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Environmental Protection
Agency

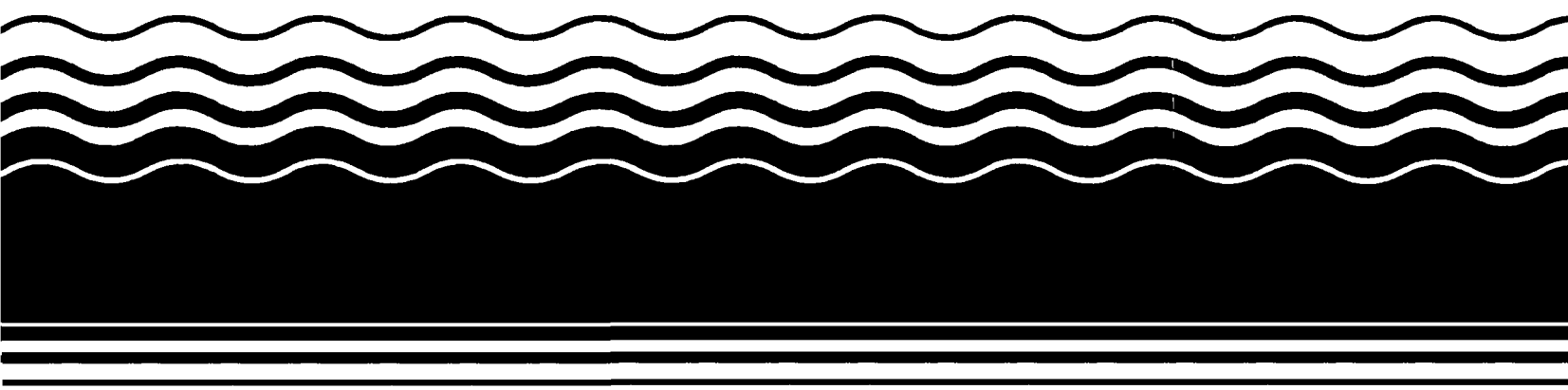
Office of
Emergency and
Remedial Response

EPA/ROD/R04-93/128
January 1993

EPA

Superfund Record of Decision:

ABC One Hour Cleaners, NC



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REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R04-93/128	2	3. Recipient's Accession No.

4. Title and Subtitle SUPERFUND RECORD OF DECISION ABC One Hour Cleaners, NC First Remedial Action	5. Report Date 01/26/93 6.
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9. Performing Organization Name and Address	10. Project Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
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15. Supplementary Notes

PB94-964039

16. Abstract (Limit: 200 words)

The 1-acre ABC One Hour Cleaners site is a dry cleaning facility located in Jacksonville, Onslow County, North Carolina. Land use in the area is predominantly commercial and residential, with woodlands located to the south. In addition, the site is located approximately 4,000 feet northwest of Northeast Creek, which eventually drains into the Atlantic Ocean. The estimated 2,800 people, including non-commissioned officers and their families from the Camp Lejeune Marine Corps Base, who reside in the nearby Tarawa Terrace Housing Development use the surficial aquifer and the Castle Hayne aquifer as their drinking water supply. ABC One Hour Cleaners began operations in 1955, and typical to the dry cleaning industry, used PCE as a dry cleaning solvent. The solvent was stored in an onsite 250-gallon above-ground storage tank, and then PCE was reclaimed through a filtration-distillation process. Following completion of the distillation process, the still bottoms, consisting of powder residues, were placed in the dirt driveway as a "pothole" filler. It is estimated that approximately one ton of still bottoms was placed on the driveway over a 30-year operating period. As a result of a 1984 routine water quality evaluation, the Navy determined that VOCs, including DCE, TCE, and PCE, were present in 10 of the onsite wells, and as a result, the affected wells were disconnected from the base and community water supply and an

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - ABC One Hour Cleaners, NC
First Remedial Action
Contaminated Medium: gw
Key Contaminants: VOCs (PCE, TCE)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 72
	20. Security Class (This Page) None	22. Price

emergency water line was installed to provide the residents of the nearby Tarawa development with drinking water. Based on this, a follow-up state study concluded that the most likely source of ground water contamination in the area was the ABC One Hour Cleaners site; and a subsequent private investigation, confirmed the presence of PCE and its derivatives in the onsite soil surrounding the underground septic tank soil absorption system. In 1986, the State notified ABC One Hour Cleaners of violations incurred to State statutes for discharging dry cleaning solvents directly into the septic tank system and into the septic nitrification field. This ROD addresses the onsite ground water plume emanating from beneath the facility, as OU1. Further field work is needed to better define the extent of contamination in the soil, and once completed, another ROD for OU2 will be issued. The primary contaminants of concern affecting the ground water are VOCs, including PCE and TCE.

The selected remedial action for this site includes treating recovered ground water onsite using air stripping with discharge of the treated water onsite into the Northeast Creek; treating air emissions using an off-gas treatment system, if needed; screening each extraction well throughout the anticipated saturated zone of the wells under pumping conditions; determining the exact number and location of the extraction wells, as well as the necessity of an off-gas treatment system during the RD phase; monitoring ground water; well installation/well permit restrictions; and implementing institutional controls, including deed and ground water use restrictions. The estimated present worth cost for this remedial action is $2,262,900, which includes an estimated annual O&M cost of $261,900 for years 1-2 and $197,700 for years 3-7.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific ground water cleanup goals are based on State standards and low concentration contract required quantitation limits, and include 1,2-DCE 70 ug/l; PCE 1 ug/l; TCE 2.8 ug/l; and vinyl chloride 1 ug/l.

RECORD OF DECISION

ABC ONE-HOUR CLEANERS SITE

JACKSONVILLE, NORTH CAROLINA
OPERABLE UNIT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

RECORD OF DECISION
ABC ONE-HOUR CLEANERS SITE

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DECLARATION FOR THE RECORD OF DECISION

OPERABLE UNIT #1: GROUNDWATER

Site Name and Location

ABC One-Hour Cleaners Site
Jacksonville, Onslow County, North Carolina

Statement of Basis and Purpose

This decision document presents the selected remedial action for the ABC One-Hour Cleaners Site, Operable Unit #1: Groundwater in Jacksonville, North Carolina. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for the Site.

Assessment of the Site

Actual or threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, and/or the environment.

Description of the Selected Remedy

This remedy addresses the groundwater contamination at the Site. The major components of the selected remedy include:

Contaminated groundwater above ARARs (Applicable or Relevant and Appropriate Requirements) will be extracted from the Surficial and the Castle Hayne aquifers using extraction wells;

The extracted groundwater will be treated by air stripping and an off-gas treatment system (if needed);

Surface water discharge of the treated groundwater will be to Northeast Creek via a National Pollutant Discharge Elimination System (NPDES);

Periodic monitoring will be conducted to assess the effectiveness of the remedy for a period up to 30 years; and

Institutional controls will be placed on well construction and water use in the general area of the Site.

RECORD OF DECISION
DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 Site Location

ABC One-Hour Cleaners Site (also referred to as the ABC Site or the Site) is located at 2127 Lejeune Boulevard, Onslow County, Jacksonville, North Carolina (Figure 1). Jacksonville, NC is located on the coast about forty-five miles north of Wilmington, NC. The dry cleaning facility encompasses an area of approximately 1 acre. ABC One-Hour Cleaners consists of three buildings joined to form one complex and is located on the southern portion of the property. A small parking lot fronts Lejeune Boulevard with driveways on the east and west of the complex. The northern most one-third of the Site is a grassy field. Across Lejeune Boulevard to the south are woodlands and the Tarawa Terrace Housing Development. The Tarawa Terrace complex serves as housing for non-commissioned officers of the Camp Lejeune Marine Corps Base (Base), and their families.

1.2 Surface Features

The ABC Site is situated at an elevation of about 30 feet above mean sea level (msl). The facility is located approximately 4,000 feet northwest of Northeast Creek, which is situated at an elevation of approximately 5 feet above msl and is influenced by tidal changes. Elevations decline gradually to the south and southeast, toward Northeast Creek. This creek flows southwestwardly towards the New River, which drains into the Atlantic Ocean.

Surface runoff from the ABC Site flows overland into ditches and culverts that are directed across Highway 24 onto Base property and, along with runoff originating on the Base, into Northeast Creek.

1.3 Subsurface Features

The oldest geologic formation penetrated by a water well in Onslow County is the Peedee. It is not known to crop out but lies within 30 feet of the surface in some valleys northwest of Richlands town. Coastward, the Peedee is more deeply buried, lying under a wedge of Castle Hayne limestone that thickens toward the coast. The Castle Hayne is exposed in many places along the New River between Richlands and Jacksonville. Southwest Creek and White Oak River are the other streams whose channels lie in the limestone in the northern part of the county. The Yorktown formation overlies the Castle Hayne, but it has been eroded away in parts of the county north of Jacksonville. This unit consists of

Statutory Determinations

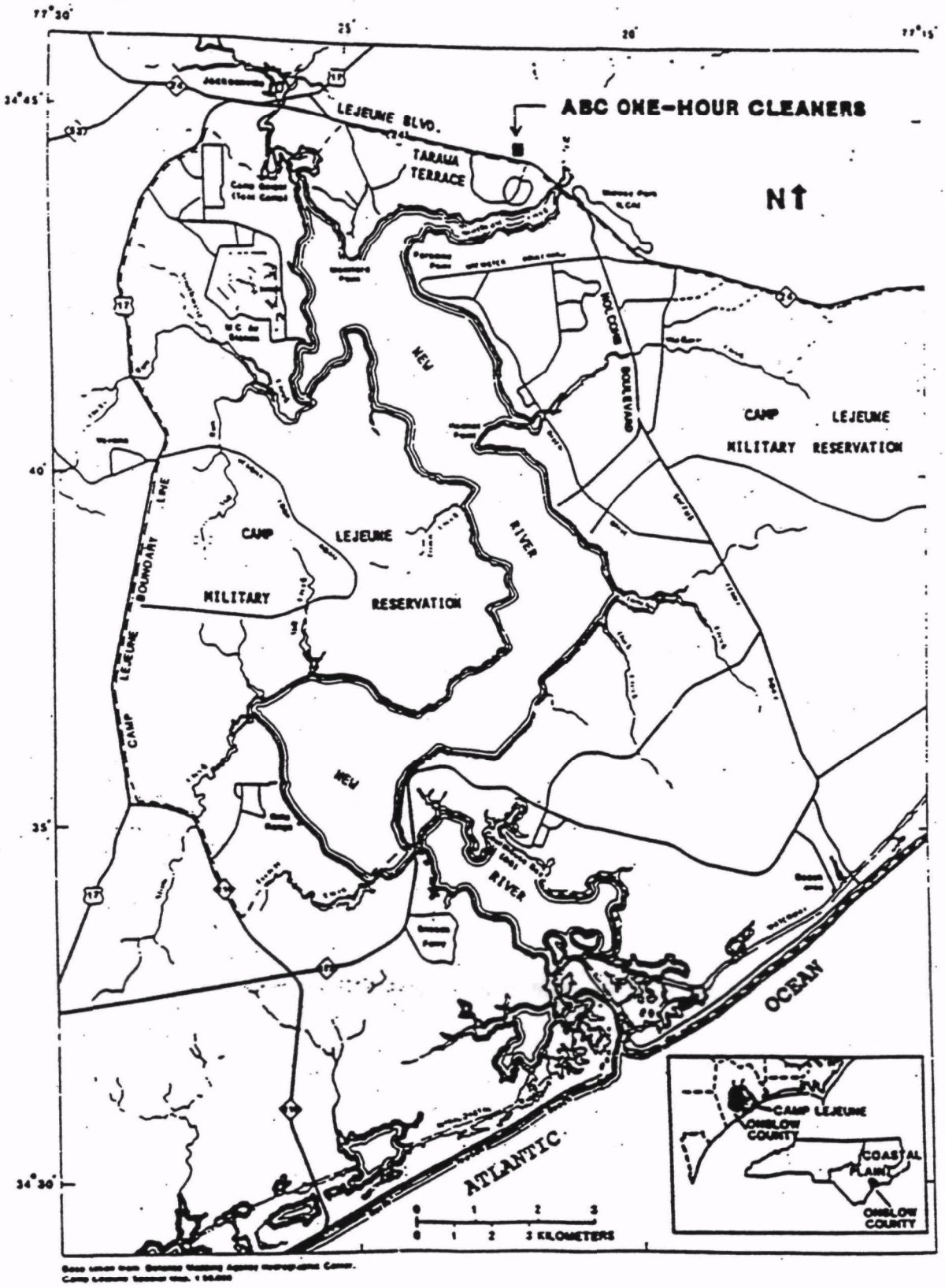
The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduce the toxicity, mobility, and/or volume as a principal element.

Because this remedy may result in hazardous substances remaining on-site above ARARs for more than five years, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. A 5-year review (or performance evaluation) will be prepared at least once every five years until groundwater contaminant concentrations no longer exceed ARARs.

Patrick M. Tobin
Acting Regional Administrator

January 26, 1993
Date

FIGURE 1 - SITE LOCATION MAP



lenses of sand, clay, marl, and limestone. Along the coast, the Yorktown reaches a thickness of about 60 feet, but is thinner inland. The Yorktown is exposed in several ravines near Silverdale and occurs within 60 feet of the surface in several wells at the Base. A thin layer of sand and clay, chiefly sand, of Pleistocene Age conceals the older formation in the interstream areas.

The sediments of the Coastal Plan physiographic province consist of interbedded sands, clays, calcareous clays, shell beds, sandstone, and limestone. These sediments are layered in nearly horizontal interfingering beds and lenses that gently dip and thicken to the east. In the Base area, sediments were deposited in marine or near-marine environments, and are about 1,500 feet thick.

Information on the shallow subsurface geology specific to ABC Site was collected during the soil boring program and the Surficial and Castle Hayne aquifer monitoring well installation programs of the Remedial Investigation (RI). Figure 2 shows the location of geological cross-sections relative to the Site and Figure 3 presents the details of the cross-sections.

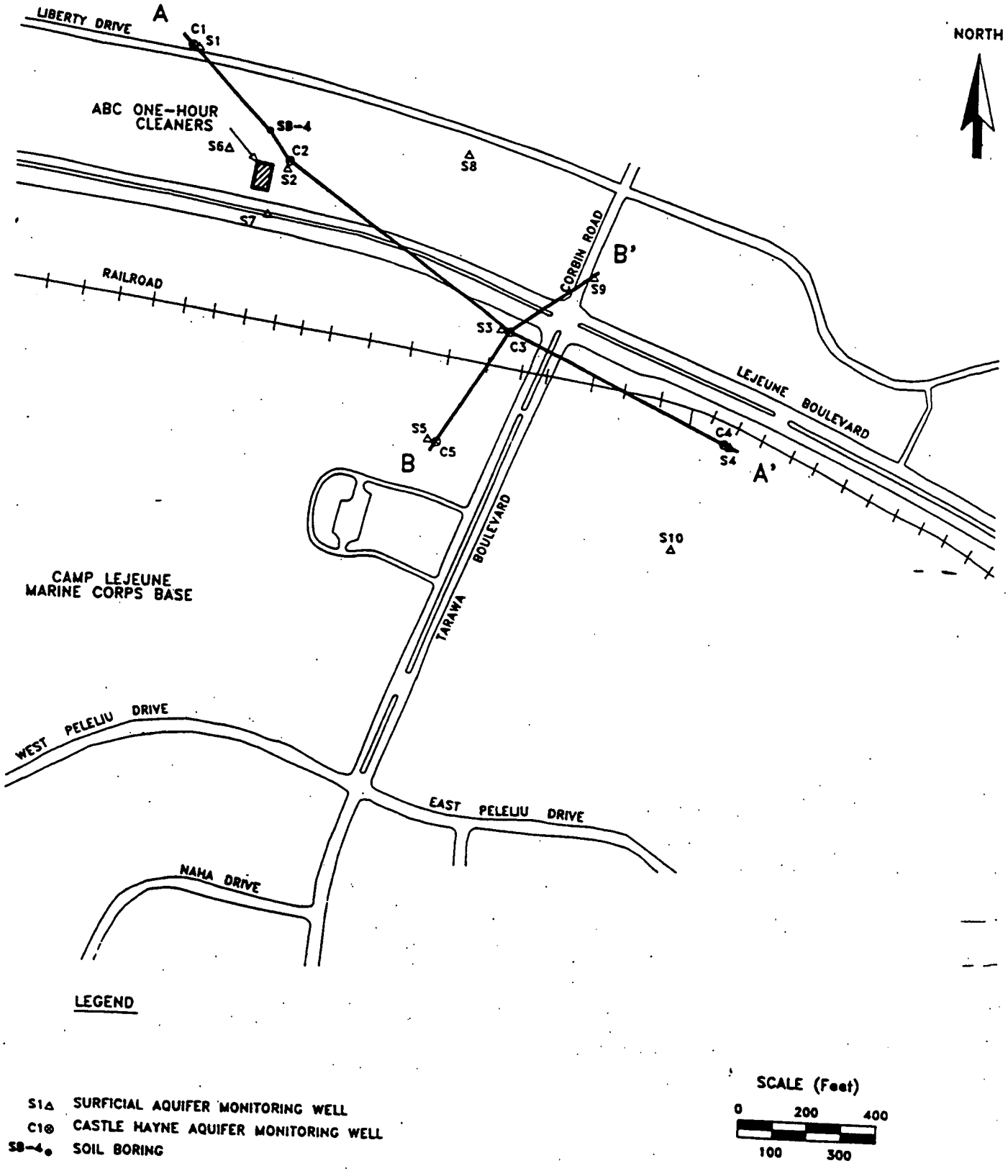
The soils at the Site area have been classified within the Onslow fine sandy soil association. Underlying the surface soils (approximately 5- to 7-inches thick) is a 6- to 8-inch thick hardpan layer. This hardpan is composed of fine sand cemented with organic matter and iron, and may locally inhibit the downward movement of recharge.

