UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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REMEDIAL INVESTIGATION REPORT FOR CHEMICAL LEAMAN TANK LINES, INC. SUPERFUND SITE LOGAN TOWNSHIP, NEW JERSEY

Draft Report Submitted by Chemical Leaman Tank Lines, Inc. to the
U.S. Environmental Protection Agency
February 1989

REVISED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY
JULY 1990

VOLUME I

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3322

PREFACE

This document represents the Remedial Investigation Report for the first operable unit of the Chemical Leaman Tank Lines, Inc. Superfund site located in Logan Township, New Jersey. This document supersedes the document entitled "Final Draft Remedial Investigation Report" prepared by Environmental Resources Management, Inc. and dated February 2, 1989.

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EXECUTIVE SUMMARY

This Remedial Investigation (RI) report evaluates the nature and extent of ground-water contamination at the Chemical Leaman Tank Lines (CLTL) Superfund site in Logan Township, Gloucester County, New Jersey. Although partial soils information is included in this report, a supplemental RI report will be written which further evaluates the extent of soil contamination at the CLTL site. In addition, an assessment of the site-related contamination that has migrated into the adjacent wetlands will be addressed in a future study.

Site Background and Summary of Previous Investigations

The CLTL Bridgeport terminal is located in Logan Township, Gloucester County, New Jersey, approximately two miles south of the Delaware River and one mile east of the town of Bridgeport. The site consists of an active terminal used for the dispatching, storage, maintenance and cleaning of tanker trucks and trailers; fallow farmland adjacent to the terminal; and wetlands bordering the terminal to the southeast. The CLTL terminal has been in operation since the early 1960s. Past wastewater handling and disposal practices at the CLTL site have resulted in organic and inorganic contamination of soil, ground water and the adjacent wetlands.

Prior to 1975, wastewater generated in the washing and rinsing operations was impounded to one of seven unlined settling and/or aeration lagoons before being discharged to the adjacent wetlands. In 1975, the lagoons were taken out of service when CLTL was required to install a wastewater containment system at the terminal. In 1977, sludge in the settling lagoons was removed prior to backfilling with clean fill and construction debris. The aeration lagoons were drained, but no lagoon materials were removed prior to backfilling. In 1982, CLTL excavated visible sludge and contaminated soil from the former settling lagoons to an approximate depth of twelve (12) feet below the surface, and the excavation was backfilled with clean sand.

In 1980-81, the New Jersey Department of Environmental Protection (NJDEP) documented volatile organic contamination in the ground water beneath the CLTL site, as well as in neighboring private wells. In 1981, CLTL conducted a hydrogeologic investigation to determine the extent of the ground-water contamination. Twenty five (25) monitoring wells were installed, and between 1981 and 1983, these wells were sampled on a quarterly basis.

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In 1985, the U.S. Environmental Protection Agency (EPA) included the CLTL site on the National Priorities List (NPL) of Superfund sites. An Administrative Order on Consent (ACO) between EPA and CLTL was signed in July 1985 pursuant to which CLTL agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS) to delineate the nature and extent of site-related contamination in the ground water, soils and surface water at the CLTL site.

In June 1989, EPA determined that the draft RI/FS documents prepared by CLTL were incomplete and inappropriate for public release and for preparing a Record of Decision (ROD) for the CLTL site. Consequently, EPA withdrew the studies from CLTL on June 15, 1989 and proceeded to revise the RI/FS and Risk Assessment (RA) documents unilaterally. This RI report has been revised by EPA in order to present a more complete description of CLTL-related contamination in the ground water, surface water and soils and support the selection of a remedy for ground water contamination.

Summary of Remedial Investigation

This RI evaluates the nature and extent of ground-water, soils and surface water contamination at the CLTL site and provides a technical basis for partial Remedial Action at the CLTL site.

The hydrogeologic field investigation conducted as part of the RI included the installation of 21 ground-water monitoring wells, four water level studies (three by CLTL and one by EPA), and an aquifer pump test.

The RI ground-water sampling effort involved the collection and analysis of samples from on-site and off-site monitoring wells and residential wells in the vicinity of the CLTL site. The ground-water sampling characterize the nature of ground-water contamination in the vicinity of the CLTL site.

Review of the regional geologic literature indicates that four geologic units underlie the CLTL site. From deepest to shallowest, these include the Wissahickon Formation (schist bedrock) located at a subsurface elevation of approximately -250 feet (MSL); the lower zone of sediments of the undifferentiated Potomac Group-Raritan Formation at approximately -200 to -250 feet (MSL); a regionally continuous clay or series of regionally continuous clay units between approximately -150 and -200 feet (MSL); the upper zone of the undifferentiated Potomac Group-Raritan Formation and where locally present, the overlying Cape May Formation. The majority of geologic information obtained during the RI field investigation pertains to the uppermost of these geologic units which occurs beneath the CLTL site in the interval from up to +20 feet (MSL) to subsurface elevations of approximately -150 feet (MSL). Additional limited geologic information obtained by EPA pertains to the interval from -150 feet (MSL) to -250 feet (MSL).

Results of the hydrogeologic investigation indicate that the upper 150 feet of sediments can be separated into three water-bearing subzones (shallow, intermediate and deep) within the upper zone of the undifferentiated Potomac Group-Raritan Formation. Drillers logs obtained by EPA indicate the presence of a regionally consistent water-bearing sand unit from approximately -200 feet (MSL) to approximately -250 feet (MSL) which is part of the lower zone of the undifferentiated Potomac Group-Raritan Formation.

Analyses of vertical hydraulic gradients at the CLTL site indicates a downward component of ground-water flow which may enhance the likelihood of vertical migration of contaminants. Horizontal hydraulic gradients in the various water-bearing zones are relatively low, ranging from 0.0003 - 0.002 feet/foot.

Results of the ground-water sampling events indicate that site-related Priority Pollutant contaminants are concentrated in the shallow and intermediate subzones. The highest concentration of contaminants in these subzones have been detected in the vicinity of the former wastewater lagoons. No deep subzone monitoring wells exist in the vicinity of the former wastewater lagoons. Deep subzone wells in other areas of the site have detected elevated levels of site-related contaminants.

Ground-water contaminants include volatile and semivolatile organic compounds, as well as metals. The former wastewater lagoons are the primary sources of site-related ground-water contamination in the vicinity of the CLTL site.

Solvents, including trichloroethene, trans-1,2-dichloroethene, and other volatile organic compounds (VOCs) are the contaminants present at highest concentrations in ground water. The VOC concentration in the shallow subzone ranges from non-detect levels to greater than 22,000 parts per billion (ppb) beneath the former settling lagoons. The VOC concentration in the intermediate subzone exceeds 75,000 ppb beneath the former settling lagoons. The extent of the VOC plume in the area generally south of the former aeration lagoons and in the area generally east and north of the former settling lagoons was difficult to determine because of the extremely shallow hydraulic gradients.

