of the site is sparsely grassed and vegetated. Since this is a commercial business, there is open access to the site; no fencing was present on any portion of the site. A subdivision (Pinewood Downs) is located approximately 500 feet behind (north of) the facility. Water meters were observed in this subdivision. Water is supplied by the city of Jacksonville from ground-water wells.

C. COMMUNITY HEALTH CONCERNS

No reports of any community health concerns were found in the records or from interviews with local, state, and federal officials.

DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

Land use in the vicinity of the ABC site and near the Camp Lejeune Marine Corps Base is primarily residential. The site is located on Lejeune Boulevard, a street with strip commercial establishments. The surrounding area may be characterized as a densely populated urban area.

There are no surface water intakes for the area within 3 miles downstream of the site. There are no surface-water-fed distribution lines for the City of Jacksonville. Within a 3-mile radius of the site, there are three community well systems--Tara Terrace, Hadnot Point, and Holcomb Boulevard. These well systems furnish water to an estimated population of 41,000 people, many who live outside of the 3-mile radius of the site (1).

The estimated populations within a 1-, 2- and 3-mile radius of the site are 2,759, 4,811 and 13,452, respectively (2). The population that may have been affected by off-site ground-water contamination of the well fields is Tarawa Terrace community, estimated at 6,274 persons. Two contaminated wells have been disconnected from this system. Data on the other ground-water supply systems were not available for evaluation. Racial makeup of the area appears to be predominantly Caucasian.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. ON-SITE CONTAMINATION

Based on preliminary ground-water investigations, the contaminants of concern found in two ABC on-site monitoring wells b5 and b6 (3) are listed in Table 1. Subsurface soil contamination and septic tank contamination results are given in Table 2.

Table 1
Monitoring Well Data
Sampling Date: September 25, 1985
Maximum Concentration in ug/L

Contaminant	
tetrachloroethylene (PCE)	12,000
trichloroethylene (TCE)	2.7
benzene	2.3
vinyl chloride	---
trans 1,2-dichloroethylene	---
ug/L-micrograms per liter	
--- not detected	

Table 2
Subsurface Soil and Septic Tank Data
Sampling Date: September 1986 (soil), April 1986 (septic tank)
Maximum Concentrations in ppm

Contaminant	Subsurface Soil 4 to 8 feet	Septic Tank	
		Water	Sludge
tetrachloroethylene	860	1.0	1,402
trichloroethylene	24	22.0	9.5
1,1-dichloroethylene	<.1	<.1	24
1,2-dichloroethylene	11.3	<.1	15

< -less than the detection limit.
ppm-parts per million

B. OFF-SITE CONTAMINATION

Based on preliminary ground-water investigations, the contaminants of concern found in the nearby Tarawa Terrace community wells b1, b2, b3 (3) are listed in Table 3.

Table 3
 Tarawa Terrace Community Wells
 Sampling Dates: Jan 16, 1985, Feb 19, 1985, Mar 11, 1985,
 April 9, 1985, Sept 25, 1985

Contamination	Maximum Concentrations in ug/L	Concentrations as of Sept 25, 1985 in ug/L
tetrachloroethylene	1,580	1,100
trichloroethylene	57	0.98
vinyl chloride	27	---
trans 1,2-dichloroethylene	92	---

ug/L-micrograms per liter
 --- not detected

No off-site soil samples were evaluated for this Preliminary Health Assessment.

C. QUALITY ASSURANCE AND QUALITY CONTROL

The results of this Preliminary Health Assessment are based on sampling data contained in the Site Investigation Report dated May 25, 1987, and soil data and other information dated September 16 and April 22, 1986. The data are assumed to be accurate and within acceptable quality assurance and quality control guidelines.

D. PHYSICAL AND OTHER HAZARDS

No unusual hazards were reported or found during the site visit conducted by ATSDR on March 13, 1989.

PATHWAY ANALYSES

A. ENVIRONMENTAL PATHWAYS (FATE AND TRANSPORT)

The major contaminant of concern is PCE--a clear, colorless, nonflammable liquid with an ether-like odor. PCE volatilizes rapidly from water; however, actual volatilization rates are dependent on temperature, water movement and depth, air movement, and other factors. PCE's half-life for typical surface waters has been estimated at 7 days for a pond, 1.4 days for a river, and 5.6 days for a lake (4).

PCE movement in the soil is characterized by medium-to-high soil mobility and possesses high leachability, as evidenced by its detection in groundwater. PCE will not partition significantly from the water column

to sediment in natural bodies of water. PCE has a relatively high vapor pressure, which indicates that it is expected to exist entirely in the vapor phase in the ambient atmosphere and not partition to atmospheric particulates. The high vapor pressure also predicts significant evaporation from dry surfaces.