1.4 Hydrogeology

A series of investigations were conducted as part of the RI to characterize the hydrogeology at the Site and in the vicinity. These investigations included lithologic sampling, water level measurement in the monitoring wells, and aquifer tests at two shallow and two deep monitoring wells. The two aquifers of concern in the vicinity of the ABC Site are the Surficial aquifer and the Castle Hayne aquifer. The findings of these investigations are summarized in the following paragraphs.

The Surficial aquifer is comprised primarily of saturated quartz sand which extends to a depth of approximately 70-feet Below Ground Surface (BGS) across the study area. Overlying the saturated sand is a zone of interbedded sands, silts, and clays extending from ground surface downward to the top of the saturated sands at approximately 25-feet BGS. The lower portion of this interbedded zone is saturated. From a comparison of the depth to first saturated soil (as observed during the lithologic samples collected during well installation) to the depth-to-water below ground surface (from water level data collected after well development, adjusted from top-of-casing reference to ground surface reference), the static water levels in the wells are typically higher than the first occurrence of saturated soil. This suggests that the interbedded zone acts to partially confine the Surficial aquifer.

FIGURE 2 - LOCATION MAP FOR CROSS SECTIONS



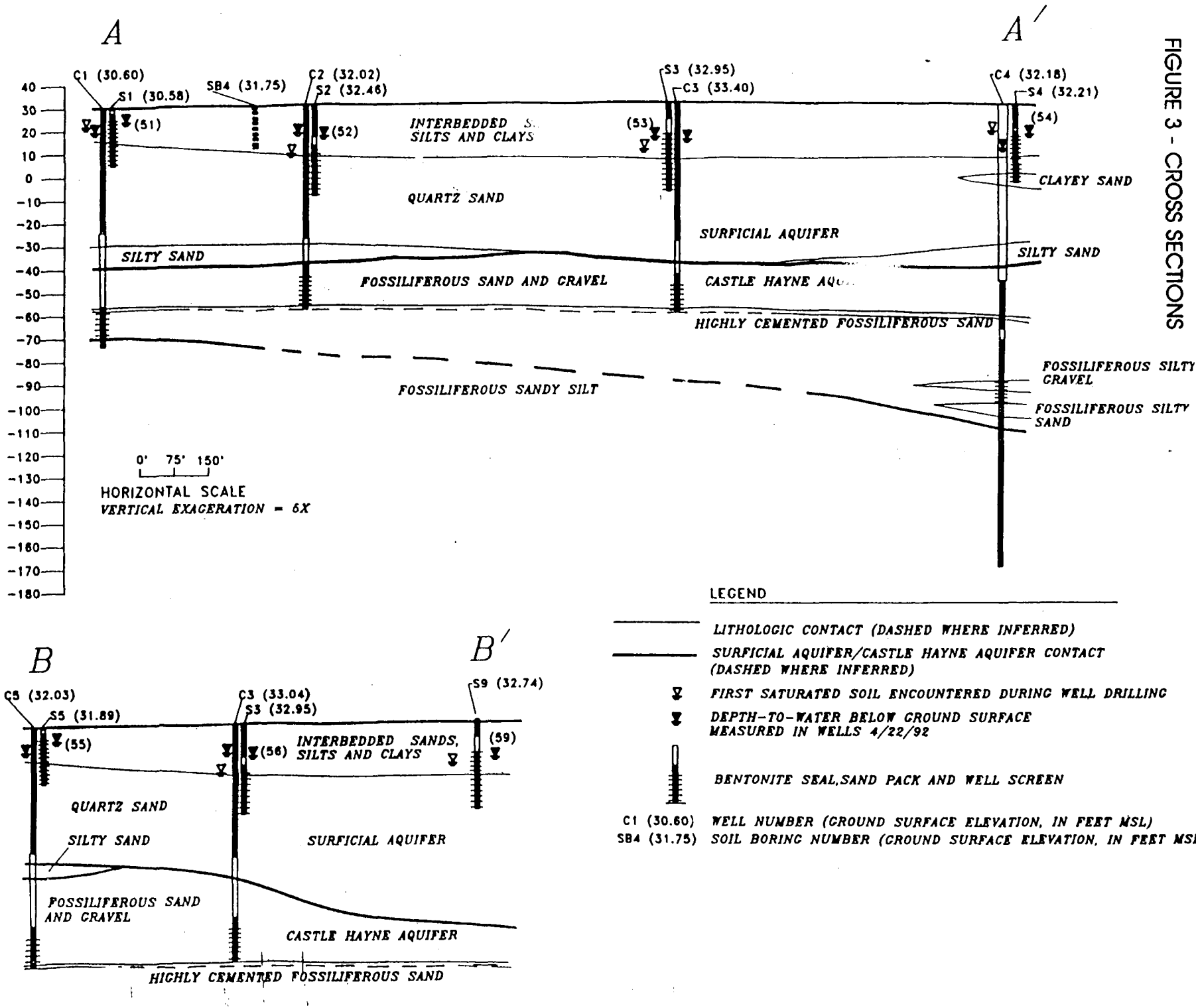


FIGURE 3 - CROSS SECTIONS

The Castle Hayne aquifer underlies the Surficial aquifer at the Site. The Castle Hayne aquifer, at the Site area, is comprised primarily of saturated fossiliferous sands and gravels with variable silt content. The uppermost portions of the aquifer (typically from about 70-feet BGS to about 100- to 120-feet BGS) contain less than about 15% silt by volume. Below this depth, the limited information available from the two well boreholes advanced below 100-feet BGS (well borehole C1 was advanced to 104-feet BGS and well borehole C4 was advanced to 200-feet BGS) indicated that the formation was comprised of approximately equal volumes of saturated fossiliferous silts and sands. At location C1, the silt content increased to about 50% at a depth of 104-feet BGS. At location C4, the silt content was at approximately 50% from about 140-feet BGS to about 200-feet BGS.(See Figure 2 for the locations of the wells and Figure 3 for the cross sections).

A highly cemented layer of fossiliferous sand was encountered at a depth of approximately 90-feet BGS. At three of the Castle Hayne well locations (C2, C3, and C5), drilling refusal was encountered at this layer, and the wells were screened from 10 feet above the cemented layer to total depth. At locations C1 and C4, the layer was penetrated and the screens were set below the layer. All of the Castle Hayne wells were screened above the lower, siltier portion of the Castle Hayne except well C4. At well C4, the upper half of the 10-foot long screen intercepted a lens of fossiliferous silty sand (estimated at about 5-feet thick).

No confining unit was observed separating the Surficial aquifer from the Castle Hayne aquifer. At all locations except C3, a 3-to-10 foot thick silty sand (silt content estimated at approximately 30% or less) was observed at the base of the Surficial aquifer.

1.5 Groundwater Elevations

The groundwater elevation information presented is based on groundwater levels measured in Surficial aquifer monitoring wells and Castle Hayne aquifer monitoring wells on April 22, 1992; June 2, 1992; and June 25, 1992. Figures 4, 5 and 6 represent the Surficial aquifer groundwater elevation maps for each date and Figures 7, 8 and 9 represent the potentiometric surface maps for the Castle Hayne aquifer.

Examination to the Surficial aquifer groundwater elevation maps (Figures 4,5 and 6) reveals a fairly consistent groundwater surface. The highest elevations are observed in the northwest corner of the Site in well S1, with elevations gradually decreasing to the southeast, with wells S10 and S4 exhibiting the lowest Surficial aquifer groundwater elevations at the Site. From the observed elevations, groundwater appears to be flowing from the northwest to the southeast towards Northeast Creek.

A review of the Castle Hayne aquifer groundwater elevation maps (Figures 7, 8 and 9) indicates that, as with the Surficial aquifer, there is considerable

FIGURE 4 - GROUNDWATER ELEVATIONS FOR THE SURFICIAL AQUIFER FOR 4/22/92

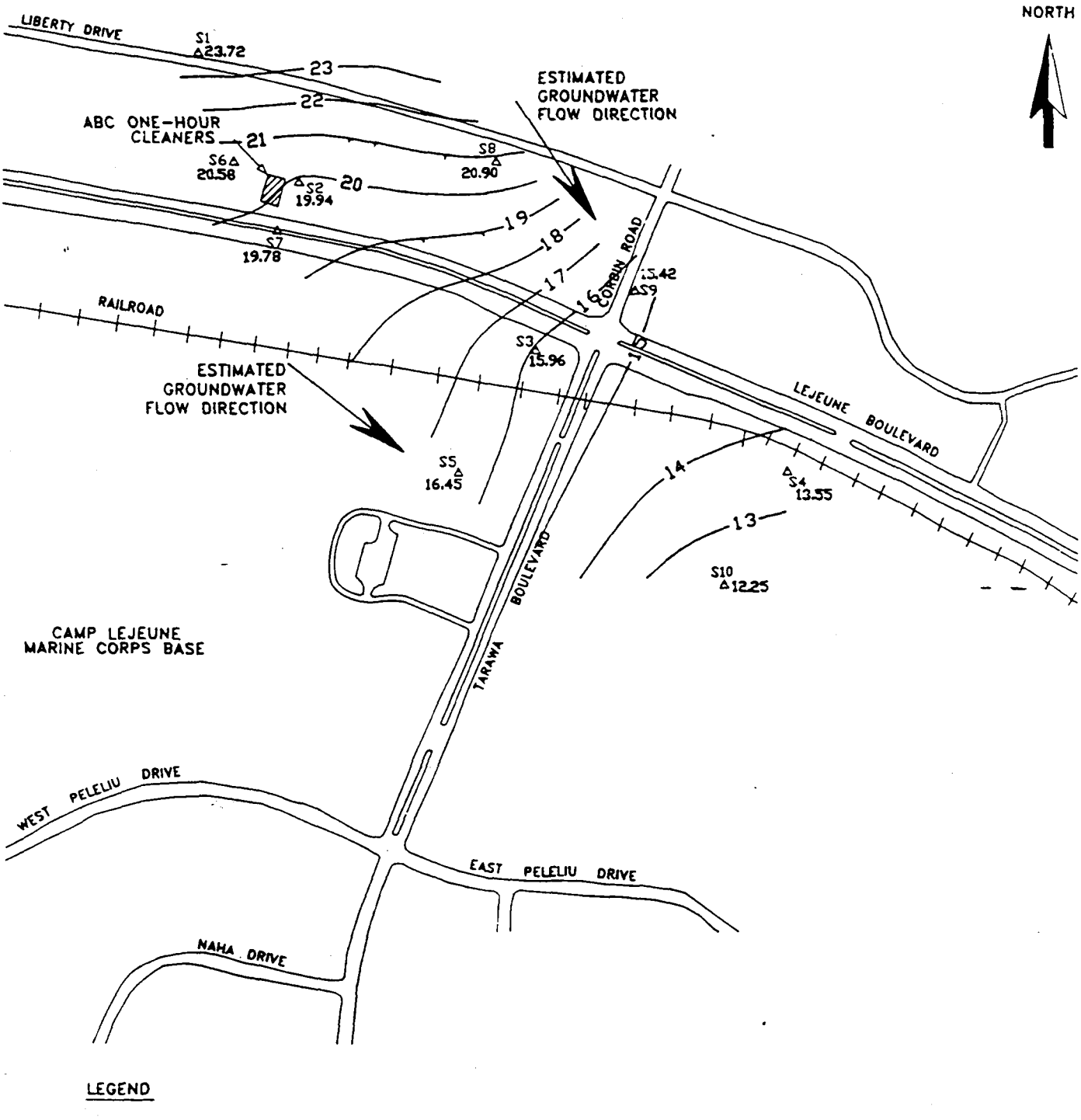


FIGURE 5 - GROUNDWATER ELEVATIONS FOR THE SURFICIAL AQUIFER FOR 6/2/92

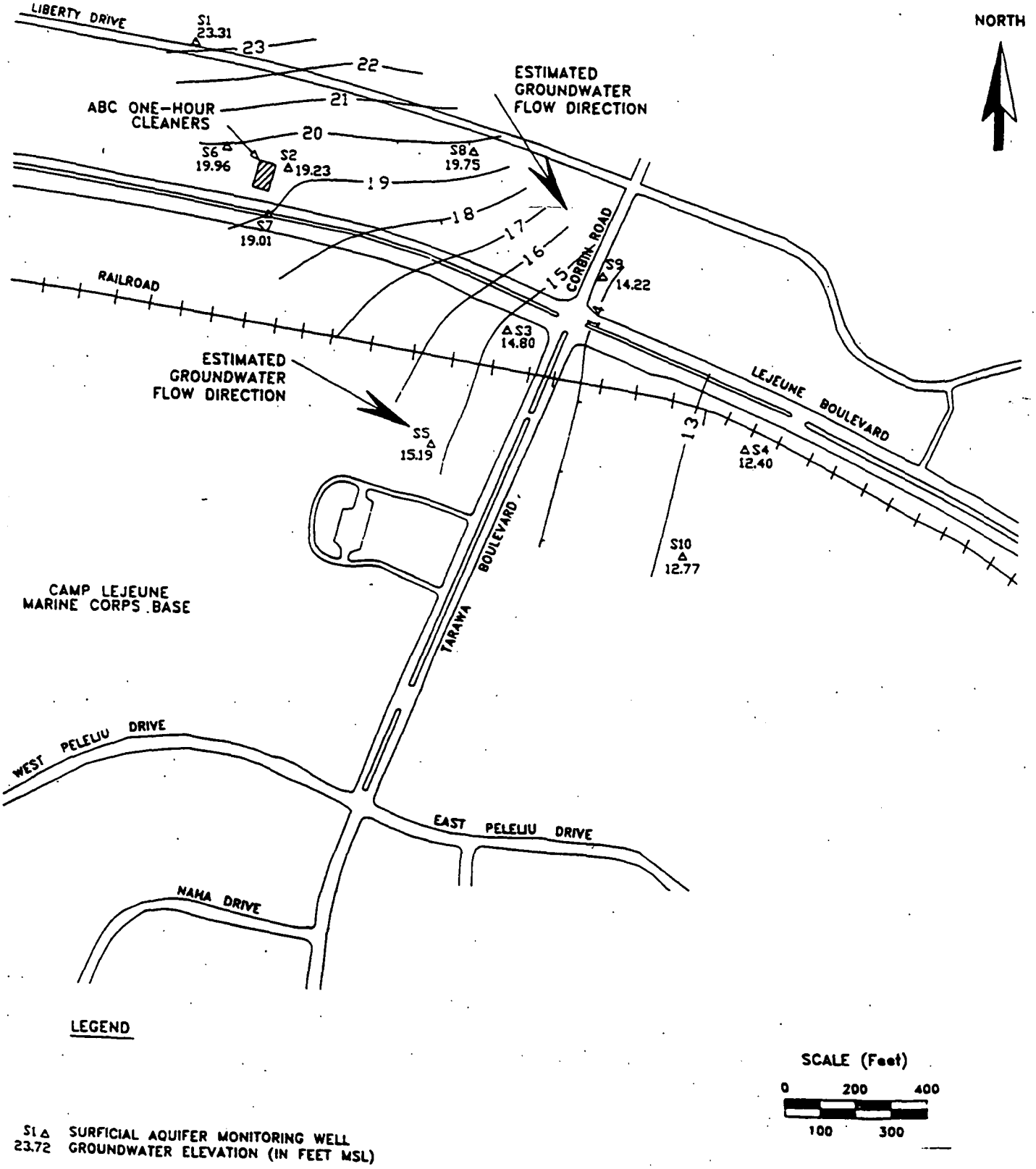
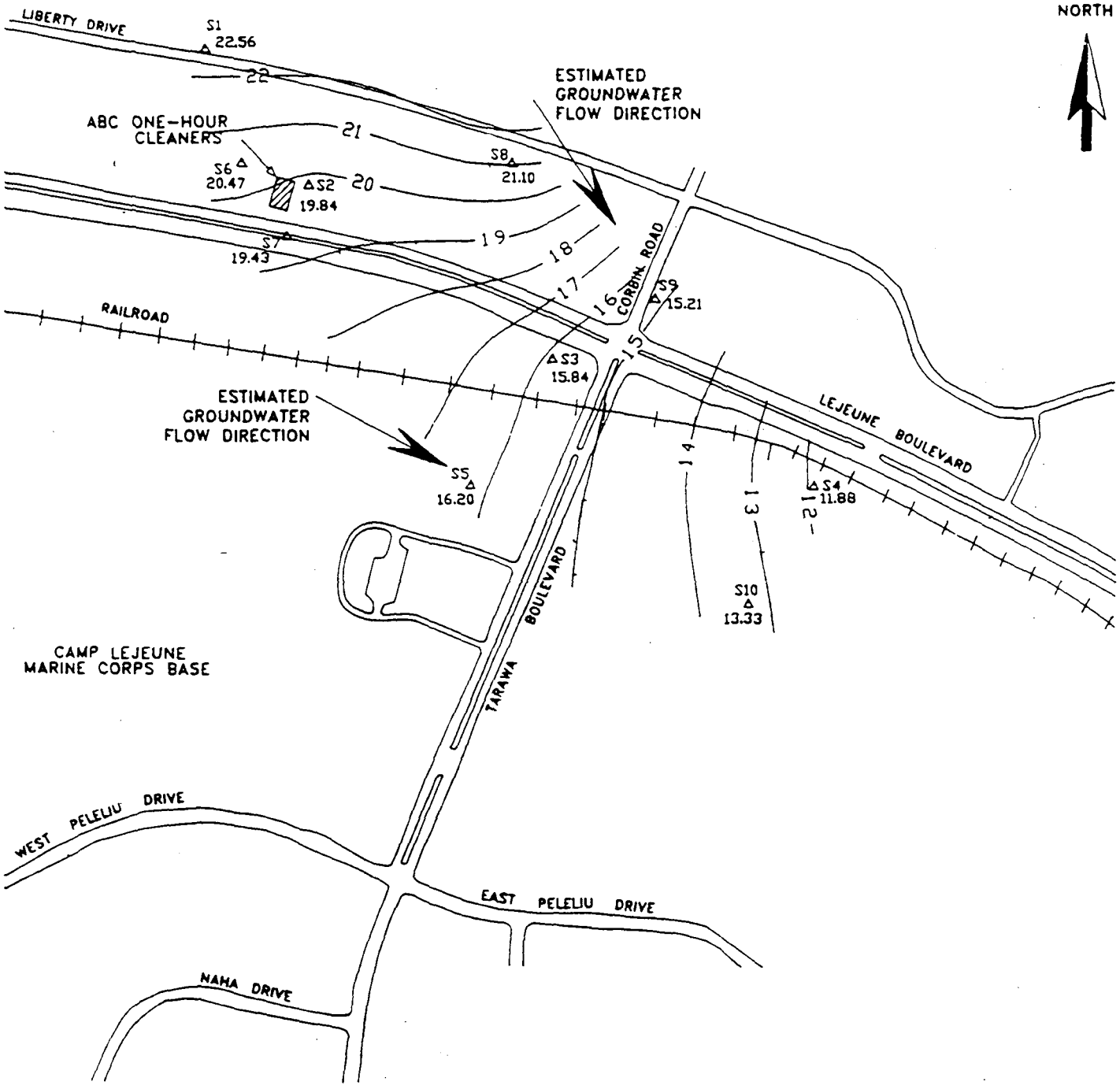