VOCs detected in the deep subzone include trans-1,2-dichloroethene (20,000 ppb) and toluene (40,000 ppb). Additional deep subzone wells will be needed to more adequately define the contaminant plume in the deep subzone.

The soil sampling conducted during the RI included the collection of soil samples at various depths from a total of 49 locations at the CLTL site. The soil samples were collected to assess the extent of soil contamination in the vicinity of the lagoons, the lagoon overflow area and the terminal truck parking lot/driveway area.

Results of the soil sampling indicate that soil with concentrations of Priority Pollutant inorganic and organic constituents above background levels occur in the vicinity of the lagoons, in the overflow area east of the former settling lagoons and at several locations in the gravel truck parking lot/driveway area.

Priority Pollutant contaminants present at elevated concentrations at the site include volatile organics, base neutral extractable (semivolatile) compounds and inorganic compounds. The concentrations of semivolatiles in soil range from non-detect levels in background areas to greater than 1,900 parts per million (ppm) in the vicinity of the former settling and aeration lagoons. Elevated concentrations of VOCs (up to 396 ppm) (mainly solvents) and metals (mainly arsenic, lead and cadmium) occur in many of the same locations as elevated concentrations of semivolatiles.

The extent of soils/sludge contamination has not been completely delineated therefore a supplemental RI report is being prepared by EPA to further evaluate the soil contamination in the active terminal/parking lot area and within the former aeration and settling lagoons.

The sources of soil contamination at the CLTL site include contaminated soils in close proximity to and below the excavated former primary settling lagoons, shallow sludges and contaminated soils in the areas of the former aeration lagoons, the former final settling lagoons and improper housekeeping practices in the gravel truck parking lot/driveway area. Seeps in the rinse water holding tank, overflows from the former settling tank and leaks from the settling tank sump pump have also contributed to soil contamination.

SECTION 1

INTRODUCTION

1.1 Site Description

Figure 1-1 shows the location of the Chemical Leaman Tank Lines, Inc. (CLTL), Bridgeport terminal in Logan Township, Gloucester County, New Jersey. The CLTL terminal lies approximately two miles south of the Delaware River and one mile east of Bridgeport, New Jersey. The Pennsylvania Reading Seashore Lines Railroad borders the facility to the north and separates it from several private homes. Route 44 and Cedar Swamp Road parallel the railroad on its north and south sides, respectively. A reach of the Great Cedar Swamp and Moss Branch flank the terminal to the south and east, and Oak Grove Road runs along the western boundary of the terminal. Cooper Lake, a small, privately owned lake, lies just north of the CLTL terminal between Route 44 and Route 130. The Bridgeport Rental and Oil Service (BROS) site, an EPA Superfund site, is located approximately one-half mile east of the CLTL terminal.

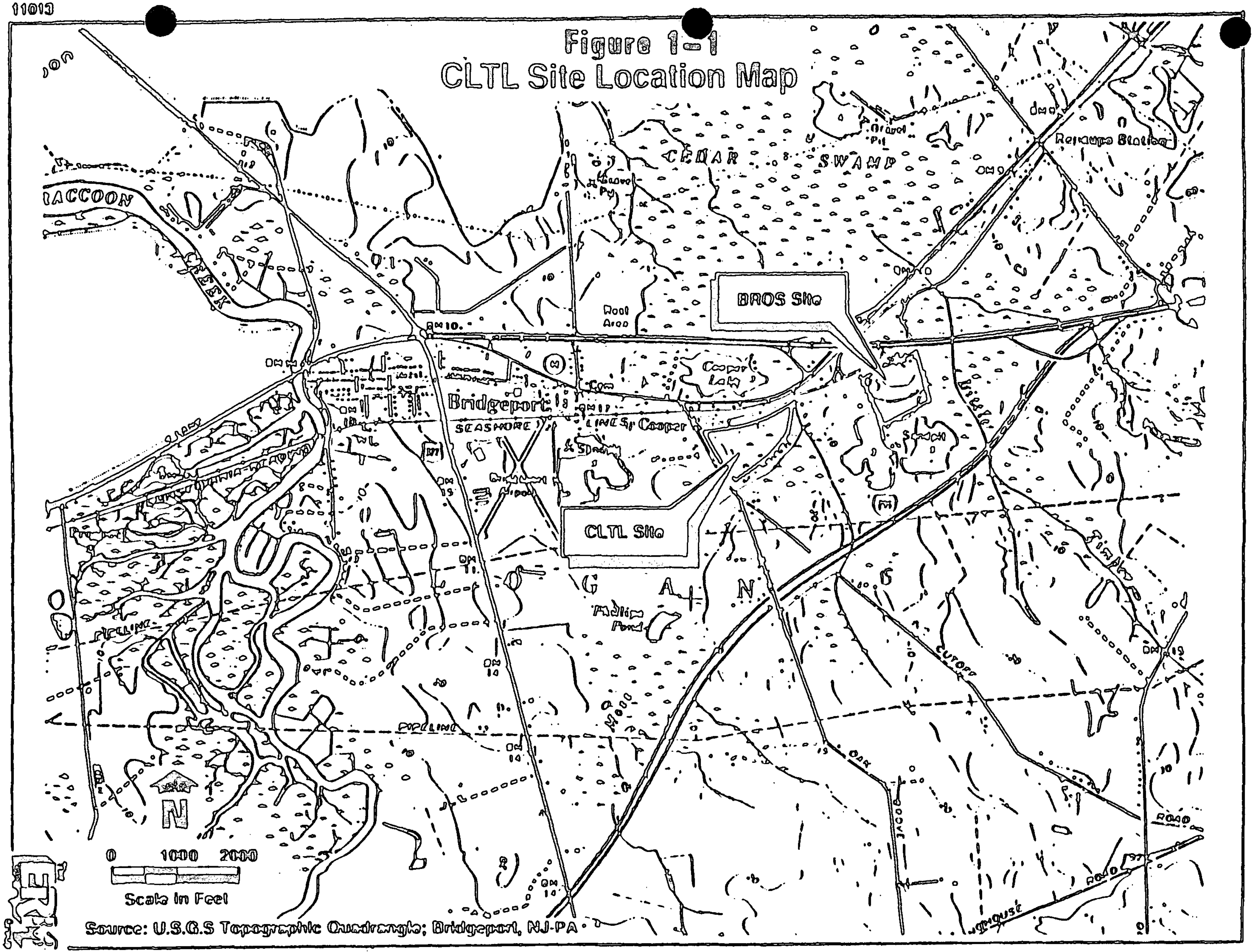
The CLTL site encompasses 31.4 acres including the CLTL terminal and the surrounding farmland and wetlands. The CLTL terminal occupies a 14.1-acre cleared area south and east of the intersection of Cedar Swamp Road and Oak Grove Road. Figure 1-2 shows the various buildings, parking areas, truck cleaning facilities, and wastewater containment system of the CLTL terminal.