Experimental studies have shown low PCE bioconcentration factors of 39 to 49 in fish. Biodegradation and hydrolysis in natural water and soil systems are probably the most important PCE transformation processes; however, neither process appears to occur rapidly in the environment. Volatilization of PCE appears to be the predominant factor for its elimination from surface waters and surface soils. For subsurface soils, deep soils, and groundwater, volatilization does not appear to be a viable process for elimination, and PCE may be relatively persistent. Most PCE is introduced into the atmosphere by evaporative losses. PCE degradation in the atmosphere, which has an estimated half-life of 96 days in typical ambient air, is the result of reaction with hydroxyl radicals. Phosgene and chloroacetylchlorides are degradation products of this reaction.

Groundwater:

Three aquifers were identified in Onslow County. These are the surficial aquifer, the Tertiary limestone aquifer, and the deeper Peedee aquifer. Water wells in this area normally utilize the surficial and Tertiary limestone aquifers. The Peedee aquifer in this vicinity is thought to be brackish and unusable for potable purposes. In the Tarawa Terrace area, the water table aquifer may extend from 1 to 80 feet below surface level, and the Tertiary limestone system may extend from 100 to 170 feet below surface level.

During preliminary investigations, a high concentration of PCE (12,000 ug/L) was found in an on-site monitoring well screened between 42 to 52 feet near the vicinity of the ABC septic tank and soil absorption system. Another on-site monitoring well with the same screened interval located approximately 400 feet southeast of this well had a PCE concentration of 4.9 ug/L. Groundwater flow direction was toward the southeast.

Three Tarawa Terrace off-site community wells are located approximately 900 feet southeast (well b1), 1500 feet southeast (well b3), and 1,800 feet south (well b2) of the ABC site septic tank (see Appendix, Figure 2). Two of these wells were disconnected from the system in February 1985. On September 25, 1985, PCE contamination levels of these wells measured b1--1,100 ug/L, b3--0.43 ug/L, and b2--4.0 ug/L. The cones of depression for these wells were calculated to be between 900 to 1,500 feet (3). The ground-water flow direction, coupled with the zone of influence resulting from well pumping, probably caused contaminants to be drawn to the community wells.

Another monitoring well near the Glam-O-Rama drycleaning site indicated a PCE concentration of 2.2 ug/L. Although Glam-O-Rama stores, uses, and

recycles PCE, Glam-O-Rama was not considered by the North Carolina NRCD to be a major contributor to the PCE contamination of the area, based on preliminary monitoring well data. The estimated PCE ground-water contamination plume, based on limited sampling, is shown in the Appendix, Figure 2. Further ground-water sampling is needed to characterize the vertical extent of contamination and further define the horizontal extent of PCE contamination.

Other Ground-water Contaminants:

TCE and benzene were found as on-site ground-water contaminants at levels of 2.7 ug/L and 2.3 ug/L, respectively. Only TCE was found in an off-site well at 0.98 ug/L during the sampling event on September 25, 1985. Earlier off-site samples for well b1 (not shown in tables) taken during January 16, 1985, indicated levels of TCE (57 ug/L), vinyl chloride (27 ug/L), and trans 1,2-DCE (92 ug/L).

Off-site contamination by TCE, vinyl chloride, and DCE could not be directly traced to the use of PCE, although TCE, vinyl chloride, and DCE are all possible anaerobic degradation products of PCE. TCE may not be conclusively attributable to on-site PCE contamination, although in the early history of PCE manufacturing, a method used TCE as a chemical feedstock intermediate. TCE could have been a contaminant in the technical grade PCE that was used in dry-cleaning. Currently, a more economical process is used to derive PCE without the use of TCE as an intermediate. A third method is also currently used to coproduce TCE and PCE. This method may also produce TCE as a contaminant in PCE.

Because vinyl chloride and 1,2-DCE were found only in sporadic ground-water sampling events, and not in the latest ground-water sampling event (September 25, 1985), and only in the well that has been disconnected from the water system, these ground-water contaminants will not be addressed further unless future ground-water sampling events confirm the presence of these contaminants.

Benzene was found in the on-site monitoring well at 2.3 ug/L. No off-site wells detected benzene as a contaminant, and a human exposure pathway could not be identified. The benzene concentration was also found to be lower than the EPA maximum contaminant level (MCL) for public drinking water supplies (5 ug/L). Benzene will not be discussed further.

A monitoring well near the Glam-O-Rama dry-cleaners indicated the presence (not shown in Tables) of methyl benzene (toluene) at 2.3 ug/L. Off-site wells did not detect this contaminant and the concentration was lower than the EPA proposed maximum contaminant level goal (PMCLG) of 2,000 ug/L. Toluene will not be considered further.

Soils, Sediments, and Septic Tank Sludge:

Preliminary on-site soil sampling data did not include surface soil

sampling. Surface soil contamination by PCE should not be a problem because of PCE's high mobility. Because of its high vapor pressure, PCE is also expected to evaporate rapidly from surface soils.

Subsurface soil data were taken at 4- and 8-foot deep intervals at several locations on the site. Results of the sampling indicate subsoil contamination by TCE (24 ppm, maximum, 4 feet, sample #12) and PCE (860 ppm, maximum, 8 feet, sample #12) and 1,2-DCE (11.3 ppm, maximum, 4 feet, sample #1). Sample #12 was located between the covered drain and the septic tank lid and sample #1 was located near the covered drain in the PCE recycling building.