FIGURE 6 - GROUNDWATER ELEVATIONS FOR THE SURFICIAL AQUIFER FOR 6/25/92



LEGEND

SCALE (Feet)

0 200 400
100 300

S1 △ SURFICIAL AQUIFER MONITORING WELL
23.72 GROUNDWATER ELEVATION (IN FEET MSL)

—13— GROUNDWATER ELEVATION CONTOUR (IN FEET MSL)

FIGURE 7 - GROUNDWATER ELEV. FOR THE CASTLE HAYNE AQUIFER FOR 4/22/92

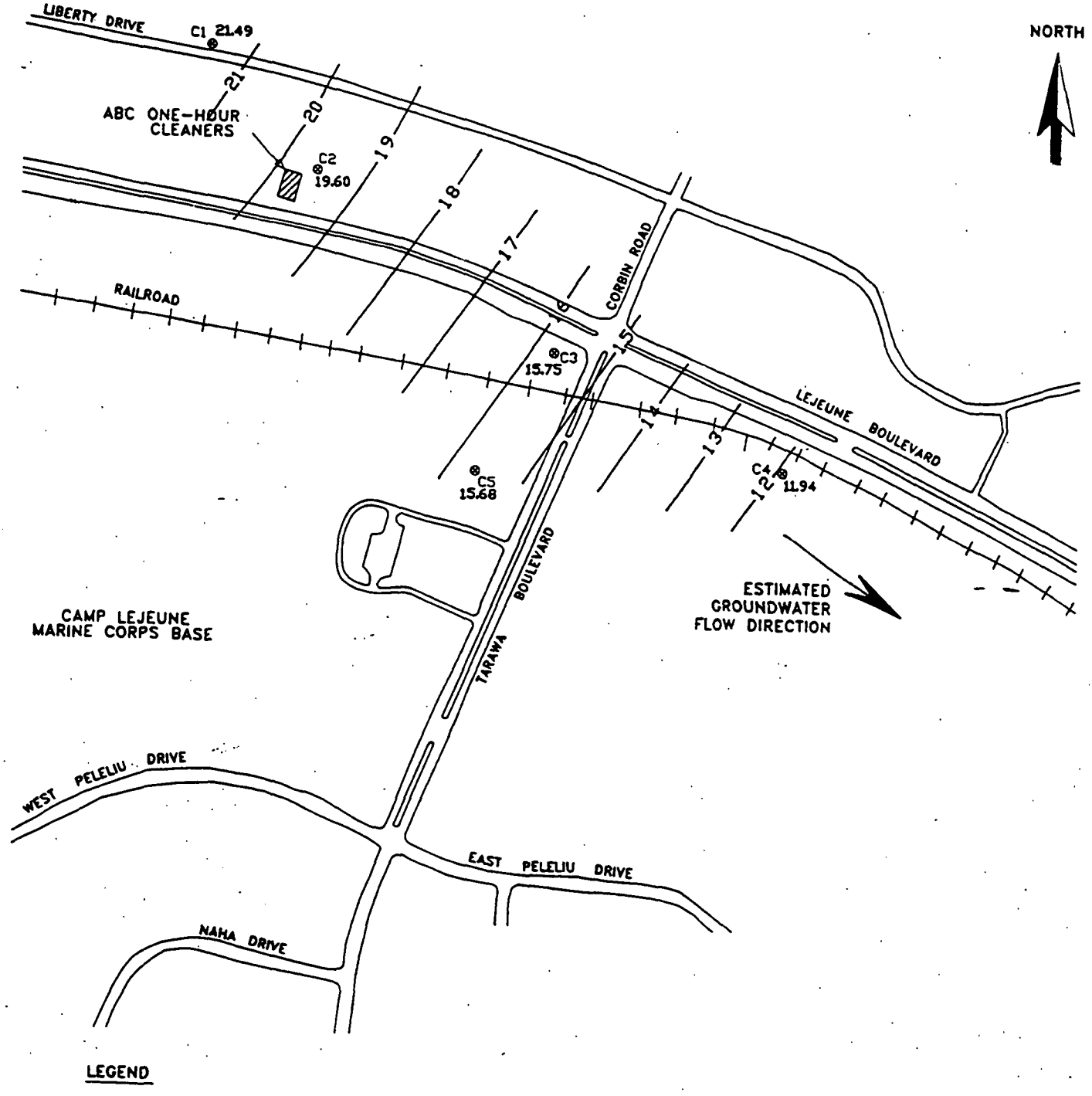


FIGURE 8 - GROUNDWATER ELEV. FOR THE CASTLE HAYNE AQUIFER FOR 6/2/92

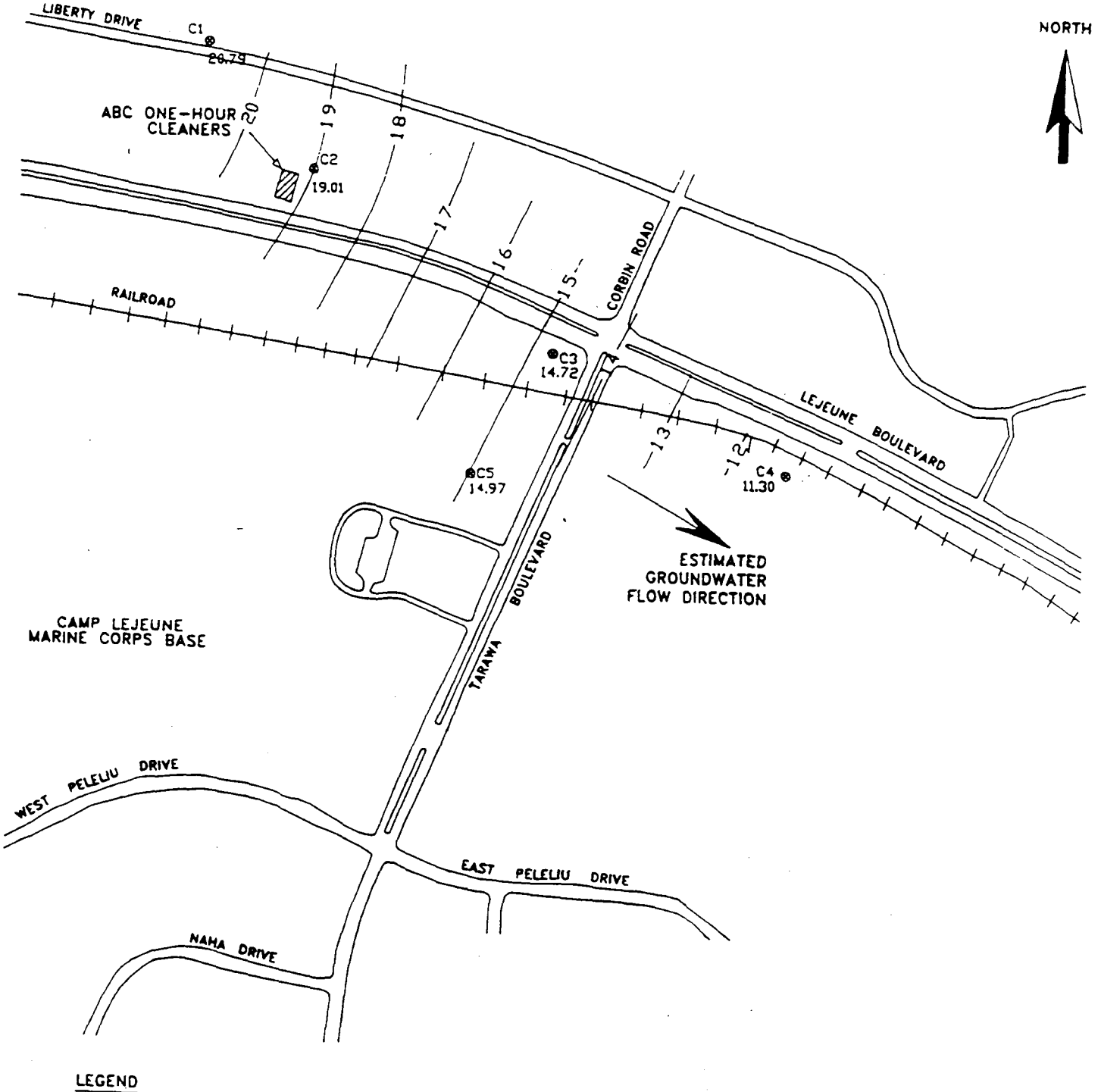
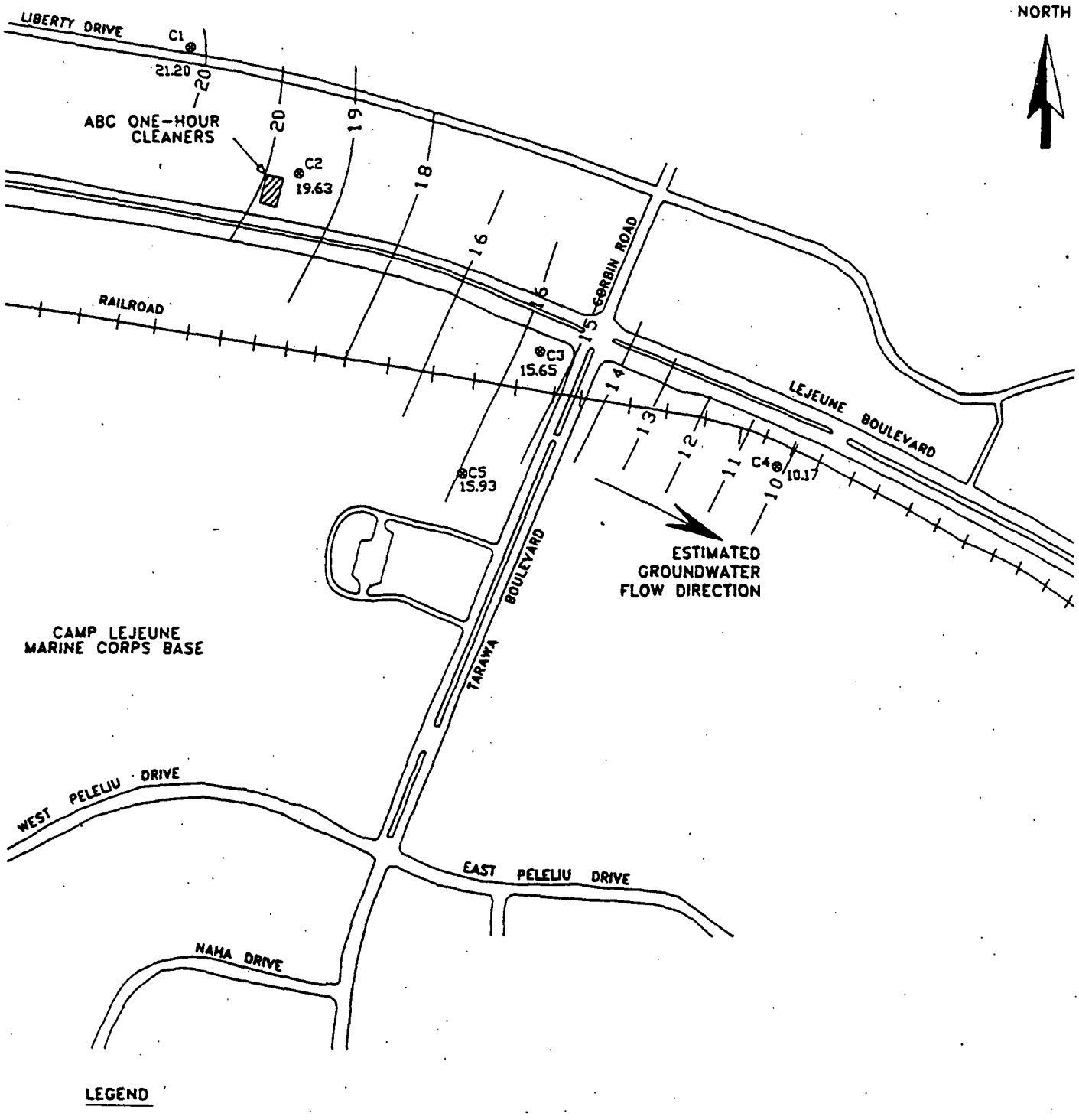


FIGURE 9 - GROUNDWATER ELEV. FOR THE CASTLE HAYNE AQUIFER FOR 6/25/92



LEGEND

C1 ⊗ 23.72 — CASTLE HAYNE AQUIFER MONITORING WELL
GROUNDWATER ELEVATION (IN FEET MSL)

—13— GROUNDWATER ELEVATION CONTOUR (IN FEET MSL)

SCALE (Feet)

0 200 400
100 300

consistency in the groundwater surfaces on the three test dates with groundwater flowing in the same general direction.

The test data indicates that there is a downward vertical hydraulic gradient which varies across the Site, and suggests that there is some degradation in hydrologic communication between the Surficial and Castle Hayne aquifers which varies across the Site. No geologic structure was identified that appeared capable of acting as an aquitard between the Surficial and Castle Hayne aquifers. It is possible that some of the variation in groundwater elevations is attributable to the presence of a thin (estimated at approximately 0.5 feet) highly cemented layer of fossiliferous sands observed within the Castle Hayne aquifer at a depth of approximately 90-feet BGS.