A chain-link fence along Oak Grove and Cedar Swamp Road restricts access to the CLTL terminal; Cedar Swamp serves as a natural barrier to access from south and east of the terminal. Employees of the CLTL terminal park their vehicles in the employee parking area on the north side of Cedar Swamp Road between the road and the railroad tracks.

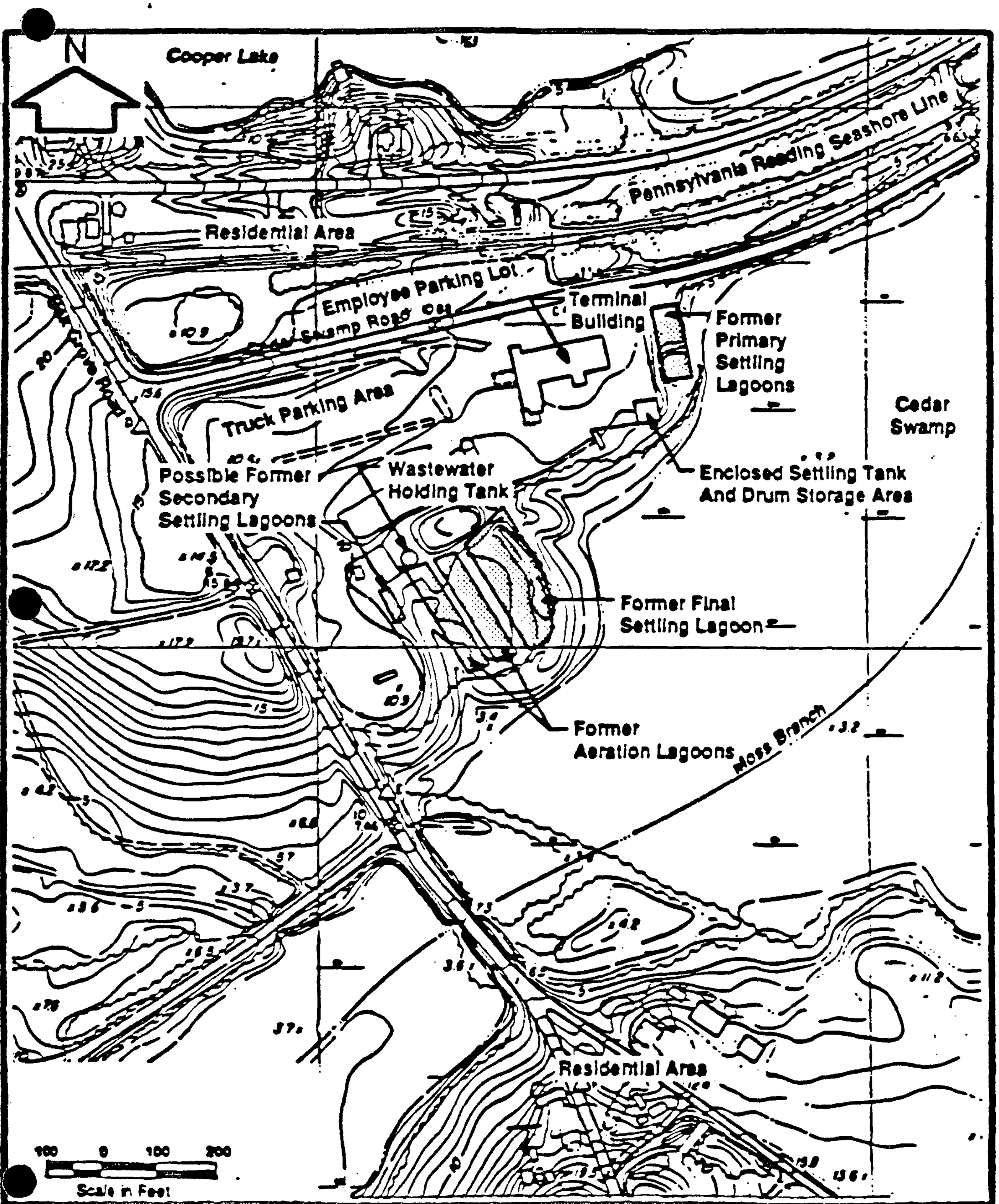
A truck parking lot/driveway area covers approximately two-thirds of the CLTL terminal between Oak Grove Road and Cedar Swamp Road. An on-site fuel station is located at the eastern edge of the truck parking lot/driveway area. The fuel station contains three diesel pumps and one gasoline pump not currently in use. Beneath the fuel station lie three underground storage tanks filled with diesel fuel and one former gasoline storage tank, now filled with water.

The terminal building, containing all administrative offices and the tractor service bays, lies near the center of the facility. A truck-washing area is located on the eastern end of this building and houses two open and three covered cleaning bays.

Figure 1-1
CLTL Site Location Map



Source: U.S.G.S Topographic Quadrangle; Bridgeport, NJ-PA



EPA Figure 1-2

Environmental Protection Agency

CDM

Camp Dresser & McKee

Chemical Leaman Tank Lines Site Map

The enclosed settling tank and drum storage area contains a 3,000-gallon, stainless steel settling tank and a sump pump located below grade. This building, which has a concrete floor, also houses drums containing residuals from trailers. The drums remain in the building until they can be disposed of off site. Drums are stockpiled outside the building for use in storing residual liquids from tankers prior to cleaning.

In the western portion of the CLTL terminal, a 50,000-gallon, concrete wastewater holding tank equipped with a mixing device is located next to a curbed and drained concrete wastewater loading pad. The wastewater holding tank is located next to a four-foot deep, unlined, excavated area with raised earthen walls.

Currently, wastewater from the trailer cleaning operation runs into the wastewater drain system located beneath the cleaning bays. [Note: During site visits, EPA staff has observed wastewater from the trailer cleaning operations flowing downgradient into the wetlands via shallow ditches.] Once in the wastewater drain system, the water flows by gravity through an underground pipe to the settling tank in the enclosed settling tank and drum storage area. A sump pump then pumps the wastewater through an underground pipe to the wastewater holding tank. The distance between the enclosed settling tank and the wastewater holding tank is approximately 500 feet (Figure 1-2). Wastewater contained in the holding tank is loaded into empty tank trailers parked on the concrete pad, which transport the wastewater to the E.I. DuPont Chambers Works facility in Deepwater, New Jersey or the Chem Clear facility in Chester, Pennsylvania, for off-site treatment and disposal. Presently, CLTL transports approximately 15,000 gallons of wastewater per day.

1.2 History of Site Operations

CLTL is a common carrier, transporting chemical commodities in bulk quantities, some of which are classified as hazardous. Table 1-1 lists some of the hazardous materials transported by CLTL. Records of all materials transported by CLTL throughout existence of the Bridgeport facility no longer exist. The terminal began operations in 1961. The facility operates 24 hours a day, Monday through Friday, with one shift on Saturday.