Sampling of the septic tank water and sludge showed contamination by PCE and TCE. Septic tank sludge also showed contamination by 1,1-DCE and 1,2-DCE, but 1,1-DCE was found only in the septic tank sludge and was not detected in any soil samples at a detection limit of 0.1 ppm. The lack of detection of 1,1-DCE may be because of the high detection limit of the analytical method used. Future analysis of 1,1-DCE should include a detection limit of 1 ppb. Deep soil sampling data would be needed to further assess soil contamination and characterize the vertical extent of contamination. At subsurface soil and deep soil depths, PCE would not be biodegraded, hydrolyzed, or eliminated rapidly. Sediment sampling was not conducted. The nearest surface water body, Northeast Creek, is 4,400 feet southeast of the site. PCE is not expected to partition significantly into sediments from the surface waters.

Surface Water:

No surface water sampling data were available for an evaluation. No surface water intakes exist in Onslow County, and the nearest surface water intake is 55 miles downstream of the site on the Cape Fear River in Pender County. Drinking water for the area is provided from ground-water wells. The nearest surface water body to the site is Northeast Creek, which is about 4,400 feet southeast of the site. Groundwater from the site vicinity is expected to discharge into Northeast Creek. Well b3, which is located about 1,500 feet southeast of the ABC septic tank, showed a PCE concentration of 0.43 ug/L. Since Northeast Creek is approximately 3,000 feet further southeast, it appears that potential PCE contamination of Northeast Creek would be minimal. However, since the vertical and horizontal extent of PCE contamination of the aquifers has not been defined accurately, sampling of Northeast Creek should be performed to confirm this hypothesis.

Air:

No ambient air data were available for evaluation. Although PCE was discovered in groundwater and subsurface soils, high levels of PCE, TCE, 1,1-DCE, and 1,2-DCE from the septic tank and soil absorption system would currently probably not be found in surface soils. PCE and the other volatile organic compounds (VOCs) should have evaporated years ago from

surface soils into the ambient air. Use of the septic tank and soil absorption system had been discontinued according to a file memorandum dated May 13, 1987 (5). PCE in ambient outdoor air and other VOC concentrations on- and off-site are not expected to be high unless a more recent spill has occurred.

B. HUMAN EXPOSURE PATHWAYS

Potential human exposure pathways associated with the ABC site are: Inhalation (contaminated ambient air or airborne soil particles, and volatilization of contaminants from groundwater during activities such as showering and laundering); ingestion (contaminated groundwater, soils, and consumable plants and animals); and dermal absorption (contact with groundwater, surface water, and soils).

Inhalation:

Ambient air data are not available for PCE, TCE, 1,1-DCE, and 1,2-DCE contamination on- and off-site. Therefore, human exposure by inhalation has been listed as a potential pathway. However, inhalation of contaminated ambient air is not expected to be a major pathway of human exposure, because use of the septic tank/soil absorption system was discontinued years ago. On-site surface soil--because of PCE, TCE, and 1,2-DCE evaporation and volatilization (1,1-DCE was not found in the soil samples, only in the septic tank sludge)--is not currently expected to be highly contaminated unless more recent spills have occurred. Therefore, the inhalation of airborne or windblown contaminated surface soil particles is not expected to be a major pathway. Subsurface soils showed contamination by PCE, TCE, and 1,2-DCE. Inhalation of airborne particles and vapors from subsurface and deeper soils is not expected to be a exposure pathway unless these soils are disturbed by remedial activities.

Contaminated groundwater may be used for household activities such as showering, bathing, and laundering. PCE may volatilize from the water and thus provide a human exposure pathway by inhalation.

Ingestion:

Sufficient preliminary ground-water data exist to implicate ingestion of PCE and TCE as a major potential human exposure pathway. Two of the most contaminated drinking water wells at Terrawa Terrace were disconnected from the system. Monitoring wells on- and off-site were found to be contaminated with PCE and TCE.

Inadvertent ingestion of soils is a potential human exposure pathway. Only limited sampling of subsurface soils has been performed on-site. No off-site soil sampling (surface, subsurface, or deep) has been performed. As discussed under inhalation above, surface soil contamination is not expected to be a problem. Human exposure may occur, during remedial activities, from inadvertent ingestion of subsurface and deeper soils

contaminated by PCE, TCE, and 1,2-DCE. Removal of sludge from the septic tank may provide an opportunity for human exposure to 1,1-DCE, in addition to PCE, TCE, and 1,2-DCE.

Sampling was not performed on consumable plants and animals during the preliminary investigations. Although ingestion is a potential human exposure pathway, it is not expected to be a major exposure pathway because the site is commercial, the surrounding area is urban residential, crops are not grown on the site, and surface soil is probably not highly contaminated.

Dermal Absorption:

Since on- and off-site groundwaters are contaminated, there is a potential for human exposure to occur through dermal contact and absorption of PCE and TCE from activities such as showering and bathing.