1.6 Aquifer Parameters

The following aquifer parameters are based on the aquifer (pump) tests conducted at the ABC Site in June of 1992:

Surficial aquifer: Effective Porosity = 0.15
Linear Groundwater Flow Velocity = 0.48 ft/day
Hydraulic Conductivity = 10.3 ft/day

Castle Hayne aquifer: Effective Porosity = 0.10
Linear Groundwater Flow Velocity = 0.84 ft/day
Hydraulic Conductivity = 14 ft/day

The hydraulic gradients for the Surficial and Castle Hayne aquifers are 0.007 and 0.006 respectively.

1.7 Demography and Land Use

The ABC Site is located in the Jacksonville city limits. The population within a 1-mile radius of the Site is approximately 2,800 and includes approximately 726 houses. Properties in the areas to the east and west of the ABC Site are presently used for general retail and commercial business purposes. To the north of the Site are residential areas, including Pinewood Downs, a multi-family residential development. Land located to the south serves as housing for noncommissioned officers and also contains woodlands.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Facility Operations and History

ABC One-Hour Cleaners, Inc., is a North Carolina corporation registered with the Secretary of State as of March 4, 1958. Martha Melts and Milton Melts purchased the property on which the ABC One-Hour Cleaners facility is located on

September 16, 1964. Prior to purchasing, the Melts' leased the property from Carolina Eastern Realty Company, Inc. (lease entered into on May 2, 1955). According to the lease document, the building was previously used as a model/hobby shop. Currently, Mr. Melts serves as the President of ABC One-Hour Cleaners; Victor Melts is the Vice President, Secretary, and Treasurer. Victor Melts and Milton Melts are the sole directors and shareholders of ABC One-Hour Cleaners.

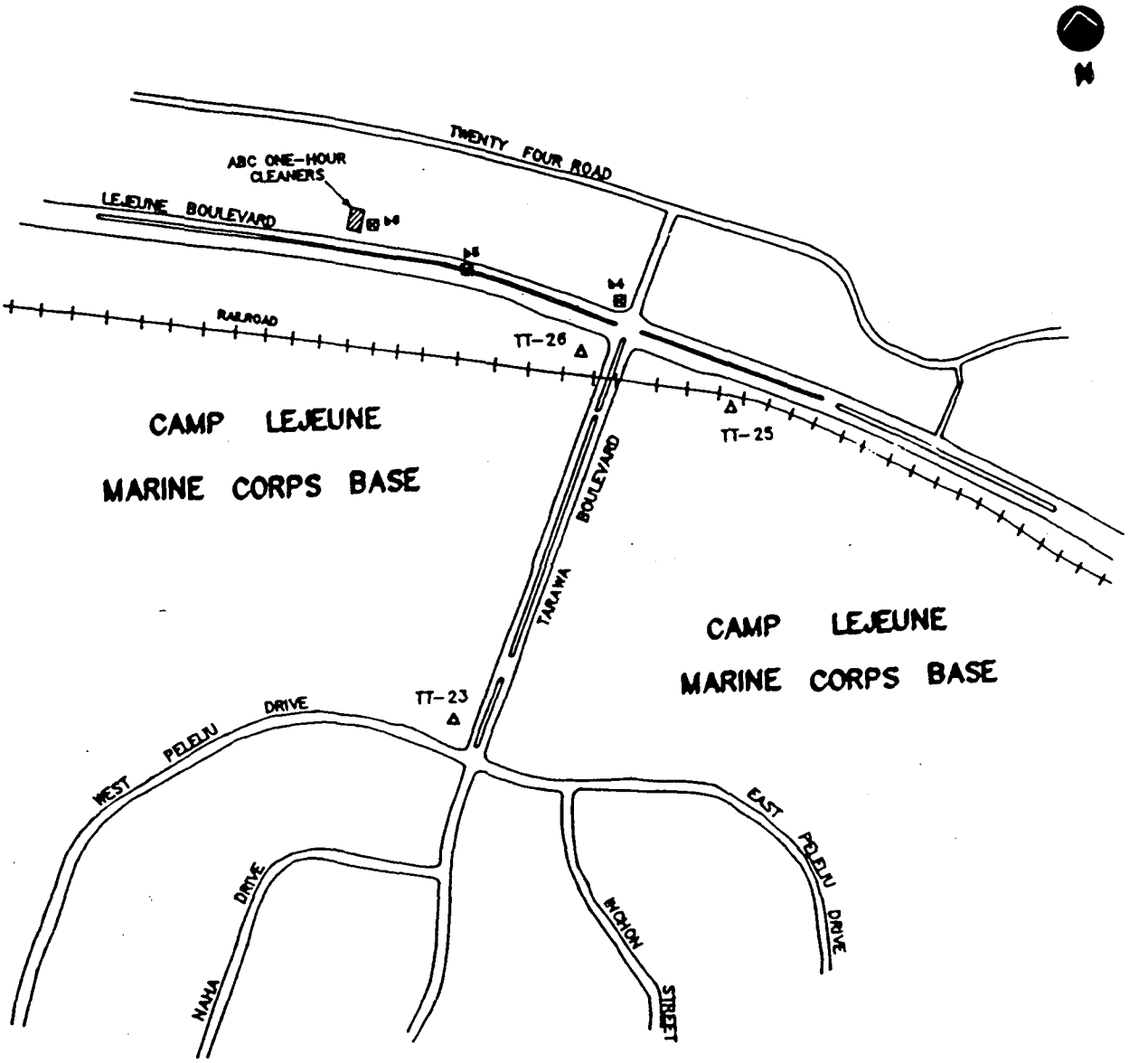
Typical of the dry cleaning industry, ABC One-Hour Cleaners utilizes tetrachloroethene (PCE) as a dry cleaning solvent. The solvent was stored in a 250-gallon above-ground storage tank located along the west side of the building. Used PCE was reclaimed through a filtration-distillation process contained within the main building. Following completion of the distillation process, the still bottoms, consisting of powder residues, were placed in the dirt driveway west of the building as a "pothole" filler. It is estimated that approximately 1 ton of still bottoms was placed on the driveway over a 30-year operating period. Since 1985, ABC One-Hour Cleaners has used the services of Safety-Kleen, Inc. to recover and recycle its dry cleaning fluid.

According to the Resource Conservation and Recovery Act (RCRA), still bottoms are considered to be a hazardous waste (RCRA Waste No.F002). ABC One-Hour Cleaners is classified as a small quantity generator under RCRA (No.NCD981751126), and generates less than 1,000 kilograms per month of hazardous waste.

A septic tank soil absorption system is located in the rear of the building complex. The septic system consists of an underground concrete tank with a concrete lid and a pipe of unknown length that discharges into the subsurface soil. The septic system is located within 4 feet of the PCE storage tank. The age of the septic system reportedly dates back to the original construction of the building (1940's). ABC One-Hour Cleaners began occupying the building in 1955. In the 1960's, ABC One-Hour Cleaners installed a floor drain to the septic tank and tied its wastewater discharge, except for its lavatories, into the Weyerhaeuser Properties' water and sewer system. The lavatories remained tied into the septic system until approximately 1985, at which time they were also tied into the Weyerhaeuser Properties' system.

In July 1984, as part of a routine water quality evaluation, the Department of the Navy collected groundwater samples from 40 of the 100 community water supply wells located on the Base. The Navy determined that dichloroethene (DCE), trichloroethene (TCE), and PCE were present in 10 of the wells sampled. Of the 10 wells in which groundwater contamination was noted, 8 of the wells had been directly impacted by sources located on the Base. The remaining two wells were located within the Tarawa Terrace well field (TT-23 and TT-26; see Figure 10) in the vicinity of two off-base commercial dry cleaning operations, ABC One-Hour Cleaners, Inc., and Glam-O-Rama, Inc.

FIGURE 10 - LOCATIONS OF TEMPORARY MONITORING WELLS INSTALLED BY NRCD IN 1985



LEGEND:

△ TT-23 — TARAWA TERRACE COMMUNITY SUPPLY WELL

●b-4 — TEMPORARY MONITORING WELL INSTALLED BY NRCD IN 1985.

SCALE IN FEET

In February 1985, the two affected wells plus a third community well (TT-25) were disconnected from the Base's drinking water supply system. In June 1985, an emergency water line from the Base's Holcomb Boulevard system was installed to provide the Tarawa Terrace development with drinking water.

During the same time period, the Wilmington Regional Office (WiRO) of the Division of Environmental Management, North Carolina Department of Natural Resources and Community Development (NCDNRCD), now called North Carolina Department of Environment, Health and Natural Resources (NCDEHNR), was notified by the United States Marine Corps, that two deep water wells in the Tarawa Terrace housing area at the Base were contaminated by what appeared to be off-site sources. From April through September 1985, WiRO staff conducted a groundwater pollution study to define the source of PCE in wells within the Tarawa Terrace well field. The study concluded that the most likely source of groundwater contamination was determined to be ABC One-Hour Cleaners, Inc.

On January 24, 1986, WiRO notified Mr. Milton Melts, president of ABC One-Hour Cleaners, Inc., that he was in violation of the following North Carolina General Statutes:

1) G.S. 143-215.1(a)(5) for changing the nature of waste discharged through a disposal system by disposing of dry cleaning solvents in the septic tank system.

2) G.S. 143-215.1(a)(6) for discharging dry cleaning solvents in the septic tank nitrification field resulting in the violation of standards for underground waters.

Subsequent to the receipt of the Notice of Violation issued by NCDNRCD, ABC One-Hour Cleaners contracted the services of Law Engineering and Testing, Inc., to conduct preliminary investigations of the septic tank soil absorption system and surrounding soils. The results of two preliminary investigations conducted on April 8, 1986 and September 10-11, 1986, confirmed the presence of PCE and its derivatives in soils immediately surrounding the septic tank and adjacent to an existing floor drain. Thus, ABC One-Hour Cleaners was confirmed as the source of groundwater contamination.

On October 30, 1986, ABC One-Hour Cleaners submitted a proposal for a remedial action plan involving partial removal and/or treatment of contaminated soils. The plan, according to NCDNRCD, failed to address problems associated with the groundwater contaminant plume emanating from beneath the ABC One-Hour Cleaners facility. The NCDNRCD rejected the proposed plan and proceeded with application of the Hazard Ranking System (HRS) and nomination of the Site for inclusion on the Superfund National Priorities List (NPL) of uncontrolled hazardous waste sites.

2.2 Enforcement Activities

Based upon observed releases of PCE and existing groundwater contamination, as well as other factors considered in the application of the HRS, the ABC One-Hour Cleaners Site was scored at 29.11. Sites with scores of 28.5 or greater are listed on the NPL. Accordingly, the Site was proposed for NPL listing in June 1988, and placed on the final list in March 1989.

On September 29, 1988, EPA sent a special notice letter to the current landowner and president of ABC One-Hour Cleaners Inc., Milton Melts, notifying him of his potential responsibility for the release of hazardous substances at the ABC One-Hour Cleaners Site in Jacksonville, North Carolina and requesting him to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site.

Since the PRPs were unable to conduct the RI/FS, EPA hired Roy F. Weston, Inc. to conduct the RI/FS. Following Work Plan approval on June 28, 1990, the RI field activities began and were completed in June of 1992. The RI and FS reports were completed in November 1992. This Record of Decision (ROD) addresses Operable Unit #1: Groundwater contamination at the ABC Site. Further field work will be done to define the extent of contamination in the soils. After this is completed, a ROD will be written for that Operable Unit.

3.0 COMMUNITY PARTICIPATION HIGHLIGHTS

In accordance with the public participation requirements of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 117 and the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a comprehensive community relations program was developed and implemented throughout the remedial process at the ABC Site.

Community interviews were conducted in early 1990 to find out the concerns of the community and to explain the Remedial Investigation process to the citizens. Their concerns are outlined in the Community Relations Plan. This plan was finalized on September 10, 1990 and also contains contacts and interested parties throughout the government and the local community. The Plan identifies communication pathways to assure timely dissemination of pertinent information.

On August 16, 1990, an Open House was held at City Hall in Jacksonville, North Carolina as a kick-off meeting for the RI/FS. This Open House was held to allow the public the opportunity to come and voice their concerns and questions regarding the ABC Site and the upcoming Remedial Investigation.

A RI/FS kick-off fact sheet was distributed in April of 1991 before field activities began at the ABC Site. This fact sheet outlined what to expect during the RI/FS.

Following the completion of the RI, a RI/FS Findings Fact Sheet was prepared and released to the public in September of 1992. This fact sheet presented the results of the RI.

The Proposed Plan fact sheet was mailed to the information repository and to the individuals at the Site mailing list on October 30, 1992. The RI/FS reports were released to the public on November 6, 1992. These documents were made available to the public in both the Administrative Record and the information repository maintained at the Onslow County Public Library and the EPA Region IV Records Center. The notice of the availability of these documents and notification of the Proposed Plan Public Meeting was announced in The Jacksonville Daily News and The Wilmington Morning Star on November 6, 1992. The Proposed Plan Fact Sheet was mailed on October 30, 1992 and the Proposed Plan Public Meeting was held on November 19, 1992 at the Onslow County Public Library. At this meeting, representatives from EPA and NCDEHNR presented EPA's preferred alternative for cleanup of the Site and answered any questions the public had regarding the preferred alternative, other alternatives considered in the FS, or any other concerns the public had related to the cleanup of this Site.

Various press releases were issued throughout the different stages of this project. These press-releases announced meetings and announced the preferred alternative for cleanup at the Site.

The public comment period was held from November 6, 1992 through December 7, 1992. A response to the comments received during this comment period, including those raised during the Proposed Plan public meeting, are addressed in the Responsiveness Summary, which is part of this Record of Decision. The Responsiveness Summary also incorporates a transcript of the Proposed Plan public meeting.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

The selected remedy for the Site is intended to address the threats to human health and the environment. This remedial action will remove the threat posed by contaminated groundwater at the Site. Remediating groundwater will prevent ingestion or inhalation of contaminated groundwater at or above the Maximum Contaminant Levels (MCLs) and North Carolina Groundwater Quality Standards (NCGWQS) and will restore groundwater to contaminant levels below MCLs and NCGWQSs. This ROD is addressing Operable Unit #1: Groundwater. Another ROD for Operable Unit #2 will be written in the future after the nature and extent of soil contamination has been defined.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 Nature and Extent of Contamination

During the field investigation program, samples for chemical analysis were collected from soil and groundwater media and from liquid and sludge phases from the septic tank located underneath the ABC One-Hour Cleaners facility. Results of the analysis conducted as part of the RI confirmed the presence of PCE in groundwater in the Surficial and Castle Hayne aquifers and the septic tank wastes. Other contaminants observed within the groundwater include constituents which may have been present in commercial grades of PCE and/or are breakdown components of PCE (trichloroethene, dichloroethene, and vinyl chloride).

5.1.1 Soils

Although soils data is not within the scope of this operable unit, it is useful to mention, that Volatile Organic Compounds (VOCs) were observed in several unsaturated soil samples collected around the ABC Site, supporting the hypothesis that the septic tank acts as a source of VOCs. These VOCs in the septic tank traveled through the unsaturated soil to reach the groundwater, and therefore, it is expected that VOCs would be present in the unsaturated soils under and near the ABC Site. The soil contamination will be investigated further as Operable Unit #2 and at that time a ROD will be written addressing the contamination in the soils.

Source area investigation in the RI was focused on two media: liquid and sludge phase material from the septic tank at the ABC Site. Two samples were collected from the septic tank. The first sample, was collected from the liquid material present in the upper part of the septic tank and the second sample was collected from the sludge material at the bottom of the tank. Concentrations of detected VOCs in the sludge sample exhibited significantly higher concentrations than observed in the liquid sample, with concentration increases varying from about a factor of two for vinyl chloride, to a factor of 30 for PCE. Based on the results of these field investigations, the ABC Site, specifically the former septic tank system, is the primary source for VOCs at the Site.

Other source areas at the Site may have existed (e.g., historical reports indicate that still bottoms from ABC Site were used to fill potholes in the driveway along the west-side of ABC Site), but this source is believed to be of secondary concern because concentrations found in the septic tank were much higher. Other organic compounds such as pesticides (DDE, DDD), Phthalates, phenols, and Polycyclic Aromatic Hydrocarbons (PAHs) were detected within the septic sludge but not in the groundwater at the Site.

5.1.2 Groundwater

The groundwater investigation at the Site began with using Direct Push Technology (DPT). The DPT investigation took three weeks to complete in which approximately 100 groundwater samples were analyzed at varying depths. This initial investigation served as an aid to better define areas where monitoring wells should be installed.

After the DPT investigation, both shallow and deep monitoring well locations were identified. Ten Surficial monitoring wells and five deep monitoring wells were installed in locations shown in Figure 11. Groundwater samples were collected from seven existing wells (Figure 12), the ten Surficial monitoring wells, and the five deep Castle Hayne monitoring wells. The results of this sampling event are described below.

Base and Residential Supply Well Sampling

Supply wells sampling (Figure 12) suggest that the concentrations of chlorinated VOCs, primarily PCE and TCE, are highest immediately down-gradient of the ABC Site and decrease in the down-gradient direction (southeast) away from the ABC Site. Non-chlorinated VOCs detected in well TT-54 do not appear to be related to the ABC Site. Table 1 presents a summary of VOC analytical results for these wells.