Wastewater is generated from the washing and rinsing of the tank trailers used to transport liquid and dry commodities. Upon arriving at the CLTL terminal, CLTL personnel inspect the trailers for undelivered product remaining in the tanker. If more than three to five gallons remain in the trailer, CLTL

TABLE 1-1

LIST OF HAZARDOUS MATERIALS TRANSPORTED BY CLTL

Allyl alcohol
2-sec-Butyl-4,6,-dinitrophenol
p-Chloroaniline
Ethylenediamine
Acrylic Acid
Aniline
Benzene
n-Butyl alcohol
Chlorobenzene
Chloroethene
Chloroform
Chloromethane
2-Chlorophenol
Creosote
Cresols
Cresylic acid
Cumene
Cyclohexane
Di-n-Butyl phthalate
1,2-Dichlorobenzene
1,1-Dichloroethene
Diethyl phthalate
Dimethylamine
Dimethylcarbamoyl chloride
1,1-Dimethyl hydrazine
Dimethyl phthalate
Tetrachloromethane
Toluenediamine
Toxaphene
1,1,2-Trichloroethane
Urethane
2,3-Dinitrophenol
2,4-Dinitrotoluene
Di-n-Octyl phthalate
Dipropylamine
Ethyl acetate
Ethyl acrylate
Ethyl ether
Ethyl methacrylate
Formaldehyde
Formic acid
Furfural
Hydrazine
Isobutyl alcohol
Maleic anhydride
Maleic hydrazine
Methanol
Methyl ethyl ketone (MEK)
Methyl isobutyl ketone
Naphthalene
Nitrobenzene
Paraldehyde
Phenol
Phthalic anhydride
N-Propylamine
Pyridine
1,1,1,2-Tetrachloroethane
Toluene
Toluene diisocyanate
Tribromomethane
Trichloroethene
Xylene

attempts to redeliver the material to the customer; quantities less than three to five gallons are drained into appropriate 55-gallon drums, which are then stored in the enclosed settling tank and drum storage area. Next, the trailer tank is washed in a recirculatory system with a solution consisting of sodium hydroxide, sequestration agents, and defoaming agents. The tanker is then rinsed with water, and the wastewater is discharged to the wastewater containment system, as described in Section 1.1.

The most commonly hauled materials during the 1960's were latex material, acids, alcohols, and light solvents; less frequently hauled were phenols and aniline (NJDOH, 1/20/69). Waste water generated in the late 1960's was estimated to average 10,000 gallons per day and contained high concentrations of BOD, COD, suspended solids, grease, detergent, phenols and other chemicals, and coliform organisms (NJDOH, 6/4/69; NUS, 12/31/84).

The wastewater from the cleaning operation was discharged into three primary settling lagoons. The wastewater was then directed to a settling tank after which it was pumped to the two spray aeration lagoons. Overflow from the aeration lagoons was directed into the final settling lagoon. Wastewater was discharged from the final settling lagoon into the adjacent wetlands via a T-pipe, probably located in the northeast corner of the final settling lagoon, as the final step in this treatment process. The discharge of this wastewater into the wetlands resulted in the death of surrounding vegetation; a 75 foot wide lane of dead trees marked the flow of effluent discharge (NJDEP 5/29/72; NUS, 12/31/84). Wastewater was discharged to the adjacent wetlands until July 1975 (NUS, 12/31/84).

Prior to August 1975, the wastewater treatment system consisted of the following on-site facilities: three unlined, approximately 1,800-square-foot, 5-foot-deep settling lagoons in series; two unlined, approximately 8,100-square-foot, 5-foot-deep spray aeration lagoons in parallel; a smaller, unlined, approximately 1,100-square-foot lagoon (possible secondary settling lagoon) of unknown depth; and a final unlined, approximately 19,100-square-foot final settling lagoon less than 5' deep. The areal extent of the former lagoons is based upon study of historical aerial photographs. Figure 1-2 shows the approximate locations and areal extent of these facilities.

In 1977, the settling lagoons east of the wash area were drained. Sludge which had accumulated in the bottom of the settling lagoons was vacuumed prior to backfilling with brickbat, sand and concrete. Also in 1977, after aerating and evaporating all possible liquid, openings were cut into aeration lagoon dikes, allowing runoff of liquids into the swamp; the remaining liquid contents were pumped into a tanker truck and transported to a landfill. The lagoons were then backfilled with perimeter diking materials and construction debris.

In the summer of 1982, CLTL excavated sludge and contaminated soil in the area of the former settling lagoons and settling tank. Excavation proceeded until the soil appeared free of dark discoloration (as documented in October 1, 1982 and November 12, 1982 correspondences between ERM and NJDEP.) No soil samples were taken from the bottom of the excavated area. Soil was excavated to an approximate depth of 12 feet using a backhoe. The excavated soil was placed on an adjacent concrete pad. After allowing the contaminated soil to dewater on the concrete pad, Browning-Ferris Industries, Inc. (BFI) transported approximately 145 truck loads of the soil to BFI's disposal facility in Baltimore, Maryland. The excavated areas were backfilled with sand and gravel from the nearby Bridgeport Materials, Inc. sand and gravel company.

After backfilling the former settling lagoons with sand and gravel, CLTL constructed a small pond above the former settling lagoons. Between 1982 and 1985, CLTL negotiated with NJDEP for a permit to operate an air stripping pond. Ultimately, NJDEP did not grant this permit to CLTL. The pond above the former settling lagoons remains at the surface today, although it is very shallow (<2 feet) and largely obscured from view by dense vegetation.

In July 1982, CLTL raised the walls of the settling tank and repaired the sump beneath the tank, as a leak had developed near the top of the sump causing the discharge of wastewater to the soil around the sump. In addition, CLTL installed a concrete pad around the tank and sump and enclosed the tank and sump in a building.

During a site visit in the spring of 1988, EPA discovered two leaks in the concrete wastewater holding tank. NJDEP ordered CLTL to shut down the holding tank temporarily in order to repair the leaks. CLTL coated the inside of the tank with 4 inches of gunite during the spring and summer of 1988. A new wastewater holding tank was installed by CLTL during the fall of 1988.

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1.3 Summary of Previous Investigations

1.3.1 Initial Investigations

CLTL was cited by the New Jersey Department of Health's Air Pollution Control Program for aerial odors in 1969. The New Jersey Department of Health (NJDOH) issued orders to CLTL to develop a plan for the treatment or disposal of their wastes (NUS, 12/31/84; NJDOH, 2/26/69).

In early 1970, NJDEP sampled wastewater discharge from the CLTL aeration lagoons. As a result, CLTL modified their wastewater containment system in an attempt to correct the problem. Additional sampling in 1972 showed no change in water quality.

In August 1975, CLTL put the current wastewater containment system into operation and ceased discharging wastewater into the adjacent wetlands. However, liquids and sludges remained in the wastewater lagoons which continued to create an air pollution problem for nearby residents.

NJDEP notified CLTL in March 1977 that the odor problems related to the former disposal lagoons still remained and that action would be required to bring all waste disposal facilities into compliance with NJDEP requirements (NJDEP 3/14/77).