No surface water data were available for an evaluation, therefore dermal absorption was listed as a potential exposure pathway. However, the nearest surface water source is 4,400 feet away, and there are no surface water intakes in Onslow County. The nearest surface water intake is reportedly 55 miles downstream of the site. Although surface water testing of the nearest water source should be performed, contaminant absorption from dermal contact with surface water is not expected to occur.

Dermal contact with contaminated soil was listed as a potential route of human exposure because of subsurface soil contamination with PCE, TCE, and 1,2 DCE. Exposure may occur during remedial activities, when subsurface soils and the septic tank sludge are disturbed. Remedial workers may also be dermally exposed to 1,1-DCE during the removal of the septic tank sludge.

General:

The preceding human exposure pathways were discussed in reference to the general public. These human exposure pathways are also relevant for on-site drycleaning workers, whose exposure to PCE (and possibly TCE) by inhalation, inadvertent ingestion, and dermal absorption is probably much greater than that of the general public.

PUBLIC HEALTH IMPLICATIONS

Preliminary information indicates that only data on groundwater, subsurface soil, and septic tank water and sludge are available. Human exposure to PCE, TCE, 1,1-DCE, and 1,2-DCE may occur from contact with these media. Additional future information on other environmental media may implicate other pathways for human exposure. The concentrations of TCE from the last few ground-water samplings were not at levels of

concern. Only the general characteristics of PCE will be discussed in detail, since this is the primary chemical of concern. Currently, 1,1-DCE, and 1,2-DCE do not have an identified human exposure pathway to the general population. However, these chemicals may affect remedial workers.

General Characteristics of PCE:

Absorption:

PCE is readily absorbed by humans following inhalation exposure, which appears to be the primary way in which PCE enters the body. PCE is readily absorbed by the lungs into the blood, and the uptake is proportional to the ventilation or breathing rate, duration of exposure, and concentration.

Human absorption of PCE into the bloodstream following ingestion is rapid and nearly complete. Peak blood levels occur about 1 hour after ingestion.

Dermal absorption of PCE by humans is poor and apparently insignificant. An experiment (6) comparing pulmonary and dermal absorption of PCE by humans found that dermal absorption of PCE was 1 percent the amount expected to be absorbed through inhalation.

Metabolism and Excretion:

Following inhalation of PCE in humans, the primary metabolites appear to be trichloroacetic acid (TCA) and trichloroethanol. TCA was detected in blood and urine, and trichloroethanol was detected in urine. The metabolism of PCE in humans is apparently saturable (7) following inhalation exposure, suggesting that the capacity of humans to metabolize PCE is limited. TCA, trichloroethanol, and unmetabolized amounts of PCE were found in urine following human oral exposure. No pertinent data regarding dermal exposure in human and animals and the resulting metabolites were found in the literature.

For all the routes of human exposure (inhalation, ingestion, and dermal), the exhalation of the unmetabolized PCE appears to be the major route of excretion. The urinary excretion of metabolites accounts for only a small percentage of the absorbed dose.

Toxicity:

Limited acute data suggests that PCE absorbed by the inhalation or oral routes is relatively nontoxic. The ingestion of 60 to 80 mg/kg doses of PCE by humans for antihelminthic (worm) medication was reported to be nonlethal, with the only side effect being inebriation observed in 46,000 treated cases (8). A maintenance worker performing work on a plugged line in a drycleaning establishment reportedly died from the inhalation of a

high concentration of PCE. Blood levels of PCE were extremely high (4.4 mg/100 ml). Animal studies (mice) have reported a 50 percent mortality rate following 4 hours of inhalation exposure at 5,200 ppm. Rat studies reported a single oral dose of 3,005 mg/kg resulted in 50 percent mortality. Human deaths due to dermal exposure have not been reported in the literature. Repeated applications of dermally-applied, pure PCE may cause a dry, scaly, and fissured dermatitis (9).

The principal target organs of PCE toxicity are the central nervous system (CNS), liver, and kidneys. The CNS and liver appear to be the most sensitive targets. Short-term inhalation studies for humans suggests that the threshold for CNS effects resulting from acute exposures is in the concentration range of 100 to 200 ppm. Symptoms include headache, dizziness, difficulty in sleeping, and sleepiness. Long-term exposed subjects are reported to experience effects such as short-term memory defects, ataxia, irritability, disorientation, and sleep disturbances. The few studies that were identified in the literature regarding neurotoxic effects after oral ingestion of PCE suggest effects paralleling those seen after inhalation. Studies were not found in the literature regarding neurotoxic effects of dermally applied PCE.

PCE is hepatotoxic to humans. Reports of liver damage to humans have been reported after inhalation of acute or chronic exposures to PCE have been documented (10). However, these were accidental exposures, and reliable quantitative exposure information is not available. Hepatotoxic effects from PCE exposure include cirrhosis of the liver, toxic hepatitis, liver cell necrosis, hepatomegaly, and altered liver function indices. Acute PCE ingestion in humans may cause fatty degeneration of the liver cells, altered liver function indices, and hepatomegaly (11). No hepatic effects of dermally-applied PCE to humans were found in the literature.