Surficial Aquifer Monitoring Wells

The VOCs detected in the Surficial aquifer monitoring wells above the drinking water standards were PCE, TCE, 1,2-DCE and vinyl chloride. A summary of the VOCs detected is presented in Table 2. The MCLs and North Carolina Groundwater Quality Standards (NCGWQS) are also listed in the table for comparison. Surficial aquifer wells S2 and S3 were found to have significantly elevated VOCs concentrations. No pesticides or polychlorinated biphenols (PCBs) were detected in any of the Surficial aquifer monitoring wells. Metals detected were below the drinking water standards or the concentrations detected are considered representative of the area.

Castle Hayne Aquifer Monitoring Wells

Seven VOCs were detected at one or more of the Castle Hayne aquifer monitoring wells. Acetone was only detected in well C5. The detection of acetone at the concentration reported in well C5 resulted in an elevation of detection limits (from 10 µg/l to 100 µg/l). The presence of acetone is considered anomalous (laboratory artifact). Table 3 presents a summary of the results of VOCs detected in the Castle Hayne aquifer. The highest chlorinated VOC concentration was observed at well C3. No VOCs were detected in the up-gradient well C1 and down-gradient well C4. The estimated PCE results (<100 µg/l) for well C5 may be the result of the past pumping of the Tarawa Terrace

FIGURE 11 - SURFICIAL AND CASTLE HAYNE AQUIFER MONITORING WELLS LOCATION

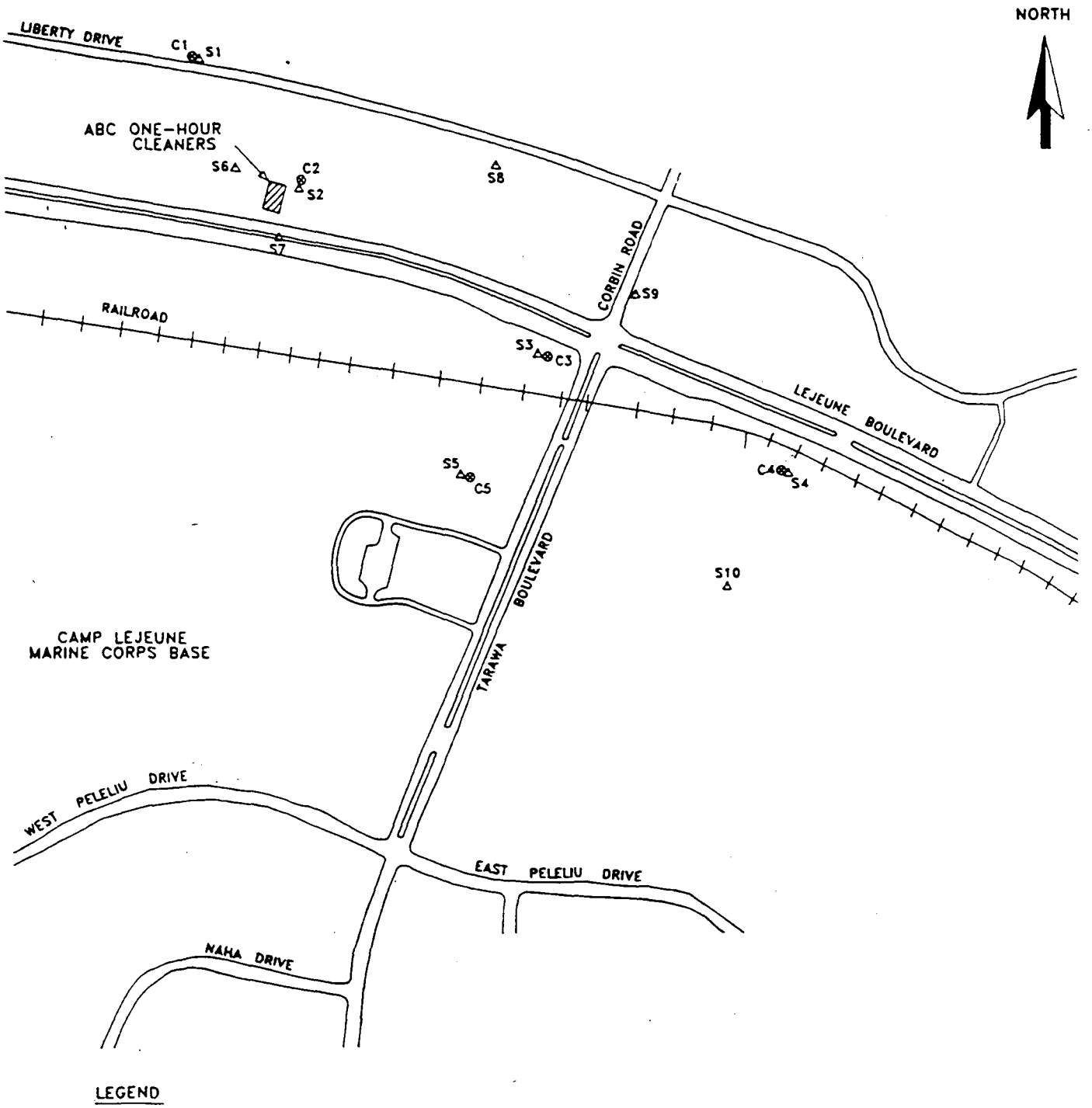


FIGURE 12 - LOCATIONS OF RESIDENTIAL AND BASE SUPPLY WELLS SAMPLED AS PART OF THE REMEDIAL INVESTIGATION

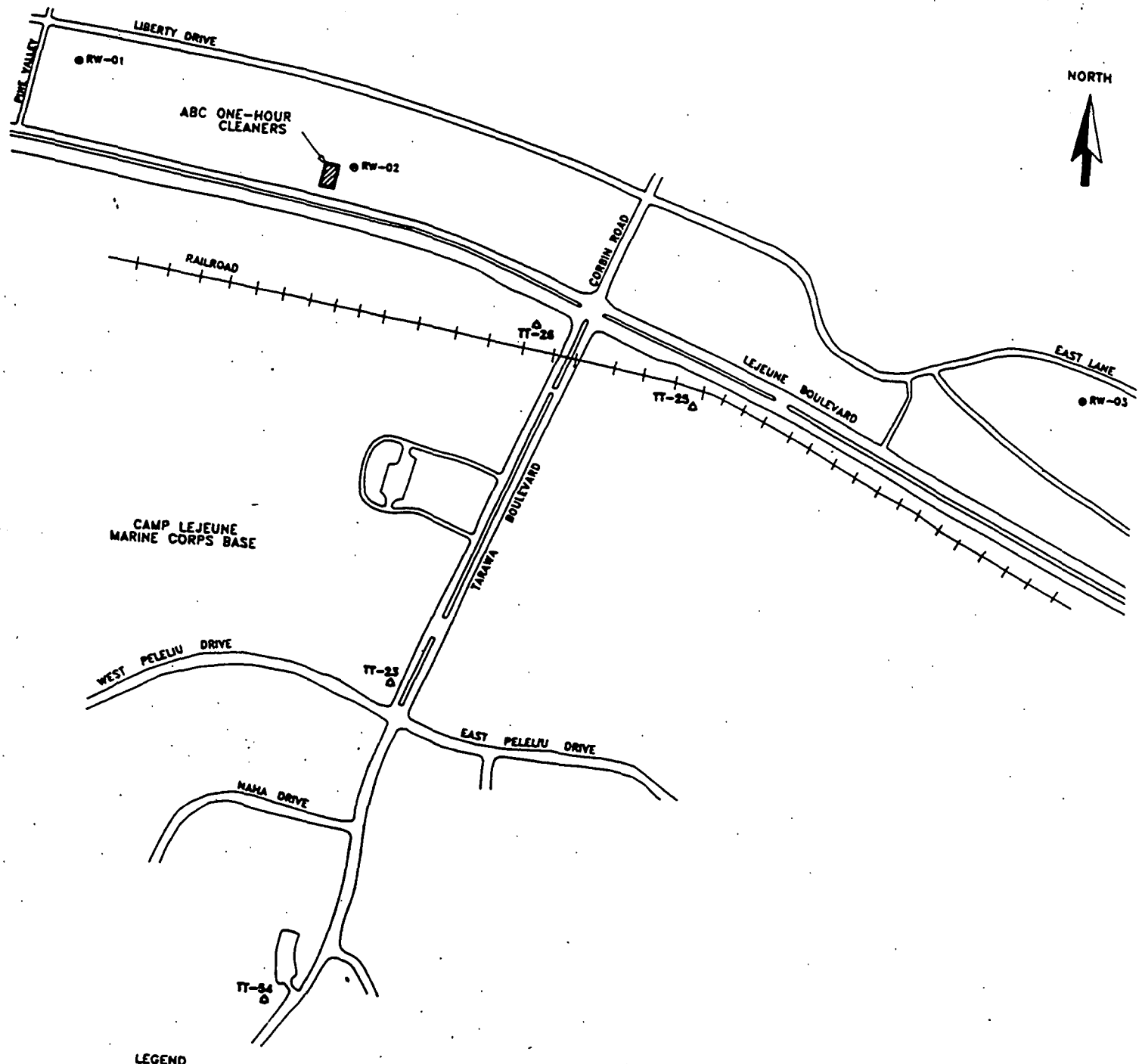


TABLE 1

VOC Analytical Results of Residential and Base Supply Wells (WESTON, July 1991)

(A) Base Supply Wells

Parameter	VOC Concentration			
	TT-23 (ug/L)	TT-25 (ug/L)	TT-26* (ug/L)	TT-54 (ug/L)
cis-1,2-Dichloroethene	<5	1.4 J	<200/15 J	<5
Benzene	<5	<5	<200/<100	1.3 J
Trichloroethene (TCE)	<5	5.8	56 J/<62 J	<5
Tetrachloroethene (PCE)	<5	23	340/360	<5

(B) Residential Wells

Parameter	VOC Concentration		
	RW-01 (ug/L)	RW-02 (ug/L)	RW-03 (ug/L)
cis-1,2-Dichloroethene	<5	<250	<5
Benzene	<5	<250	<5
Trichloroethene (TCE)	<5	<250	<5
Tetrachloroethene (PCE)	<5	760	<5

Notes: * - Two sets of values indicate duplicate samples
J - Estimated Value

VOCs Detected in the Surficial Aquifer Wells (WESTON, April 1992)

Analyte	Federal MCLs (ug/L)	NC GW Standards (ug/L)	Well Identification					
			S1 (ug/L)	S2 (ug/L)	S2 (Dup) (ug/L)	S3 (ug/L)	S5 (ug/L)	S6 (ug/L)
Benzene	5	1					2 J	2 J
Chlorobenzene	100	300					5 J	
Chloroform	100	0.19		1 J				
1,1-Dichloroethane	7	7		5 J	5 J	6 J		
1,2-Dichloroethene/(total)	70/100*	70/100*		1,200	1,200	1,200		
Ethylbenzene	700	29						28
Tetrachloroethene (PCE)	5	0.7	10	880	910	5,400	3 J	4 J
Toluene	1,000	1,000			1 J		4 J	3 J
1,1,2-Trichloroethane	5	--				2 J		
Trichloroethene (TCE)	5	2.8		690	720	640		
Vinyl Chloride	2	0.015		100	100	110		
Xylenes (total)	10,000	400			1 J			

Key: * cis-1,2-DCE/trans-1,2-DCE
J Estimated value

Notes: (1) All surficial aquifer wells (S1 through S10) were sampled and analyzed for the analytes listed in the table. Only detected values are presented in the table.
(2) Shaded areas indicate concentrations above Federal MCLs and North Carolina Groundwater Quality Standards.

TABLE 2

TABLE 3

VOCs Detected in the Castle Hayne Aquifer Wells (April 1992)

Analyte	Federal MCLs (ug/L)	NC GW Standards (ug/L)	Well Identification				
			C1 (ug/L)	C2 (ug/L)	C3 (ug/L)	C4 (ug/L)	C5 (ug/L)
Acetone	--	--					1,400
Benzene	5	1					18 J
Chloroform	100	0.19		2 J			
1,2-Dichloroethene/(total)	70/100*	70/100*		9 J	14		
Tetrachloroethene (PCE)	5	0.7		1 J	7 J		
Toluene	1,000	1,000					25 J
Trichloroethene (TCE)	5	2.8		3 J	28		17 J

Notes : * cis-1,2-DCE/trans-1,2-DCE
J Estimated value

Shaded areas indicate concentrations above Federal MCLs and NCGWQS

water supply wells or may be related to the anomalous acetone result and the associated higher detection limits. No SVOCs, pesticides, or PCBs were detected in any of the Castle Hayne monitoring wells. The distribution of metals at the Site suggests that the ABC Site is not contributing metal contaminants to the groundwater. Concentrations of metals in the background well are generally comparable to, or higher than, metals detected in other wells located downgradient of the Site.

Benzene was also detected above the drinking water standards in C5, but the source does not appear to be the ABC Site. EPA has notified Camp Lejeune Marine Corp Base of the presence of benzene in well C5. Accordingly, the Base will take appropriate action to determine the source of benzene.

5.2 Contaminant Fate and Transport

The septic system was determined to be the primary source of the chlorinated hydrocarbons at the Site. Constituents of the septic system entered the drain field and percolated downward through the unsaturated zone to the water table. The contaminants then were transported by advection and dispersion through the aquifer system. Chemical processes that may have affected the distribution of chlorinated hydrocarbons include volatilization, sorption, biodegradation and breakdown by dehalogenization.

The dehalogenation process would have degradated the PCE into TCE, 1,2-DCE, and vinyl chloride. The process of volatilization is limited due to the concrete floor at the ABC Site facility building and the asphalt covered areas that overlay the soils. The biodegradation process may be enhanced, however, by the presence of sewage mixed with the PCE.

Historical pumping data of the Base TT wells indicate that pumpage of these wells created a cone of depression causing the hydraulic gradient to increase in the southeast direction. The increased gradient likely enhanced the migration of PCE away from the ABC Site. Also the TT wells probably acted as recovery wells which captured the contaminants present in the aquifer systems. When the pumping of these wells was discontinued, removal of the VOCs from the aquifer system also ceased.

The stoppage of pumping from the TT wells had a dual effect. Once the natural (non-pumping) hydraulic gradient was restored, the contaminant travel times to the TT well locations would have decreased; however, the removal of VOCs would have discontinued, and the plume could migrate beyond the TT wells to locations further downgradient of the source area. When the TT wells were stopped, the groundwater flow resumed its natural gradient which is more to the east and therefore, the plume has traveled in that direction predominantly.

It should be noted that during the investigation for Operable Unit #2, a well will be placed downgradient of TT-23 (Figure 12) to verify that contamination has not

migrated in the southerly direction after pumping ceased.

6.0 SUMMARY OF SITE RISKS

A Baseline Risk Assessment (RA) has been conducted for the ABC One-Hour Cleaners Site and the results are presented in Section 7 of the RI report. The purpose of the RA is to evaluate the potential adverse human health effects due to the presence of chemicals in the groundwater resulting from past or present activities at the ABC Site. The RA is also intended to provide information that can be used to determine the need for remedial action and, if necessary, to select remedial alternatives.

6.1 Contaminants of Concern

Based on the groundwater data available at the ABC Site and the origins of the contaminants detected in the groundwater, the contaminants of concern at the Site are: Tetrachloroethene (PCE), Trichloroethene (TCE), Total 1,2-dichloroethene (1,2-DCE) and vinyl chloride. By examining the contaminant concentrations in the Surficial and Castle Hayne aquifers, it is apparent that the larger surface area of contamination is defined by the Surficial aquifer PCE plume. PCE is also the contaminant with the highest detected concentration in the groundwater. Therefore, the Surficial aquifer PCE contaminant plume will be used to define the outer boundary of the plume of the contaminants of concern.

Tables 4 and 5 show the groundwater exposure concentrations that were used in the risk assessment for each chemical in each aquifer. Many of the chemicals listed in these tables will not be addressed further in the ROD because they do not pose unacceptable risks and/or the concentrations detected are below the remediation goals.

Although arsenic, acetone, and benzene have been identified as some of the contaminants which pose risk according to the Risk Assessment study, these chemicals will not be addressed in the ROD for the following reasons: Arsenic was found in one sample below MCLs and NCGWQS and is considered to be a background concentration, not a Site contaminant. Acetone was also found in one sample and is considered to be a laboratory artifact and is not related to the Site contaminants. Benzene was found in one sample above MCLs and NCGWQS, since this is not a Site contaminant and the well is located on Camp Lejeune Marine Corps Base, the Base has been notified and will be pursuing the source of the benzene.

Since acetone and benzene are both VOCs, if present in the groundwater, these compounds would be treated along with the other VOCs known to be present in the groundwater and originating from the Site.