In August 1975, CLTL put the current wastewater containment system into operation. In 1980, NJDEP recommended that CLTL undertake a hydrogeologic investigation to determine the extent and degree of ground-water contamination resulting from its past operations.

1.3.2 Preliminary Hydrogeologic Investigation

In early 1981, CLTL contracted ERM to conduct a hydrogeologic investigation at the CLTL site to determine the extent of ground-water contamination resulting from previous activity at the CLTL terminal. The investigation included the following tasks:

- Excavation of 22 backhoe test pits in the vicinity of the former lagoons, the former aeration lagoons and the enclosed settling tank and drum storage area. These test pits (TP-1 through TP-22) ranged in depth from 3 to 12 feet below the ground surface, and were excavated to determine visually the extent of soil contamination resulting from previous activity.

- Installation of "shallow" test pit wells in 18 of the 22 test pits; wells were not installed in test pits TP-5, TP-7, TP-11 and TP-21. Plate 1 shows the location of the 18 test pit wells and the 4 additional test pits without wells. Test pit wells (designated TP-1, TP-2, etc.) consisted of five-foot lengths of two-inch (I.D.) PVC screens connected to galvanized steel riser pipe. The screen and riser pipe were placed in the pits, and the excavated soil was backfilled around the wells. Figure 1-3 presents a monitoring well construction schematic of the "shallow" test pit wells. Finished to depths ranging from 5.6 to 13.1 feet below the ground surface, the test pit wells were installed to monitor shallow ground-water levels and ground-water quality. This method of well installation was not in accordance with EPA and NJDEP well construction and ground-water sampling procedures, and therefore, data pertaining to these wells are to be considered as semi-qualitative indicators of groundwater quality.

- Installation of "intermediate depth" wells in four locations at the CLTL site including the northwest corner of the truck parking area, the northern edge of the employee parking lot, the former primary settling lagoons, the former aeration lagoons, and the final settling lagoons. These wells, designated CL-1, CL-2, CL-3, and CL-4 were finished to depths ranging from 30 to 46 feet below the ground surface using hollow-stem auger methods. The screened intervals for these "intermediate depth" wells range in elevation from -0.73 to -37.16 feet (MSL). Figure 1-4 presents a monitoring well construction schematic of the "intermediate depth" wells.

- Installation of wells including one "moderately deep" well (CL-5), one "deep" well (DW-1) located near the former primary settling lagoons, and one "deep" well (DW-2) located north of the employee parking area. These monitoring wells were installed using mud rotary drilling methods and were finished to depths of 68, 97 and 102 feet, respectively. CL-5 was screened in two subsurface intervals (-23.45 to -25.45 feet and -59.45 to -61.45 feet MSL), while DW-1 (-89.40 to -91.40 feet MSL) and DW-2 (-89.37 to -91.37 feet MSL) were each screened in one subsurface interval. Figure 1-5 presents a monitoring well construction schematic of the "moderately deep" well and Figure 1-6 shows a schematic of the two "deep" wells. Wells were cased in such a manner as to prevent cross contamination between subzones.

- Collection of an initial set of ground-water samples from monitoring wells; including all TP wells, CL-1 through CL-4, the CLTL production well, and the Penns Grove water supply well; and collection of 3 surface-water samples from

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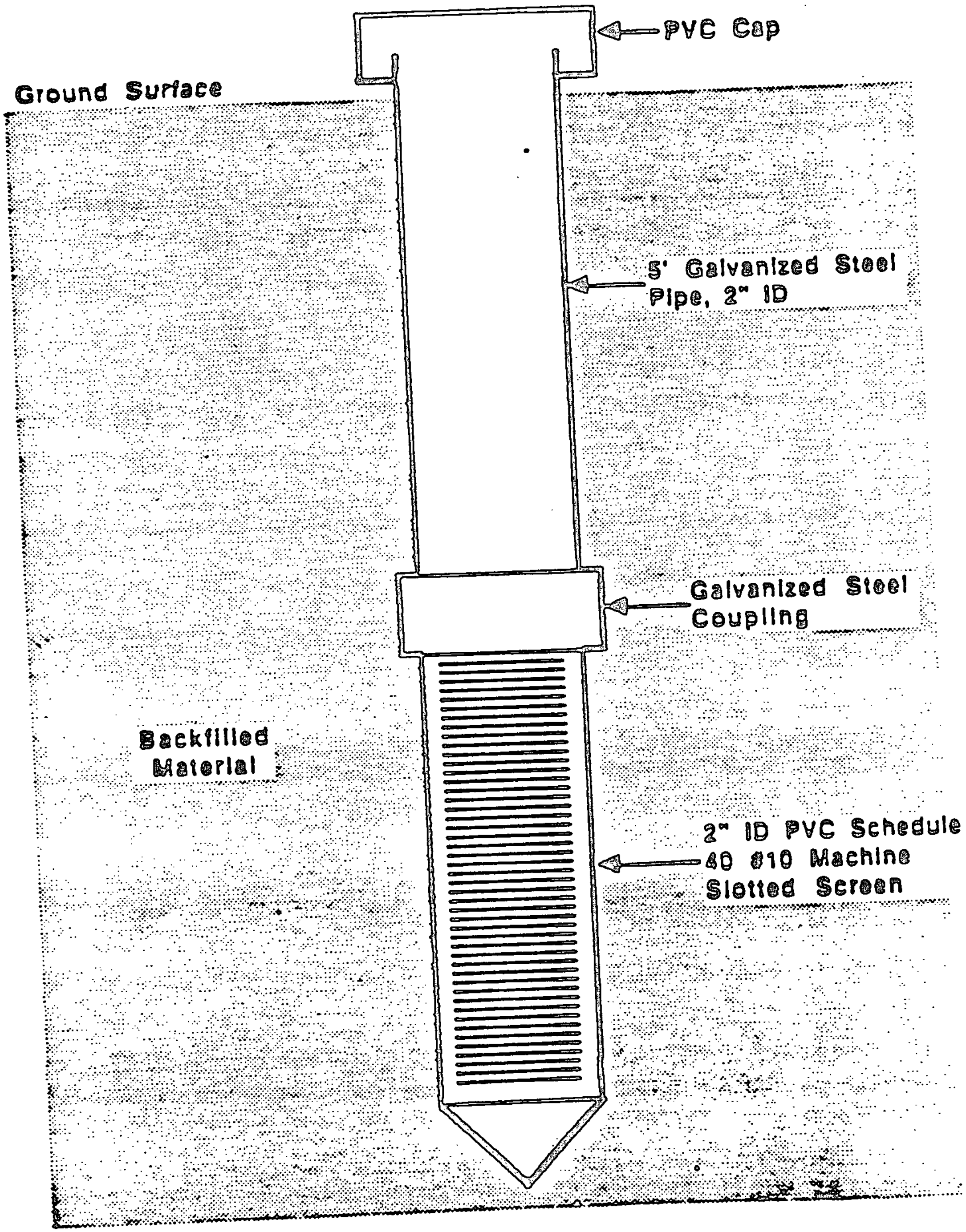
Figure 1-3
Monitoring Well Construction Schematic "Shallow" Test Pit Wells, ERM (1981)