PCE may cause renal dysfunction. Symptoms reported from accidental inhalation exposure to PCE include diminished excretion of urine, uremia, elevated serum creatine, proteinuria, and hematuria. However, these exposures were not quantified, and other factors may have been responsible for some effects. Acute renal failure and glomerulonephritis were reported as possible late-stage consequences of acute oral PCE ingestion in humans (11). Specific human exposures and related effects resulting from the ingestion of PCE were not found in the literature. No studies of specific human renal effects from dermally-applied PCE were found in the literature.

Fetotoxic effects have been reported in mice and rats exposed to 300 ppm of PCE by inhalation. No teratogenic effects were observed. Human data regarding fetotoxic effects were not available. Human reproductive effects from exposure to PCE were not found in the literature. An inhalation study with mice exposed to 500 ppm of PCE suggests that PCE may cause sperm abnormalities.

Epidemiologic studies of drycleaning and laundry workers have determined excesses in mortality due to cancers of the lung, cervix, kidney, skin, and colon (12, 13, 14, 15, 16). However, because these workers have been exposed to other petroleum solvents and drycleaning agents, as well as PCE, these studies are regarded as inconclusive for implicating PCE. The only investigation of drycleaning workers with no known exposure to petroleum solvents was a subcohort study from the Brown and Kaplan (16) study. No excess cancer risk was found for the subcohort study. The entire cohort study, however, which included workers with potential occupational exposure with petroleum solvents, indicated significant increases in mortality from kidney and bladder cancer.

In animals, the carcinogenicity of PCE from inhalation and oral exposure routes is documented. Animal dermal exposures to PCE did not indicate significant tumor-initiating activity.

Site Specific Implications:

The ABC site has documented PCE contamination of both on-site and off-site groundwater. The Environmental Protection Agency (EPA) has classified PCE as a class B2 carcinogen--a probable human carcinogen. A maximum contaminant level has not been established for public drinking water supplies. However, consumption of 2 liters of water a day for 70 years, contaminated with PCE at a calculated level of 6.6 ug/L, may result in an increased cancer risk. As of September 25, 1985, off-site contamination by PCE in a Tarawa Terrace water well was 1,100 ug/L. This well, one of two taken out of service in February 1985, is no longer providing water to the community water system. Water users prior to February 1985 may have been exposed to levels of PCE. However, because these wells accounted for only two out of ten production wells, blending should cause the overall concentration of PCE to be substantially lower. No data regarding PCE contamination were available on the Tarawa Terrace water system before and after February 1985. The concentrations during exposure and the lengths and times of exposure also are not known.

Unless the on-site surface soils are disturbed, ATSDR does not expect the inadvertent ingestion of soils to be of public health concern. However, if the surface soils are disturbed by remedial activities, remedial workers may be exposed to PCE-, TCE-, and 1,2-DCE-contaminated soils by inadvertent ingestion. Cleaning or removing the septic tank sludge may also expose workers to the above contaminants, in addition to 1,1-DCE via inadvertent ingestion. Because no off-site soil sampling was conducted, ATSDR cannot comment on the public health concerns of this media.

In addition to ingestion exposure, inhalation exposure would be of primary toxicological significance if such exposure occurred and could be documented. Although no on-site and off-site ambient air testing has been performed, ATSDR does not expect PCE, TCE, 1,1-DCE and 1,2-DCE air concentrations to be of public health concern. The exposure duration would be short to customers and visitors to the site. The PCE, TCE, 1,1

DCE, and 1,2-DCE ambient air concentrations on- and off-site are expected to be low. Airborne contaminated soil particles are also expected to be negligible unless remedial activities disturb the on-site soil surface. Remedial workers would then be exposed by inhalation to both contaminated soil particles and vapors from PCE, TCE, and 1,2-DCE, although the exposures would probably be of short duration.

TCE has been classified by EPA as a probable human carcinogen. There is inadequate data to evaluate the carcinogenicity of 1,2-DCE. Workers involved in the removal of the sludge from the septic tank may also be exposed by inhalation to 1,1-DCE in addition to PCE, TCE, and 1,2-DCE. EPA has classified 1,1-DCE as a possible human carcinogen. On the basis of the limited data, exposure from contaminants volatilizing from the groundwater should not be of concern, because the only water wells known to be affected were the Tarawa Terrace water wells, and two of the contaminated wells have been disconnected. Although past exposures may have occurred, the magnitude and duration of exposure is not known.

Dermal exposure to PCE, TCE, 1,1-DCE, and 1,2-DCE from on-site soil is not expected to be of public health concern unless remedial workers disturb the soil surface and the septic tank sludge. Dermal exposure of remedial workers to PCE from on-site groundwater may be at levels of health concern. Although PCE dermal exposure could have occurred from contaminated off-site groundwater sources (Tarawa Terrace) and may potentially occur from surface water, the absorption and transfer of PCE from aqueous solutions through the intact human skin would not be significant at low concentrations. This may not be true if the skin is abraded or compromised. PCE concentrations in the Tarawa Terrace water system are expected to be very low, since blending of the water occurs, and the most contaminated wells have been disconnected. Current water system data are needed to confirm this premise.