Table 4

Groundwater Exposure Concentration - Surficial Aquifer

Chemical	Upper 95% Confidence Limit of the Mean (μg/L)
Organics	
Benzene	2.0[a]
Chlorobenzene	5.0
Chloroform	3.0[a]
1,1-Dichloroethene	5.31
1,2-Dichloroethene	1,200[a]
Ethylbenzene	11.5
2-Methylnapthalene	3.0[a]
Napthalene	3.0[a]
Tetrachloroethene	5,400[a]
Toluene	4.0[a,b]
1,1,2-Trichloroethane	2.0[a]
Trichloroethene	705[a]
Vinyl Chloride	110[a]
Xylenes	3.0[a]
Inorganics	
Arsenic	28.0[a]
Barium	191
Chromium	37.5
Cobalt	15.8
Lead	7.9

a Maximum detected concentration was used in place of the upper 95% confidence limit of the mean concentration.
b Elimination of quantitation limits in samples S07-01, S08-01, S09-01, and S10-01 form the averaging reduced the mean to the maximum detected concentrations.

Table 5

Groundwater Exposure Concentration - Castle Hayne Aquifer

Chemical	Upper 95% Confidence Limit of the Mean (µg/L)
Organics	
Acetone	1,400[a]
Benzene	18.0[a]
Chloroform	2.0[a]
1,2-Dichloroethene	14.0[a,b]
Tetrachloroethene	7.0[a,b]
Toluene	25.0[a]
Trichloroethene	28.0[a]
Inorganics	
Arsenic	14.0[a]
Chromium	32.0[a]

a Maximum detected concentration was used in place of the upper 95% confidence limit of the mean concentration.
b Elimination of the high quantitation limit in sample C05-01 form the averaging reduced the mean to the maximum detected concentrations.

6.2 Exposure Assessment

The objective of the exposure assessment is to estimate the degree to which potential receptors may be exposed to contaminants of concern that are present at, or are migrating from, the Site. One overall exposure condition was evaluated. This condition is future land use which evaluates potential risks that may be associated with any probable change in the Site use assuming no remedial action occurs. Current land use condition was not evaluated because at the present time the potential for exposure to groundwater has been eliminated by the removal from service of the contaminated wells (TT-wells). The affected community (Tarawa Terrace) was placed on the Holcomb Boulevard water supply.

Available hydrogeologic information shows that the Surficial aquifer is classified as Class II-B aquifer and the Castle Hayne aquifer is classified as Class II-A aquifer, resource which should be maintained at drinking water quality. As stated above, the Surficial aquifer is not currently used for drinking water. The Castle Hayne aquifer is the principal source of drinking water for the Base, as well as for Onslow County.

There are currently no surface water bodies located on the ABC Site property and no current evidence of impact on off-site surface water bodies due to past or present Site activities. Exposure to contaminated soils was not evaluated in this Baseline Risk Assessment because it will be considered Operable Unit #2.

The properties to the east and west of ABC Site are presently used for general retail and commercial business purposes. To the north of the Site are residential areas and the land located to the south serves as housing for noncommissioned officers and also contains woodlands; therefore the Site will be available for unrestricted use in the future and also the current residential areas would remain residential in the foreseeable future.

A future resident scenario was evaluated in which it was assumed that a home would be located such that a private supply well would draw water from either the Surficial or the Castle Hayne aquifer within the plume currently associated with groundwater contamination from the ABC Site.

The future resident was assumed to be on-site on a daily basis, year round for 350 days/ year of exposure to groundwater. Two age groups were evaluated, a child age 1 to 6 years old and an adult. The exposure duration for all the exposure routes was assume to be 30 years and the residential duration was divided into a six year duration for young children ages 1 to 6 and a 24 year duration for adults. The mathematical models and the assumptions that were used to calculate the intakes (i.e., doses) of the chemicals of concern for each receptor through the applicable exposure route are presented in Table 6 through Table 8.

Table 6

Model for Calculating Intakes from the Ingestion of Groundwater

$$\text{Intake from Groundwater Ingestion (mg/kg-day)} = \frac{CW \times CF \times IR \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (μg/L)
CF	=	Conversion factor (10^{-3} mg/μg)
IR	=	Ingestion rate (L/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Exposure Assumptions (future child and adult residents):

CW = Upper 95% confidence limit of the mean concentration in groundwater (Table 7-5 and 7-6).

IR = 2 liters/day, for the future adult resident (EPA, 1991a).
= 1 liter/day, for the future child resident (assuming one-half of the adult ingestion rate).

EF = 350 days/year for the future child and adult residents (EPA, 1991a).

ED = 6 years for the future child resident (EPA, 1991a).
= 24 years for the future adult resident (EPA, 1991a).

BW = 15 kg for the future child resident (EPA, 1991a).
= 70 kg for the future adult resident (EPA, 1991a).

AT = Exposure duration (years) x 365 days/year for evaluating noncancer risk.
= 70 years x 365 days/year for evaluating cancer risk.

Table 7

Model for Calculating Intakes from Inhalation Exposure to Groundwater During Showering

$$\text{Intake from Noningestion Groundwater Use (mg/kg-day)} = \frac{CW \times CF \times NIE \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (μg/L)
CF	=	Conversion factor (10^{-3} mg/μg)
NIE	=	Noningestion exposure equivalent (L/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Exposure Assumptions (future child and adult residents):

CW = Upper 95% confidence limit of the mean concentration in groundwater (Table 7-5 and 7-6).

NIE = 2 liters/day for the future adult resident (EPA, 1991c).

1 liter/day for the future child resident (estimated).

EF = 350 days/year for the future child and adult residents (EPA, 1991a).

ED = 6 years for the future child resident (EPA, 1991a).
= 24 years for the future adult resident (EPA, 1991a).

BW = 15 kg for the future child resident (EPA, 1991a).
= 70 kg for the future adult resident (EPA, 1991a).

AT = Exposure duration (years) x 365 days/year for evaluating noncancer risk.
= 70 years x 365 days/year for evaluating cancer risk.

Table 8

Model for Calculating Intakes from Dermal Exposure to Groundwater During Showering

$$\text{Intake from Dermal contact with Groundwater (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (µg/L)
SA	=	Skin surface area available for contact (cm^2)
PC	=	Chemical-specific dermal permeability constant (cm/hr)
ET	=	Exposure Time (hr/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
CF	=	Volumetric conversion factor for water (1 liter/1,000 cm^3)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged - days)

Exposure Assumptions (for the adult and child residents):

CW	=	Upper 95% confidence limit of the mean concentration in groundwater (Table 7-5 and 7-6).
SA	=	18,150 cm^2 for the adult resident (EPA, 1989a)
	=	7,195 cm^2 for the child resident (EPA, 1989a)
PC	=	See Table 7-10.
ET	=	0.25 hours/day for the future child and adult resident (EPA, 1989c)
EF	=	350 days/year for the future child and adult residents (EPA, 1991a).
ED	=	6 years for the future child resident (EPA, 1991a)
	=	24 years for the future adult resident (EPA, 1991a)
BW	=	15 kg for the future child resident (EPA, 1991a)
	=	70 kg for the future adult resident (RAGS, 1991a)
AT	=	Exposure duration (years) x 365 days/year for evaluating noncancer risk.
	=	70 years x 365 days/year for evaluating cancer risk.

The potential exposure routes that were considered for groundwater were:

Drinking water ingestion - Ingestion of tap-water and/or beverages made from tap-water from a domestic source.

Inhalation of chemicals volatilized from groundwater - Incidental inhalation of volatile organic chemicals (VOCs) during daily showering or bathing.

Dermal contact - Normal dermal contact with groundwater during daily showering or bathing.

6.3 Toxicity Assessment

In evaluating potential health risks, both carcinogenic and non-carcinogenic effects must be considered. Excessive exposure to any pollutant can potentially produce non-carcinogenic effects, while the potential for carcinogenic effects is limited to exposure to certain substances. The purpose of the toxicity assessment is to identify and select route-specific non-carcinogenic (reference dose) and carcinogenic toxicity values (cancer slope factor) for the appropriate contaminants of concern.

6.3.1 Carcinogens

Slope factors (SFs) have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen in mg/kg-day to provide an upper bound estimate of the excess lifetime cancer risk associated with the exposure at the intake level. The term "upper bound" reflects the conservative estimate of the risk calculated from the SFs. Use of these approaches makes underestimation of the actual cancer risk highly unlikely. SFs are derived from the results of human epidemiological studies of chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

The EPA weight-of-evidence classifications system for carcinogenicity is presented in Table 9.

6.3.2 Noncarcinogens

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminants of concern from environmental

Table 9

EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY

GROUP	DESCRIPTION
A	Human carcinogenic
B1 or B2	Probable human carcinogenic B1 indicates that limited data are available. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans.
C	Possible humans carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of human noncarcinogenicity for humans

media (e.g., the amount of a contaminant of concern ingested from contaminated drinking water) can be compared to the RfDs. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). The RfDs used in this evaluation and the reference used for each contaminant are listed in Table 10.

6.4 Risk Characterization

Human health risks are discussed independently for potential carcinogenic and non-carcinogenic effects for contaminants because of the different toxicological endpoints, relevant exposure duration, and methods employed in characterizing risk. Excessive exposure to all contaminants can potentially produce non-carcinogenic health effects while the potential for carcinogenic effects is limited to exposure of those contaminants categorized as carcinogens.

At the present time, potential exposure to groundwater has been eliminated, only the potential for future exposure was evaluated. Therefore carcinogenic and noncarcinogenic risks were evaluated only for future residents.

Potential risks were addressed for groundwater based on the upper 95% confidence limit (UCL) of the mean and using a Reasonable Maximum Exposure (RME) dose.

6.4.1 Carcinogenic Risks

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess life-time cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

risk = a unit less probability (e.g., 2×10^{-5}) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg-day); and

SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$

These risks are probabilities that are generally expressed in scientific notation. An excess lifetime cancer risk of 1×10^{-6} indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of Site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the Site.

The combined exposure of a child and an adult was considered to calculate the

Table 10

HEALTH CRITERIA FOR CONTAMINANTS IN THE SURFICIAL AND CASTLE HAYNE AQUIFERS

CHEMICAL	Oral Slope Factor $(mg/kg/day)^{-1}$	Oral Reference Dose (mg/kg/day)	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Inhalation Reference Dose (mg/kg/day)	Dermal Slope Factor $(mg/kg/day)^{-1}$	Dermal Reference Dose (mg/kg/day)
ORGANICS						
Acetone	NTV	1.00E−01 b	NTV	1.00E−01 j	NTV	9.00E−02 v
Benzene	2.90E−02 b	1.00E−03 k	2.90E−02 b	1.00E−03 j	3.22E−02 v	9.00E−04 v
Chlorobenzene	NTV	2.00E−02 b	NTV	2.00E−02 l	NTV	1.80E−02 v
Chloroform	6.10E−03 b	1.00E−02 b	8.05E−02 b	1.00E−02 j	6.78E−03 v	9.00E−03 v
1,1−Dichloroethylene	6.00E−01 b	9.00E−03 b	1.75E−01 b	9.00E−03 j	6.67E−01 v	8.10E−03 v
1,2−Dichloroethylene	NTV	2.00E−02 b,m	NTV	2.00E−02 j	NTV	1.80E−02 v
Ethylbenzene	NTV	1.00E−01 b	NTV	2.86E−01 b,n	NTV	9.00E−02 v
2−Methylnaphthalene	NTV	4.00E−02 a	NTV	3.70E−04 a	NTV	2.00E−02 sv
Naphthalene	NTV	4.00E−02 c	NTV	3.70E−04 f,n	NTV	2.00E−02 sv
Tetrachloroethylene	5.20E−02 g	1.00E−02 b	2.00E−03 g	1.00E−02 j	5.78E−02 v	9.00E−03 v
Toluene	NTV	2.00E−01 b	NTV	1.14E−01 c	NTV	1.80E−01 v
1,1,2−Trichloroethane	5.70E−02 b	4.00E−03 b	5.78E−05 b	4.00E−03 j	6.33E−02 v	3.60E−03 v
Trichloroethylene	1.10E−02 g	6.00E−03 b	6.00E−03 g	6.00E−03 j	1.22E−02 v	5.40E−03 v
Vinyl Chloride	1.90E+00 c	1.30E−03 k	3.00E−01 c	1.30E−03 j	2.11E+00 v	1.17E−03 v
Xylenes (Total)	NTV	2.00E+00 b	NTV	2.00E+00 j	NTV	1.80E+00 v
INORGANICS						
Arsenic	1.75E+00 e	3.00E−04 b	NA	NA	3.50E+01 i	1.50E−05 i
Barium	NTV	7.00E−02 b	NA	NA	NTV	3.50E−03 i
Chromium III	NTV	1.00E+00 b	NA	NA	NTV	5.00E−02 i
Chromium VI	NTV	5.00E−03 b	NA	NA	NTV	2.59E−04 i
Cobalt	NTV	1.60E−01 k	NA	NA	NTV	8.00E−03 i
Lead	NTV	9.40E−04 k,d	NA	NA	NTV	4.70E−05 i

a − RfD for naphthalene was used
c − IRIS 1992
d − HEAST 1992
e − E.P.A. Region IV 1992
f − Calculated from the unit risk factor

f − ECAO, 1992c
g − ECAO, 1992a
b − ECAO, 1992b
k − derived; see Subsection 7.1.3.8 for derivation
l − HEAST−,1992−Alternative method used

m − for trans−1,2−dichloroethene
n − calculated from the reference concentration (RfC)
i − inorganics
sv − semivolatiles
v − volatiles

j − Oral reference dose was used
NTV − No toxicity value currently available
NA − Not applicable by this route of exposure

carcinogenic risk for the future resident using groundwater from the Surficial aquifer and the Castle Hayne aquifer. Carcinogenic risks were calculated for each chemical through each exposure route using lifetime Reasonable Maximum Exposure doses (RME). For the Surficial aquifer, the total RME carcinogenic risk was 9.47×10^{-3} . The majority (86.4%) of the total risk in the Surficial aquifer was due to the ingestion of groundwater, with a 7.7% of the risk contributed by inhalation while showering and 5.9% contributed by dermal contact while showering. The chemicals which contributed to the total RME carcinogenic risk are listed in Table 11.

For the Castle Hayne aquifer, the total RME carcinogenic risk was 4.12×10^{-4}. As in the Surficial Aquifer, the majority of the total risk in the Castle Hayne aquifer (92.9%) was due to the ingestion of groundwater, with 3.1% of the risk contributed by inhalation while showering and 4.0% contributed by dermal contact while showering. The chemicals which contributed to the total RME carcinogenic risks in the Castle aquifer are listed in Table 12.

In summary, the route of exposure contributing the majority of carcinogenic risk was ingestion of groundwater. The carcinogenic risk for the Castle Hayne aquifer was one order of magnitude (23 fold) lower than the respective cancer risks for the Surficial aquifer.

6.4.2 Noncarcinogenic Risks

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specific time period (e.g., life-time) with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called a hazard quotient (HQ). By adding the HQs for all contaminants of concern that affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RFD

where:

CDI = Chronic Daily Intake

RfD = Reference dose; and

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term)

To evaluate the noncarcinogenic health effects for the adult resident using groundwater from the Surficial aquifer, RME hazard quotients and indices for each

Table 11

CHEMICALS OF CONCERN CONTRIBUTING TO THE TOTAL RME RISK IN THE SURFICIAL AQUIFER

Chemical	Carcinogenic Risk	Primarily Exposure Route
Tetrachloroethene	4.86E-03	Ingestion
Vinyl Chloride	3.65E-03	Ingestion
Trichloroethene	1.83E-04	Ingestion

Table 12

CHEMICALS OF CONCERN CONTRIBUTING TO THE TOTAL RME CARCINOGENIC RISK IN THE CASTLE HAYNE AQUIFER

Chemical	Carcinogenic Risk	Primarily Exposure Route
Trichloroethene	7.25E-06	Inhalation
Tetrachloroethene	6.23E-06	Ingestion

chemical were calculated. The cumulative hazard index using the RME is 49.6, and the chemicals of concern which exceed a hazard quotient of 1.0 are presented in Table 13. The results show a potential for adverse noncarcinogenic health effects to occur in a future adult resident.

For a child using groundwater from the Surficial aquifer, the cumulative hazard index is 115. This index was calculated using the upper 95% confidence limit concentrations and the RME. The chemicals of concern which exceed a hazard quotient of 1.0 using the upper 95% confidence limit are listed in Table 14. The results show a potential for adverse noncarcinogenic health effects to occur to a future child resident.

The majority of the hazard index for an adult and for a child, based on upper 95% confidence limits concentrations, is due to groundwater ingestion, followed by inhalation and dermal contact while showering.