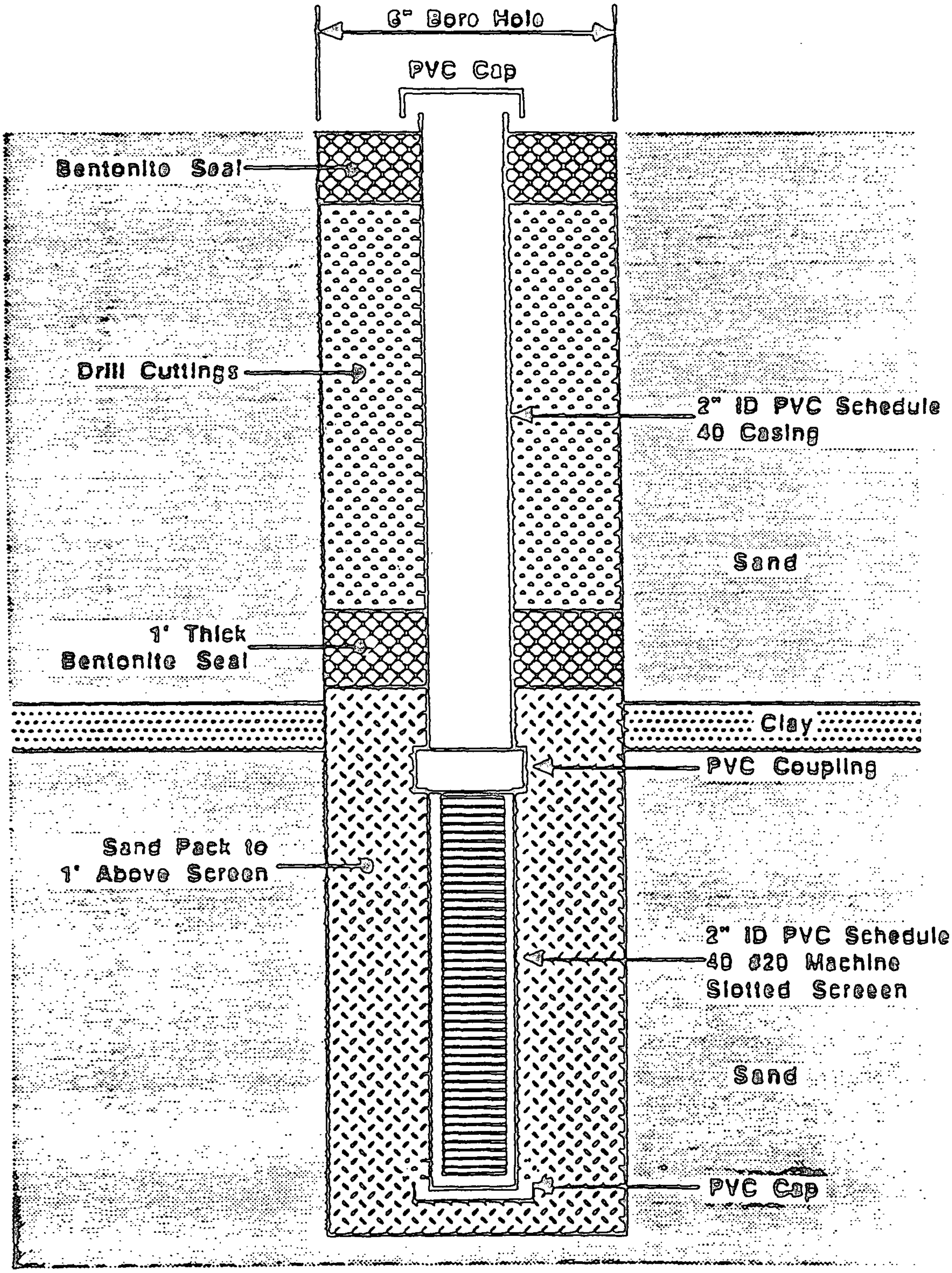


Applies to all TP-series Wells installed by ERM in 1981.

Not drawn to scale.

The ERM Group

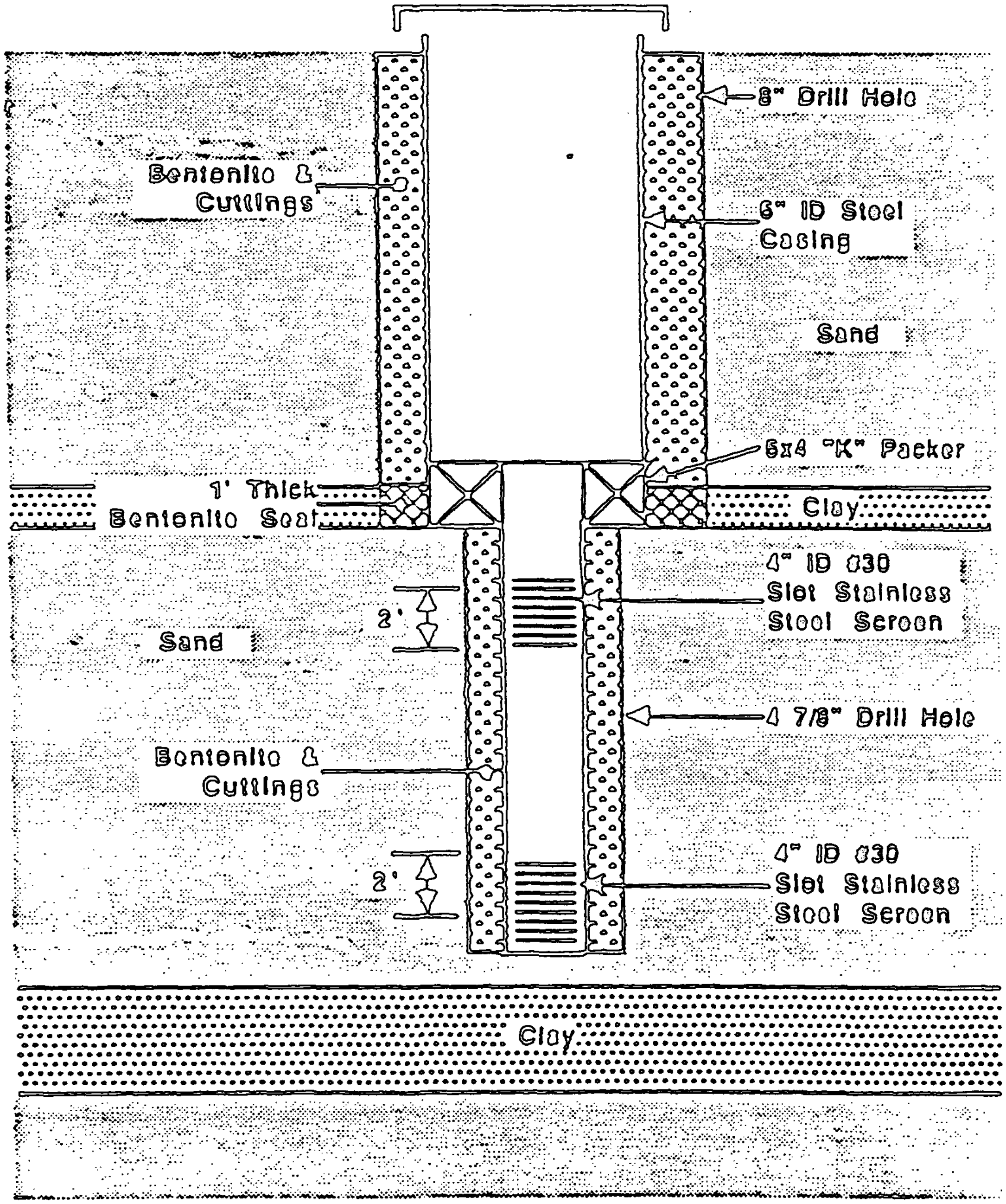
Figure 1-4
Monitoring Well Construction Schematic
"Intermediate Depth" Wells, ERM (1981)