Although many of the human exposure pathways discussed above are not expected to be of public health concern, sampling of the environmental media associated with these pathways is necessary to confirm this hypothesis.

Only TCE (at 0.98 ug/L) was detected in the off-site water wells in the latest sampling event on September 25, 1985. The EPA has established a MCL of 5 ug/L for TCE. The latest sample shows TCE to be lower than the MCL. ATSDR does not believe that the present levels of TCE would be of public health concern. This well, which also exhibited a high level of PCE, was disconnected from the Tarawa Terrace water system.

This Preliminary Health Assessment did not address the drycleaning establishment and any workers that may be employed by the establishment; because no data were available concerning the workplace. The worker environment would be regulated under by the Occupational Safety and Health Administration (OSHA) whose regulations encompass workplace safety.

CONCLUSIONS

On the basis of the information reviewed, ATSDR has concluded that this site is of potential public health concern because humans may be exposed to hazardous substances at concentrations that may result in adverse health effects. As noted in the Human Exposure Pathways Section above, human exposure to PCE and other volatile organic compounds may occur or be occurring or have occurred via inhalation, ingestion, and dermal absorption.

Preliminary investigations into the ABC site showed evidence of on- and off-site ground-water contamination by PCE and other organic chemicals. PCE contamination has affected community water wells associated with Tarawa Terrace. Two of the most contaminated wells have been removed from the system. Subsurface soil data shows contamination with PCE, TCE, 1,1-DCE and 1,2-DCE. The potential human exposure pathways are inhalation, ingestion, and dermal absorption. Although many of the human exposure pathways are not expected to be of public health concern, sampling of the environmental media is needed to confirm this hypothesis. Currently, there are potential health concerns for the off-site well users because of ground-water contamination and for the on-site remedial workers because of subsurface soil contamination.

RECOMMENDATIONS

1. Continued sampling of the existing monitoring wells and the Tarawa Terrace water wells is advised. PCE and possibly other organic chemicals may contaminate other water wells in the area. Additional monitoring wells are needed to further define the vertical and horizontal PCE contamination plume.
2. Although the extent of contamination in surface soil, ambient air, surface water, and sediment is thought to be minimal, limited sampling should be performed in these environmental media to confirm this hypothesis. Environmental media that should be extensively sampled on- and off-site are groundwater, subsurface soil, and deep soil.
3. Current and past sampling data on the Tarawa Terrace finished water should be provided so that evaluation of the public health implications of this site can be completed.
4. Future sampling events definitely should include sampling for vinyl chloride, 1,1-dichloroethylene, 1,2-dichloroethylene, trichloroethylene, and benzene. Some of these contaminants were found sporadically but frequently enough to warrant further testing. Vinyl chloride and benzene are known human carcinogens. Trichloroethylene contamination may have resulted from the use of technical grade PCE.

5. An inventory should be performed to locate all wells within a half mile radius of the site. The well inventory would define the potential population that may be exposed to ground-water contamination.
6. The detection limit for 1,1-DCE should be 1 ppb rather than 100 ppb (0.1 ppm). At the 100 ppb detection limit level, 1,1-DCE was not detected in the subsurface soil or the septic tank water. If found in the septic tank water, the groundwater may be affected. The ATSDR could not determine if previous ground-water sampling included analysis for 1,1-DCE.
7. To prevent exposures to contaminants associated with this site during remedial activities, remedial workers should be provided with adequate personal protective equipment, as required by the Occupational Safety and Health Administration (OSHA). Also, workers should be required to follow all other applicable National Institute for Occupational Safety and Health and OSHA guidelines, advisories, and regulations.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, the ABC One Hour Cleaners Site in Onslow County, North Carolina, has been evaluated for appropriate follow-up with respect to health effects studies. Although there are indications that human exposure to on-site or off-site contaminants may be currently occurring and may have occurred in the past, this site is not being considered for follow-up health studies at this time because current exposure levels are believed to be below levels of concern. However, if data become available suggesting that human exposure to significant levels of hazardous substances is currently occurring or has occurred in the past, ATSDR will evaluate this site for any indicated follow-up.

When indicated by public health needs, and as resources permit, the evaluation of additional relevant health outcome data and community health concerns, if available, is recommended.