The cumulative RME hazard index for the adult resident using groundwater from the Castle Hayne aquifer is 3.5. The majority (67%) of the hazard index is due to groundwater ingestion, 30% is due to dermal absorption while showering, and 2.7% is due to inhalation while showering.

For a child resident, the cumulative RME hazard index using groundwater from the Castle Hayne is 8.11. The majority (67.5%) of the hazard index is due to groundwater ingestion, 30.3% is due to dermal contact while showering, and 2.7% is due to inhalation while showering.

In summary, the route of exposure which contributed the majority of the noncarcinogenic risk was ingestion of groundwater. As with carcinogenic risk, the noncarcinogenic risk for the Castle Hayne aquifer was an order of magnitude lower than non-cancer risk for the Surficial aquifer.

6.5 Ecological Considerations

The U.S. Department of the Interior, Fish and Wildlife Service lists three threatened species in Onslow County. These include the American alligator, the green sea turtle, and the loggerhead sea turtle. In addition, it lists six endangered species in Onslow County. These include the red-cockade woodpecker, the rough-leaved loosestrife, Cooley's meadowrus, the Eastern cougar, the leatherback sea turtle, and the Kemp's Ridley sea turtle.

The *Initial Assessment Study of Marine Corps Base, Camp Lejeune, North Carolina,* April 1983, lists additional threatened species at the Base, which is south of the dry cleaning facility. These include the Venus Flytrap, and Yellow, Sweet, Hooded, and Flytrap Pitcher Plants. The study also lists the Brown Pelican as an endangered species.

There are no habitat areas of high quality in the immediate vicinity of the Site.

Table 13

CHEMICALS OF CONCERN EXCEEDING A HAZARD QUOTIENT (HQ) OF 1 FOR AN ADULT USING THE SURFICIAL AQUIFER

Chemical	Hazard Quotient (HQ)	Primarily Exposure Route
Tetrachloroethene	31.4	Ingestion and inhalation
Trichloroethene	6.6	Ingestion and inhalation
Vinyl Chloride	4.7	Ingestion and inhalation
1,2 Dichloroethene	3.7	Ingestion and inhalation

Table 14

CHEMICALS OF CONCERN EXCEEDING A HAZARD QUOTIENT (HQ) OF 1 FOR A CHILD USING SURFICIAL AQUIFER

Chemical	Hazard Quotient (HQ)	Primarily Exposure Route
Tetrachloroethene	74.2	Ingestion and inhalation
Trichloroethene	15.3	Ingestion and inhalation
Vinyl Chloride	10.9	Ingestion and inhalation
1,2 Dichloroethene	7.75	Ingestion and inhalation

The Site includes several commercial and residential buildings, paved roads and paved parking areas, and areas of mowed grassy fields and small stands of pine trees. This configuration inhibits the formation of habitat areas, as it is completely developed. Given the nature of the ABC One-Hour Cleaners Site, it is unlikely that the Site would attract any of the threatened or endangered species described above.

Additional information regarding known critical habitats and species of special concern were accumulated through a review of the National Heritage Program database. Results of this database review failed to identify any critical habitats within a 3-mile radius of the Site. The only species of special concern identified within 3 miles of the Site was the American alligator, which were spotted in 1987 in Scales Creek, approximately 2-miles southwest of the Site. Given that the ecological setting of ABC Site is primarily an urban/residential community, that little suitable wildlife habits have been identified in the area, and that the major contaminant pathway of concern (groundwater migration) does not appear to have impacted any wetland communities, it is doubtful that contamination from this Site would pose a potential for adverse effects to the ecological environment. Based on these observations and assumptions, an ecological risk assessment for Operable Unit #1 was not conducted. The Ecological Risk Assessment for the ABC Site will be included in the Operable Unit #2.

6.6 Risk Uncertainty

There is a generally recognized uncertainty in human risk values developed from experimental data. This is primarily due to the uncertainty of data extrapolation in the areas of (1) high to low dose exposure, (2) modeling of dose response effects observed, (3) route to route extrapolation, and (4) animal data to human experience. The Site-specific uncertainty is mainly due to the degree of accuracy of the exposure assumptions.

In the presence of such uncertainty, the EPA and the risk assessor have the obligation to make conservative assumptions such that the chance is very small for the actual health risk to be greater than that determined through the risk process. On the other hand, the process is not to yield absurdly conservative risk values that have no basis in reality. That balance was kept in mind in the development of exposure assumptions and pathways and in the interpretation of data and guidance for this baseline risk assessment.

7.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

The following remedial alternatives were selected for evaluation:

* Alternative 1: No-Action

* Alternative 2: Institutional Controls

* Alternative 3: Groundwater Recovery By Extraction Wells and Treatment By Air Stripping

* Alternative 4: Groundwater Recovery By Downgradient Interception Wells and Treatment By Air Stripping

Common Features of the Alternatives

Castle Hayne Aquifer

The vertical extent of contamination has not been thoroughly defined. Several more wells will be installed and sampled in the Castle Hayne aquifer during the investigation of the soil contamination in Operable Unit #2 to better define the contamination at this depth. The results of this investigation will be used in the design of the extraction systems described in alternative 3 and 4.

Institutional Controls

All alternatives, except No Action, include institutional controls such as deed restrictions, local ordinances or record notices applied as appropriate for long-term management and prevention of exposure to contaminants.

Treated Groundwater Discharge

Alternatives 3 and 4 generate treated groundwater which must be discharged. The discharge will be released to Northeast Creek via a National Pollutant Discharge Elimination System (NPDES) permit.

Site Monitoring

While wastes remain at the ABC Site, CERCLA requires that monitoring data collected from the Site be evaluated every five years. This evaluation would include spatial and temporal analysis of existing data to determine increasing, decreasing, or stationary trends in contaminant concentrations. The result of this evaluation would be used to reassess the need to maintain, increase or decrease the number and types of samples and analysis required for monitoring, and the need to change the remedial response at the Site.

Existing Controls

Back to 1985, Tarawa Terrace community was connected to an emergency water supply line and disconnected from the contaminated wells TT-25 and TT-26. The emergency water supply line was built from the Holcomb Boulevard water supply. This arrangement is active to date, and according to the Base authorities, the Holcomb Boulevard treatment plant meets the full water supply demand of the

community. At a minimum, the Tarawa Terrace community will remain on this water supply system until remediation of the aquifers are complete.

Groundwater Modeling

The groundwater model FLOWPATH was used to develop conceptual design scenarios for groundwater extraction. The following parameters were used as site-specific input parameters in the groundwater model for alternatives 3 and 4:

Number of extraction wells	5 (Alternative 3) 2 (Alternative 4)
Groundwater extraction rate per well	100 gpm
Aquifer type	Unconfined
Aquifer thickness	150 ft
Hydraulic conductivity of the aquifer	12.15 ft/day
Porosity of soil	0.125
Retardation factor	6.82
Time period for capture zone simulation	7 yrs (Alternative 3) 40 yrs (Alternative 4)

Some of these parameters could change after the extent of groundwater contamination in the Castle Hayne aquifer is determined, and the aquifer test results are obtained. The final number and location of extraction wells may be revised during the remedial design to include the additional information regarding the extent of contamination in both aquifers.

7.1 Alternative 1: No Action

CERCLA requires that the "No Action" alternative be considered at every site against which the other alternatives are evaluated. Under this alternative no action would be taken.

The only reduction of contaminant levels in Site groundwater would occur through natural processes. The time for groundwater contaminant levels to drop below NCGWQS and/or MCLs is on the order of several thousand years. This alternative leaves the volume of hazardous substances unchanged, and there is potential for an increase in volume of impacted environmental media - groundwater.

Because contaminated groundwater would remain in place, untreated, at the Site, CERCLA requires that data be collected and evaluated at least every five years to assure that a selected remedy continues to be protective of human health and the environment. Therefore, selected Site groundwater monitoring wells would be sampled for Volatile Organic Compounds (VOCs). Based upon the findings of the review, EPA may determine other studies and/or actions should be taken.

This alternative has no capital costs. The present worth cost of the five years review program is $140,000.

7.2 Alternative 2: Institutional Controls

As with the No Action alternative, no active remediation would be conducted under this alternative. However, institutional measures would be taken to prevent exposure to contaminated groundwater. The institutional controls include well installation/well permit restrictions, alternate water supply to affected residents, and groundwater monitoring.

Well installation/well permit restrictions involve development of restricted groundwater management zones downgradient of the ABC Site based upon groundwater monitoring data. A "no well" zone would be delineated within which groundwater does not meet drinking water standards without treatment. In the "no well" zone, well installation would be restricted by the State or by use of the well permit system. Implementation of "no well" zone may be facilitated if the plume remains confined to a few commercial properties near the Site and Camp Lejeune.

Under this alternative, groundwater would be monitored semi-annually for 5 years at the existing ten Surficial wells and five Castle Hayne aquifer wells. By that time, it is assumed the plume will have migrated beyond the furthest downgradient monitoring well. Six more downgradient wells will be installed after 5 years to track the migration pattern of the plume and the concentration of the contaminants as the plume expands. The number of wells may be increased based upon the sampling results of the existing monitoring wells and/or newly installed monitoring wells. Thereafter, the existing and new wells will be monitored semi-annually. The locations of the new wells will be based upon the results of sampling the existing monitoring wells over the first 5 year period.

The total estimated present worth cost for this alternative is $1,283,900. The capital costs associated with this alternative include the installation of five monitoring wells after 5 years. The O&M costs include long-term monitoring activities, which have been evaluated for an indefinite period of time.

7.3 Alternative 3: Groundwater Recovery By Extraction Wells and Treatment By Air Stripping

In this alternative, groundwater would be extracted using extraction wells located along the center line of the plume. The exact number and location of extraction wells as well as the necessity of a off-gas treatment system would be determined during Remedial Design (RD). The actual depth of contamination has not been defined at this time, but will be evaluated as part of the Operable Unit 2. Each extraction well would be screened throughout the anticipated saturated zone of the wells under pumping conditions. Recovered water would be treated by an

Table 15

GROUNDWATER CLEANUP LEVELS

Contaminant	Cleanup Levels (µg/l)	Point of compliance	Base
Tetrachloroethene	1.0	Entire contaminant plume	CRQL
Trichloroethene	2.8	Entire contaminant plume	NCGWQS
1-2 Dichloroethene	70.0	Entire contaminant plume	NCGWQS
Vinyl chloride	1.0	Entire contaminant plume	CRQL

NCGWQS - North Carolina Groundwater Quality Standards
CRQL - Contract Required Quantitation Limit

above ground treatment system via air stripping and if needed, the use of an off-gas treatment system. The treated water would be discharged to Northeast Creek located approximately one-half a mile from the air stripper, through a pipeline. The point of compliance would be the entire contaminated plume and the groundwater would be extracted and treated until the remedial goals (cleanup levels, Table 15) are achieved.

In the air stripping system, the groundwater is pumped from the well and sent to the top of an air stripping tower. While the water cascades down through a large tube, a high-powered fan blows the contaminants from the water. The fan then sends the contaminated air out of the top of the air stripping tower. If needed, the volatilized contaminants are treated by an off-gas system. The air stripping system is most effective in removing VOCs.

The well installation/well permit restrictions described for Alternative 2 would be included in this alternative as well. A groundwater monitoring program would be conducted to assess the changes in concentrations of the contaminants.

The present worth cost for this alternative, based on the placement of 5 extraction wells, has been estimated to be $2,262,900. This cost is estimated for an anticipated 7-years of cleanup.

7.4 Alternative 4: Groundwater Recovery By Downgradient Interception Wells and Treatment By Air Stripping

In this alternative, groundwater would be extracted from interception wells located downgradient of the plume. The purpose of installing the downgradient wells is to capture the plume at the anticipated downgradient edge considering anticipated migration of the plume between the time of data collection and the start-up of groundwater remediation system. The point of compliance for this alternative would be the entire contaminated plume and the groundwater would be extracted and treated until the remedial goals (cleanup levels, Table 15) are achieved.

As stated in Alternative 3, the depth of contamination would be further defined as part of Operable Unit 2 and the necessity of an off-gas treatment system would be determined in the Remedial Design phase. Each extraction well would be screened throughout the entire anticipated saturated thickness of the wells under pumping conditions. Recovered groundwater would be treated by an above ground treatment system via air stripping and if needed the use of an off-gas treatment system. The treated water would be discharged to Northeast Creek located approximately one half mile from the air stripper, through a pipeline. The well installation/well permit restrictions described in Alternative 2 would be included in this alternative as well. A groundwater monitoring program would be conducted to assess the changes in concentrations of the contaminants.

The present worth cost for Alternative 4 has been estimated to be $3,249,600.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

A detailed comparative analysis using the nine evaluation criteria set forth in the NCP was performed on the four remedial alternatives developed during the FS. The advantages and disadvantages were compared to identify the alternative with the best balance among these nine criteria.

8.1 Threshold Criteria

8.1.1 Overall Protection of Human Health and the Environment

Section 8.1.1 addresses whether or not a remedy provides adequate protection and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

All alternatives except for the "No Action" alternative, would be protective of human health and the environment. The "No Action" alternative is not protective because it would not prevent unacceptable risk from ingestion or inhalation of groundwater. There is uncertainty related to the Institutional Control alternative on how this alternative would continue to protect human health and the environment over a long period of time. Both alternatives 3 and 4 would be effective removing the contaminants from the groundwater and thus these alternatives would be protective to human health and the environment.

Since the "No-Action" alternative does not eliminate, reduce, or control any of the exposure pathways, it is therefore not protective of human health and the environment and will not be considered further in this analysis.

8.1.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 8.1.2 addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provide grounds for a waiver. The identified ARARs for this Site are listed in Section 9.2.

Alternatives 3 and 4 would reduce the levels of contaminants in the groundwater and comply with Federal and State ARARs.

Alternative 2 would not be in full compliance with all Federal and State ARARs.

8.2 Primary Balancing Criteria

8.2.1 Long-Term Effectiveness and Permanence

Subsection 8.2.1 refers to expected residual risk and the ability of a remedy to

maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Both alternatives 3 and 4 afford the highest degree of long-term effectiveness because all of the contaminated groundwater would be treated to levels protective of human health and the environment. The remedial action objectives for preventing further contamination would be quickly achieved through implementation of extraction wells. These wells would provide assurance that containment of the entire contaminant plume is adequate.

With Alterative 2, remedial action objectives would not be met through natural attenuation processes in the foreseeable future. Therefore, the magnitude of the potential risks remaining at the Site after many years may still exceed acceptable levels, and would only be mitigated by continued diligence in tracking plume migration and restricting water use.

8.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This subsection refers to the anticipated performance of the treatment technologies a remedy may employ.

Alternatives 3 and 4 would accomplish a reduction in toxicity, mobility, and volume. The alternatives would reduce the toxicity by volatilization of VOCs from the groundwater. Mobility would be reduced once the extraction wells were installed. These extraction wells would prevent the plume from spreading. The volume of the VOCs would be reduced as the treatment progresses. Both alternatives 3 and 4 provide for destruction of air emissions out of the air stripper, if warranted, through properly selected, designed, and operated emission controls.

Alternative 2 would not provide reduction in toxicity or mobility in the foreseeable future. Overall volume of the contaminated groundwater may increase with the downgradient migration of the plume.

8.2.3 Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy until cleanup levels are achieved.

Alternative 3 would require approximately 7 years to remediate the groundwater to ARARs.

Alternative 4 would require approximately 40 years to remediate the groundwater to ARARs. This alternative would require a long period of time for the cleanup

because the contaminants located at the up-gradient edge of the plume are required to travel the entire length of the plume to reach one of the extraction wells.

For both of these alternatives (3 and 4), adequate protection would be provided to the workers and to the community during the remedial actions. The alternatives protect the community and workers by reducing the contaminants in groundwater and air (through the use of emission controls on the air stripper if warranted).

In Alternative 2, a significant reduction of contaminant concentrations would not be expected. Without a treatment system, the plume would be allowed to migrate further and contaminate other water resources. Therefore, Alternative 2 is not considered to be an effective remedial solution. The risk to on-site workers under this alternative is minimum.

8.2.4 Implementability

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

Alternative 2 is easily implemented using existing technology.

For alternatives 3 and 4, groundwater containment/air stripping measures are extremely common and widely available. Monitoring groundwater and its restoration should not pose extraordinary problems.

Alternative 4 would only require two extraction wells that could be placed on the same property eliminating substantial logistical problems with access.

Alternative 3 would require the extraction wells (and the treatment system) to be placed off-site on multiple properties, and the installation of pipelines across railroad tracks and major roads which could cause access problems.

8.2.5 Cost

The total Present Worth Costs for the alternatives evaluated are as follows:

Alternative 1: $ 140,000

Alternative 2: $ 1,283,900

Alternative 3: $ 2,262,900

Alternative 4: $ 3,249,600

8.3 Modifying Criteria

8.3.1 State Acceptance

EPA and the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) have cooperated throughout the RI/FS process. The State has participated in the development of the RI/FS through comment on each of the various reports developed by EPA, and the Draft ROD and through frequent contact between the EPA and NCDEHNR site project managers. EPA and NCDEHNR are in agreement on the selected alternative. Please refer to the Responsiveness Summary which contains a letter of concurrence from NCDEHNR.