Applies to "Intermediate Depth"
Wells CL-1, CL-2, CL-3, CL-4
installed by ERM in 1981.

Not drawn to scale.

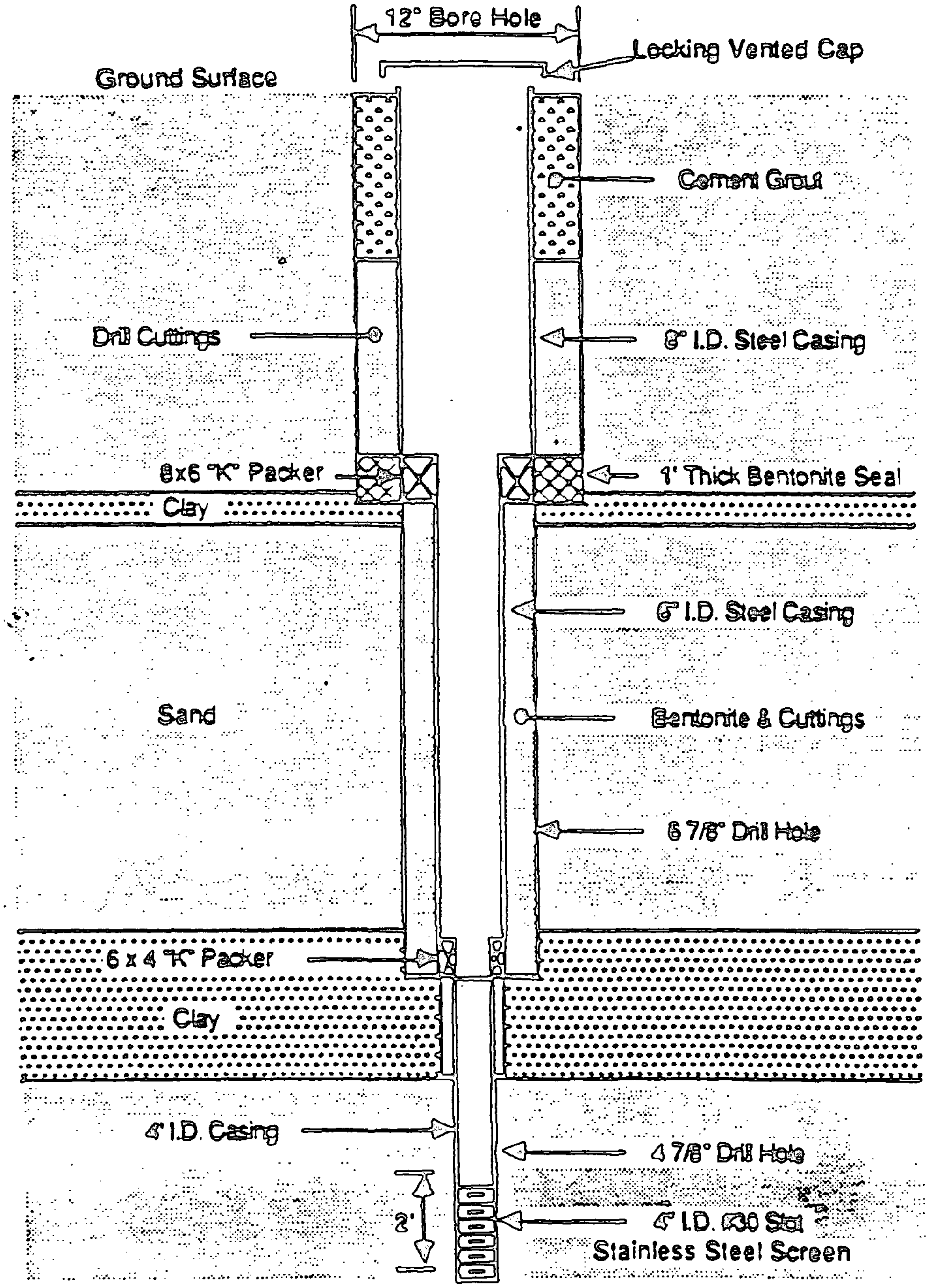
Figure 1-5
Monitoring Well Construction Schematic "Moderately Deep" Well, ERM (1981)



Applies to "Moderate Deep" Well CL-5 installed by ERM in 1981.

Not drawn to scale.

Figure 1-6
Monitoring Well Construction Schematic "Deep" Wells, ERM (1981)



°Applies to "Deep" wells DW-1 and DW-2 installed by ERM in 1981

Not drawn to scale.

Moss Branch. These samples were analyzed by Betz, Converse and Murdock, Inc. (BCM), Laboratories of Norristown, Pennsylvania, for the following parameters:

pH
TDS
Specific Conductance
Phenol
Oil and Grease
Total Alkalinity
Hexavalent Chromium
Calcium
Magnesium
Sodium
Potassium
Chloride
Sulfate
Volatile Organics Scan by GC/MS

- Collection of a second set of ground-water samples from seven monitoring wells including DW-1, DW-2, CL-2, CL-3, CL-5, TP-4 and the CLTL production well. Table 1-2 presents the results of the organics scans from the initial and second round of sampling.

- Measurement of water levels in all wells to evaluate the hydrogeologic characteristics of the aquifer and ground-water flow patterns ERM (1981). Appendix A contains geologic logs of wells installed by CLTL during 1981. Table 1-3 lists the screened intervals and the total depths of the wells installed during 1981.