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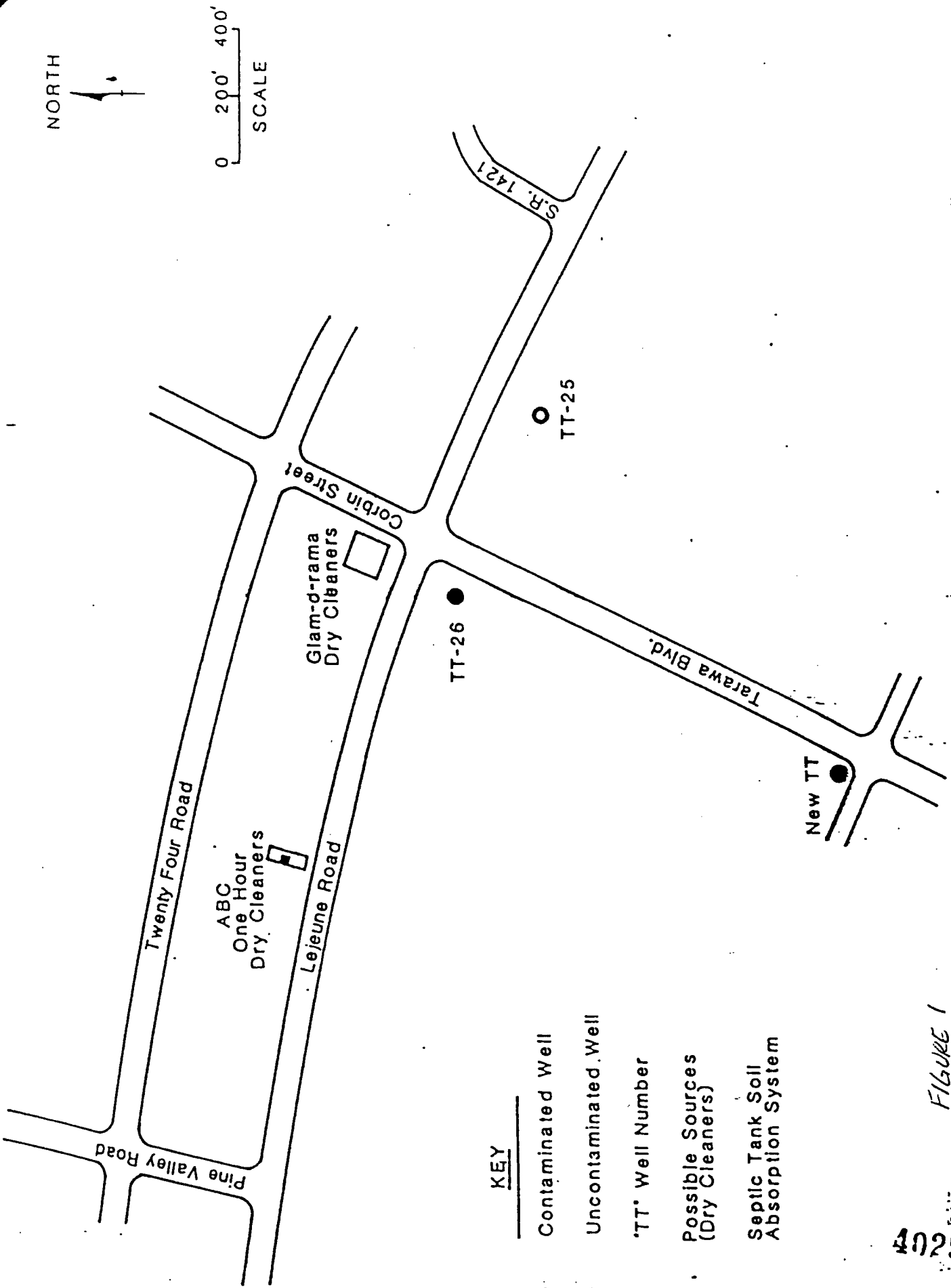
REFERENCES

1. National Priority List Hazardous Ranking System (HRS), ABC One Hour Cleaners, Jacksonville, North Carolina, Cheryl A. McMorris, 26 May 1987.
2. McMorris, Cheryl A., Site Inspection Report, ABC One Hour Cleaners, Jacksonville, N.C., North Carolina Solid and Hazardous Waste Management Branch, CERCLA Unit, 27 May 1987.
3. Draft Summary Report: 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, North Carolina Department of Natural Resources and Community Development (DNRCD).
4. Agency for Toxic Substances and Disease Control. Draft Toxicological Profile for Tetrachloroethylene. Atlanta, Georgia. (In Draft). December 1987.
5. McMorris, Cheryl A., File memorandum concerning a telephone conversation with Victor Melts, manager ABC One Hour Cleaners, 13 May 1987.
6. Riihimaki V., Pfaffli P. 1978. Percutaneous absorption of solvent vapors in man. Scand J Work Environ Health; 4:73-85.
7. Ohtsuki Y, Sato K, Koizumi A, Kumai M, Ikeda M. 1983. Limited capacity of humans to metabolize tetraachloroethylene. Int Arch Occup Environ Health; 51:381-390.
8. Lambert SM. 1933. No title provided. JAMA; 100:247
9. Sittig, M., Handbook of Toxic and Hazardous Chemicals and Carcinogens, 2nd edition, Park Ridge, NJ, Noyes publications, (1985).
10. Hake CL, Stewart RD. 1977. Human exposure to tetrachloroethylene: inhalation and skin contact. Environ Health Persp; 21:231-238.
11. Koppel C, Arndt I, Arendt U, Koeppe P. 1985. Acute tetrachloroethylene poisoning: Blood elimination kinetics during hyperventilation therapy. J Toxicol Clin Toxicol; 23(2-3):103-116.
12. Blair A, Decoufle P, Grauman D. 1979. Causes of death among laundry and dry cleaning workers. Am J Pub Health; 69:508-511.
13. Kaplan SD. 1980. Dry-Cleaner Workers Exposed to Perchloroethylene. A Retrospective Cohort Mortality Study. U.S. DHEW Contract No. 210-77-0094. Cincinnati, OH: NIOSH.