8.3.2 Community Acceptance

EPA solicited input from the community on the Proposed Plan for clean-up of the ABC Site. Although public comments indicated no specific opposition to the preferred alternative, some local residents express their concerns during the Proposed Plan public meeting. Please see the Responsiveness Summary which contains a transcript of the public meeting.

9.0 THE SELECTED REMEDY

Based upon consideration of the CERCLA requirements, the detailed analysis of the alternatives using the nine criteria, and public comments, both EPA and NCDEHNR have determined that Alternative 3 is the most appropriate remedy for the ABC One-Hour Cleaners Site in Jacksonville, North Carolina.

The selected remedy shall include the following: (1) the installation of extraction wells to contain and extract the contaminated groundwater with an above ground treatment system via air stripping; and (2) institutional controls placed on well construction and water use in the general area of the Site.

It is estimated that the present worth cost of the selected remedy will be approximately $2,262,900. This is based on 7 years of pump and treat of the groundwater. Itemized breakdowns of capital and Operation and Maintenance costs for Alternative 3 are presented in Table 16 and 17.

Alternative 3 will permanently reduce the risk of exposure to contaminants in groundwater and will also prevent further contamination to the environment.

9.1 Performance Standards

(1) Groundwater Recovery by Extraction Wells and Treatment by Air Stripping

Extraction wells and pumping systems will be installed to extract contaminated

Table 16

ESTIMATED CAPITAL COSTS FOR THE SELECTED REMEDY

Item	Description	Quantity	Unit Cost ($)	Total cost ($)
1	Predesign Study			
	• Installation of monitoring wells	6	variable	68,000
	• Installation of pumping well	1	15,000	15,000
	• Conduct a 72-hr pump test		lump sum	20,000
	• Groundwater sampling (21 monitoring wells, 4 supply wells, 4 Base tank farm wells, 1 field blank, 1 duplicate, 1 MS, and 1 MSD). Cost includes labor, analysis, report preparation, and other expenses.		lump sum	30,000
	• Revise groundwater model		lump sum	23,100
2	Permits/Approvals (assuming no air permits are needed)		lump sum	15,000
3	Installation of groundwater extractor wells (4 additional), and pumps, flow meters, valves, well heads, and riser pipes for all 5 wells.	5	variable	70,000
4	Piping system for transport of recovered groundwater from the extraction wells to the air stripper			
	• Pipeline including excavation, bedding, and backfill	1800 ft	16.50/ft	29,700
	• Railroad and road crossings		lump sum	85,100

Table 16 (continued)

ESTIMATED CAPITAL COSTS FOR THE SELECTED REMEDY

Item	Description	Quantity	Unit Cost ($)	Total cost ($)
5	Installation of the air stripper			
	• Air stripper, including blower and ductwork		lump sum	55,000
	• Electrical work, instrumentation/ controls		lump sum	14,000
	• Prefabricated structure for the air stripper		lump sum	10,000
6	Piping system for transport of treated water from the air stripper to Northeast Creek			
	• Discharge pump, controls, and associated electrical work		lump sum	12,100
	• Pipeline including excavation, bedding, and backfill	2500 ft	16.50/ft	49,600
	• Local road crossings		lump sum	10,000
7	Miscellaneous costs			
	• Foundations and related cast in place concrete work		lump sum	13,000
	• Electrical heat tracing and freeze protection		lump sum	8,500
	• Area lighting and power to prefabricated structure		lump sum	4,800
	• Insulation as required, allowance		lump sum	3,500
	• Painting and coatings, as required, allowance		lump sum	2,800
	• Paving and other site development costs		lump sum	10,000
	Subtotal			549,200
8	Mobilization/demobilization and construction management (22%)			120,800
9	Engineering design (20%)			109,800
10	Overhead and profit (15%)			82,400
11	Contingency (25%)			137,300
	Total			999,500

Table 17

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR THE SELECTED REMEDY

Item	Description	Annual Quantity (yrs 1-2)	Annual Quantity (yrs 3-7)	Unit Cost ($)	Total Cost/yr (yrs 1-2) ($)	Total Cost/yr ($) (yrs 3-7)
1	Labor (3% of the capital cost)			lump sum	30,000	30,000
2	Maintenance (2% of the capital cost)			lump sum	20,000	20,000
3	Air stripper effluent monitoring (weekly)	52	52	250/sample	13,000	13,000
4	Utilities			lump sum	27,200	27,200
5	Groundwater monitoring					
	• Analysis (26 wells, 1 field blank, 1 duplicate, 1 MS, and 1 MSD). First 2 years quarterly, 3-7 years semi-annually.	120	60	250/sample	30,000	15,000
	• Labor (sampling)	4	2	10,000/ sampling event	40,000	20,000
	• Labor (report preparation)	4	2	3,000/ sampling event	12,000	6,000
	• Other expenses			lump sum	10,000	5,000
	Subtotal				182,200	136,200
6	Administrative costs (15%)			lump sum	27,300	20,400
	Subtotal				209,500	156,600
7	Contingency (25%)			lump sum	52,400	39,100
	Total				261,900	197,700

groundwater from both aquifers and restore the aquifers to within the cleanup levels established by this ROD. EPA will determine the final number and location of extraction wells for the Site. The extracted groundwater will be treated using an above ground treatment system via air stripping. The total quantity of VOC in the air emissions are estimated to be 17.9 lbs/day at design conditions. The present state guidelines allow discharge of up to 40 lbs/day without treatment.

Accordingly, no emission control is required for the air stripper as per the state guidelines (15A NCAC 2D.0518). In the event the air exhaust will not meet the state guidelines of 40 lbs/day, then the air will be treated through Granular Activated Carbon (GAC), thermal treatment, or photolytic oxidation before it is released into the atmosphere.

The treated water will be pumped to a discharge location. Discharge will be directly into Northeast Creek via a National Pollutant Discharge Elimination System (NPDES) permit. If in the future, the City of Jacksonville increases their capacity then the alternative to discharge to the local publicly owned wastewater treatment works (POTW) will be evaluated.

The groundwater extraction system will continue to operate until cleanup levels for the contaminants of concern are reached throughout the contaminant plume.

The Surficial and Castle Hayne aquifers will be treated until the cleanup levels for the contaminants as listed in Table 15 are attained.

Additional monitoring wells will be installed as part of the Operable Unit #2 investigation, to better define the vertical extent of groundwater contamination. The sampling frequency, number, and location of the extraction wells, and the location of additional monitoring wells needed will be designated during the Remedial Design (RD).

The goal of this remedial action is to restore the Surficial and Castle Hayne groundwater to its beneficial use, which is, for drinking water. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, EPA and NCDEHNR believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the groundwater extraction systems, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation levels. In such a case, the system performance standards and/or remedy will be reevaluated.

The selected remedy will include groundwater extraction for an estimated period of 7 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Adjustments to the operating system may include:

a) discontinuing operation of extraction wells in areas where cleanup levels have

been attained;

b) alternating pumping at wells to eliminate stagnation points; and

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater.

To ensure that cleanup levels continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of at least every 5 years following discontinuation of groundwater extraction.

All extracted groundwater shall be treated to levels which allow for discharge to surface water: Northeast Creek. All groundwater discharge actions shall comply with Federal and State discharge requirements.

As stated previously all air emissions from the air stripper shall be in compliance with Federal and State Clean Air Act (CAA) standards. Off-gas emissions, if determined necessary during RD, will be controlled by Granular Activated Carbon (GAC), thermal treatment, or photolytic oxidation.

(2) Institutional Controls Placed on Well Construction and Water Use in the General Area of the Site

As necessary, institutional controls will be placed on well construction in the general area of the Site. No well will be located, constructed, or operated which results in the diminution of the extraction wells at the ABC One-Hour Cleaners Site or in the degradation of the Surficial or Castle Hayne aquifers. Institutional controls would also restrict the use of groundwater containing, or potentially containing, levels or contamination in excess of MCLs and NCGWQS. Institutional controls may include deed restrictions, record notice, or some other appropriate measures. The controls shall remain in effect until EPA determines through monitoring that the cleanup levels have been attained.

9.2 Site specific ARARs

Chemical-Specific ARARs:

Clean Water Act (CWA) Water Quality Criteria (CWA Part 303; 40 CFR Part 131) establishes water quality criteria based on the protection of human health and aquatic life.

Safe Drinking Water Act (SDWA) National Primary Drinking Water Standards (40 CFR Part 141) establishes health-based enforceable standards (maximum contaminant levels (MCLs)) for public water system.

SDWA National Secondary Drinking Water Standards (40 CFR Part 143) establishes aesthetic-based, non-enforceable guidelines (secondary maximum contaminant

levels (SMCLs)) for public water systems.

SDWA Maximum Contaminant Levels Goal (MCLG) (40 CFR Part 141) establishes non-enforceable drinking water quality goals (MCLGs) set at levels of no known or anticipated adverse health effects. The MCLGs are based on an adequate margin of safety without consideration of available treatment technology or cost.

NC Drinking Water and Groundwater Standards; Groundwater Classifications and Standards (NCAC Title 15 Chapter 2, Subchapters 2L.0200 and 0.0201) establishes groundwater and drinking water standards based on usage.

NC Surface Water Quality Standards (NCSWQS) Classification and Water Quality Standards (NCAC Title 15A Chapter 2, Subchapters 2L.0100 and 2L.0200) establishes a series of classifications and water quality standards for surface waters.

NCSWQS Technology-Based Effluent Limitations (NCAC Title 15A Chapter 2, Subchapter 2B.0400) establishes guidelines for effluent limitations based on the Best Available Technology (BAT) economically achievable.

NC Air Pollution Control Regulations (NCAPCR) (NCAC Title 15A Chapter 2, Subchapter 2D.0518) permit requirements for VOC emissions from air strippers.

Location-Specific ARARs:

There are no location-specific ARARs.

Action-Specific ARARS:

CWA National Pollutant Discharge Elimination System (NPDES) Requirements (CWA Part 402; 40 CFR Part 125) requires a permit for effluent discharge for any point source into surface waters of the United States.

CWA National Pretreatment Standard for Indirect Discharge to a POTW (CWA Part 307(b); 40 CFR Part 403) establishes standards to control pollutants which pass through or interfere with treatment processes in public treatment works which may contaminate sewage sludge.

CWA Technology-Based Effluent Limitations (CWA Part 301(b)) establishes guidelines to determine effluent standards based on the BAT economically achievable.

NC Water and Air Resources Act (General Statutes Chapter 143, Article 21B) achieves and maintains a total environment with superior quality (state equivalent of Federal CWA and CAA).

NC Drinking Water Act (NCDWA); Regulations on Drinking Water (General statutes Chapter 130A, Article 10) establishes criteria for protection of state public water supplies.

NC Water Pollution Control Regulations (NCWPCR) (NCAC Title 15 Chapter 2, Subchapter 2H) requires permit for discharge of effluent from point sources into surface waters. State-level version of Federal NPDES program.

NCWPCR Wastewater Treatment Requirements (NCAC Title 15 Chapter 2, Subchapter 2H.0100) establishes basic wastewater treatment requirements for effluent discharge.

NC Wells Construction Standards (NCAC Title 15A Chapter 2, Subchapter 2C) establishes classes of wells and set forth requirements and procedures for permitting, construction, operation, etc.

NC Air Pollution Control Regulations (NCAPCR) (NCAC Title 15A Chapter 143, Subchapter 2D.0518) permit requirements for VOC emissions from air strippers.

10.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select remedies that are protective to human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous waste as their principal element. The following sections discuss how this remedy meets these statutory requirements.

10.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment through groundwater extraction and treatment via air stripping and institutional controls placed on well construction and water use in the general area of the Site. Air stripping will irreversibly remove organic compounds from groundwater. Air emissions will be controlled, if needed, through properly selected, designed, and operated emission controls.

No short-term threats are associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will be in full compliance with all applicable or relevant and appropriate chemical-, action-, and location- specific requirements (ARARs). A complete discussion of these ARARs which are to be attained is outlined in Section 9.2.

10.3 Cost Effectiveness

The selected remedy, Alternative 3, was chosen because it provides the best balance among criteria used to evaluate the alternatives considered in the Detailed Analysis. The alternative was found to achieve both adequate protection of human health and the environment and to meet the statutory requirements of Section 121 of CERCLA. The selected remedy was found to be cost-effective when compared to other acceptable alternatives. The present worth cost of Alternative 3 has been estimated to be $ 2,262,900.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

EPA and NCDEHNR have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and NCDEHNR have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction of toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability and cost, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

The selected remedy treats the principal threats posed by groundwater, achieving significant contaminants reductions. This remedy also provides the most effective treatment of any of the alternatives considered.

10.5 Preference for Treatment as a Principal Element

By treating the contaminated groundwater by air stripping (and carbon adsorption if it is necessary), the selected remedy addresses the principal threats posed by the Site through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

APPENDIX B

STATE CONCURRENCE

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

December 14, 1992

Mr. Luis Flores
Remedial Project Manager
North Superfund Remedial Branch
345 Courtland Street, NE
Atlanta, Georgia 30365

RE: Comments on Draft Record of Decision (ROD)
Operable Unit #1, Groundwater
ABC One Hour Cleaners Site
Jacksonville, Onslow County, NC
NCD 024 644 494

Dear Mr. Flores:

The Draft Record of Decision (ROD) for the ABC One-Hour Cleaners Site, Operable Unit #1: Groundwater, located in Jacksonville, North Carolina has been received and reviewed by the North Carolina Superfund Section. This document has also been forwarded to the NC DEM for concurrent review. Their comments will be forwarded when available. The following comments are offered by the North Carolina Superfund Section.

1. Declaration For The Record of Decision - Near bottom of page. "Elimination" was left out of NPDES to the Northeast Creek.

2. Figures 7 and 8 should be switched. See references to these figures at the top of pages 6 and 16.

3. Page 22, 2nd paragraph. ..."degradated" is not a word.

4. Page 22, 5th paragraph. Figure 2-3 is not located in the table of contents or in the body of this report.

5. Table 5 (Health Criteria, Contaminants of Concern in Groundwater) is not legible, especially footnotes.

6. An important aspect of groundwater extraction, which has not been considered, is possible damage to structures and pavements caused by foundation settlement resulting from the lowering of the water table within the vicinity of the proposed extraction wells. Documentation and monitoring of structural and pavement integrity should be performed before initiation of groundwater extraction systems and throughout the remedial process.

7. Page 28, section 6.4.2: The term "95% upper hazard quotient" is unclear. Do you mean a hazard quotient calculated using the upper 95% confidence limit concentrations?

8. Page 34, second paragraph: It is unclear to the reader what information is presented in the last sentence.

The North Carolina Superfund Section concurs with the concepts presented in the Draft Record of Decision (ROD) and the Selected Remedy (Alternative 3), prepared by the US EPA Region IV, for the ABC One-Hour Cleaners site, Operable Unit #1: Groundwater. If applicable or relevant and appropriate requirements become evident at any time in the future, which significantly affect the conclusions or remedy selection contained in the Draft ROD, the State may modify or withdraw this concurrence with written notice to EPA Region IV. The State also reserves the right to review, comment, and make independent assessments of all future work relating to this site.

If you have any questions or comments, please do not hesitate to contact Randy McElveen or me at (919) 733-2801.

Sincerely,

Jack Butler

Jack Butler, PE
Environmental Engineering Supervisor
Superfund Section

RM/dk/abc.rm/14

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

January 14, 1993

Jack Butler
Department of Environment,
Health and Natural Resources
Superfund Section
401 Oberlin Road
Suite 150
Raleigh, North Carolina 27605

RE: North Carolina's Concurrence
Record of Decision (ROD)
Operable Unit #1: Groundwater
ABC One-Hour Cleaners Site
Jacksonville, North Carolina

Dear Mr. Butler:

EPA-Region IV appreciates the State's concurrence on the Record of Decision (ROD) for the ABC One-Hour Cleaners Site in Jacksonville North Carolina. EPA would like to respond to the comments submitted by North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) - Superfund Section in your December 14, 1992 correspondence. This response, along with your December 14, 1992 letter, will be included as an Appendix to the ROD. These letters should stand as official documentation that EPA-Region IV and NCDEHNR-Superfund Section have agreed in the preferred alternative at this point in time.

Comment number six, which made reference to the possible damage to structures and pavements caused by foundation settlement resulting from the lowering of the water table within the vicinity of the proposed extraction wells will be considered during the remedial design. The rest of the comments are reflected in the final document.

Please contact me at (404) 347-7791 if you have any questions.

Sincerely,

Luis E. Flores
Remedial Project Manager
North Superfund Remedial Branch

cc: Randy McElveen, NCDEHNR