14. Katz RM, Jowett D. 1981. Female laundry and dry-cleaning workers in Wisconsin. A mortality analysis. Am J Pub Health; 71:305-307.
15. Duh RW, Asal NR. 1984. Mortality among laundry and dry-cleaning workers in Oklahoma. Am J Public Health; 74(11):1278-1280.
16. Brown DP, Kaplan SD. 1985. Retrospective cohaort mortality study of dry cleaner workers using perchloroethylene. Cincinnati, OH: NIOSH, U.S. Department of Health and Human Services.

APPENDICES

1. Figure 1- ABC One Hour Cleaners Site Location Map
2. Figure 2- Tetrachloroethylene (PCE) Contamination Plume



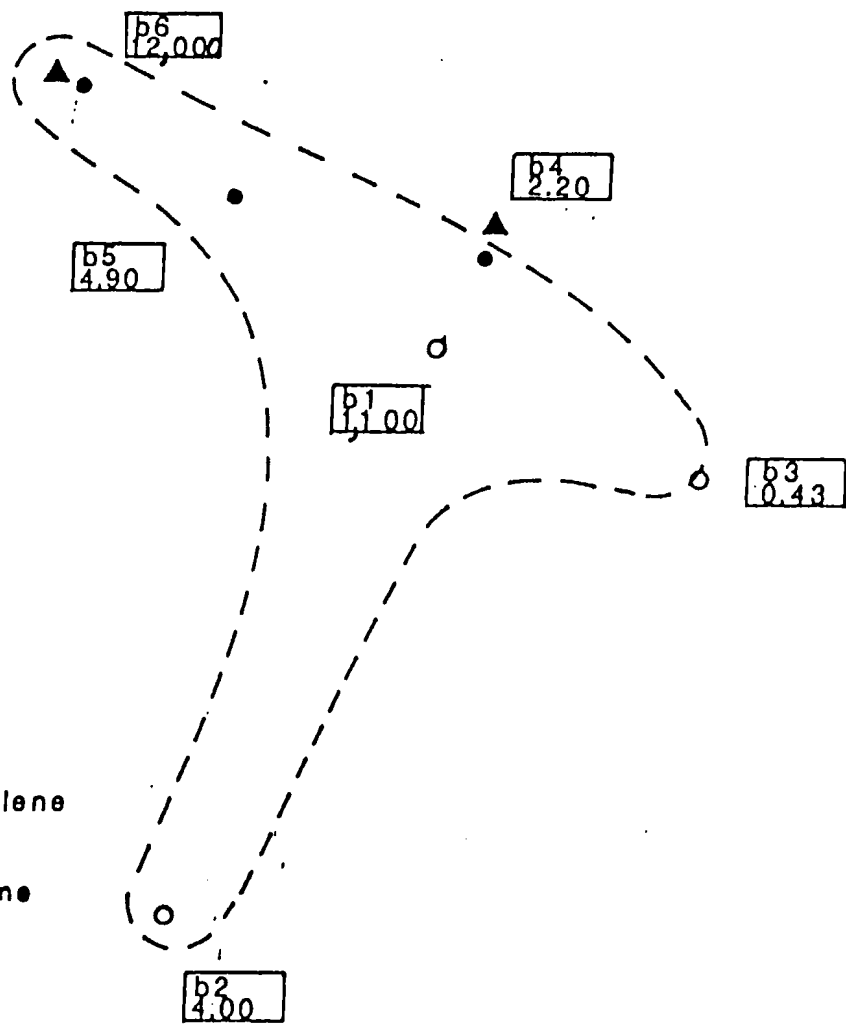
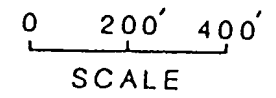
KEY

- Contaminated Well
- Uncontaminated Well
- 26 'TT' Well Number
- Possible Sources (Dry Cleaners)
- Septic Tank Soil Absorption System

FIGURE 1

Map That Shows Location Of Possible Sources To Contaminated Wells.

NORTH



KEY

- ▲ Possible Source
- D.N.R.C.D. Wells
- Tarawa Terrace Community Water Supply Wells
- b1 Well Number
- 1100 Concentration Of Tetrachloroethylene (ug/L)
- Extent Of Tetrachloroethylene Plume

Map # 2

FIGURE 2

Figure 2: Map That Shows The Concentration Of Tetrachloroethylene

4017