The CLTL production well was installed at the terminal in the early 1960s as a water supply well for the terminal. Although a driller's log for the CLTL production well does not exist, ERM (1981) indicated that the well has 12 feet of 6-inch steel screen set at -77 to -89 feet (MSL) with 6-inch steel casing set from -77 feet (MSL) to the ground surface. In the 1970s, CLTL perforated the 6-inch screen in the production well and installed 4-inch steel screen and casing within the 6-inch screen and casing. This modification of the well construction was performed in an effort to improve the efficiency of the production well which had become a problem due to iron buildup (ERM, 1981). Since modifying the well construction of the CLTL production well, iron buildup has necessitated periodic redevelopment. CLTL personnel redevelop the well by removing the pump and riser pipe from the well and introducing a sulfuric acid solution into the well. The acid solution remains in the well overnight and is pumped out the next day. CLTL performs this redevelopment approximately every 1 to 2 years.

During September 1981, CLTL installed a new "intermediate depth" well east of the former primary settling lagoons. The new well, designated CL-6, was finished to a depth of 44 feet, and screened through the subsurface interval of -22.16 to -37.16 feet (MSL)

Table 1-2

Priority Pollutant Organic Compounds Detected in Monitoring Wells at the CLTL Site Sampled by ERM in 1981

COMPOUND	BW-1	BW-2	CL-1	CL-2	CL-2	CL-3	CL-3	CL-4	CL-5L	CL-5U	TP-1	TP-2	TP-3	TP-4	TP-4	TP-5	TP-6	TP-8
	Jun-81	Jun-81	Mar-81	Mar-81	Jun 81	Mar-81	Jun 81	Mar-81	Jun-81	Jun 81	Mar-81	Mar-81	Mar 81	Mar 81	Jun 81	Mar-81	Mar-81	Mar-81
VOLATILES																		
METHYLENE CHLORIDE	60 2	2		1 3	60 4	850	950	16		2 8	5	414	5700	23400	850000	28		
TRANS-1,2 DICHLOROETHYLENE	2000	1000		470	4500	3600		700	15	702	117	103	7500	1335	850000	6300	1	
CHLOROFORM	44 1						450					770			15000			
TRICHLOROETHENE	920	22.2		556	245	3700	543	800	2 3	46	112	330	22070	10900	1400000	28	1	
BENZENE	70 5			1 5	6 5	136	6 5	171	0 0		13 5		1040		1800000	430		
TOLUENE	82			3	23	64	77	23			0 1	302	730	1050	8100000	130		
VINYL CHLORIDE																		
1,2-DICHLOROETHANE	92 9	30 0		8	372		510	40		7 0	104	7400	10770	4070	840000	700		
TETRACHLOROETHENE	65	2 2		164	64	33	31 3	1 5		2	76	225			730000			
CHLOROBENZENE	16.2				12 4	84	70	11			17 5	730	2150	1010	7000000	150		
ETHYLBENZENE						14		10			3 0			1130	2400000	53		
1,1-DICHLOROETHENE	106	8		0 8	30 7	12	207	3				56				30		
1,2-DICHLOROPROPANE	8.4							2.4			1 1	8850		413	18000	11		
TRICHLOROFLUOROMETHANE					10 3										820000			
1,1,2-TRICHLOROETHANE																		
DICHLOROFLUOROMETHANE	84.0	0.5			54 4		102			30 6								
1,1-DICHLOROETHANE					1 0	310												
BROMOMETHANE	74.8	8.0			1220		2500											
XYLENE												130						
TETRAHYDROFURAN												101					80	
1,1,1-TRICHLOROETHANE	10																	
TRANS-1,3-DICHLOROPROPYLENE										40 4								
DICHLOROBROMOMETHANE																		
CHLOROETHANE																		
SEMIVOLATILES																		
1,2-DICHLOROBENZENE								100			10.0	107	700	6000				
1,3-DICHLOROBENZENE																		
1,4-DICHLOROBENZENE																		
NAPHTHALENE																		
DI-N-BUTYL PHTHALATE																		
DIETHYL PHTHALATE																		
N-NITROSODIPHENYLAMINE																		
1,2,4-TRICHLOROBENZENE																		
2-CHLORONAPHTHALENE																		
BUTYL BENZYL PHTHALATE																		
BIS(2-ETHYLHEXYL)PHTHALATE																		
ISOPHORONE																		
DIMETHYL PHTHALATE																		
NITROBENZENE																		
PHENOL												1300						
2,4-DIMETHYLPHENOL																		
2,4-DICHLOROPHENOL																		
4-NITROPHENOL																		
2-NITROPHENOL																		
ISOPROPYLBENZENE															34			
BIS-2 CHLOROETHYLETHER																		
ISOPHORONE																		
FLUORANTHENE																		
PHENANTHRENE																		
PYRENE																		
ANTHRACENE																		
PESTICIDES																		
HEPTACHLOR																		
ALPHA BHC																		
DELTA BHC																		
TOXAPHENE																		
DDT																		
ENDOSULFAN 1																		
ENDOSULFAN SULFATE																		
DDE																		

CONCENTRATIONS GIVEN IN ug/l (PPB)
BLANKS INDICATE COMPOUND NOT DETECTED ABOVE DETECTION LIMIT

3355

Table 1-2 (cont.)

Priority Pollutant Organic Compounds Detected in Monitoring Wells at the CLTL Site Sampled by ERM in 1981

COMPOUND	TP-10 Mar 81	TP-12 Mar 81	TP-13 Mar 81	TP-14 Mar 81	TP-15 Mar 81	TP-16 Mar 81	TP-17 Mar 81	TP-18 Mar 81	TP-19 Mar 81	TP-20 Mar 81	TP-22 Mar 81	Penn's Grove Water Supply Mar 81	CLR Prod Well Mar 81	CLR Prod Well Jun 81	Moss Br Oak Grove at Road May 81	Moss Br. adj to CLTL Terminal May 81	Moss Br. Cedar Swamp at Road May 81
VOLATILES																	
METHYLENE CHLORIDE	1000			560					120						33	5	10
TRANS-1,2-DICHLOROETHYLENE	3020	80	3100	1100		44	203	10	1	3000	10		8350	3100			
CHLOROFORM							3							07 0			
TRICHLOROETHENE		120	80	2500	15	77	4	74		3000		44	2740	307			
BENZENE	174	3	24	76			07	11		33			61	34 3			
TOLUENE	70		12 5	140			10	12		18			14	12 0			
VINYL CHLORIDE	12																
1,2 DICHLOROETHANE	110	10	27	347			113	13		2000			42		11	13 6	30
TETRACHLOROETHENE		7	60					0	2	24			14	370			
CHLOROBENZENE	73			07			34	30		82			40	12 0			
ETHYLBENZENE	38			70			3	6					1				
1,1-DICHLOROETHENE	20		1.7										4	31			
1,2 DICHLOROPROPANE				11			00	13		040							
TRICHLOROFLUOROMETHANE									3300								
1,1,2 TRICHLOROETHANE																	
DICHLORODIFLUOROMETHANE														10 3			
1,1 DICHLOROETHANE																	
BROMOMETHANE														07 0			
XYLENE																	
TETRAHYDROFURAN																	
1,1,1-TRICHLOROETHANE																	
TRANS-1,3-DICHLOROPROPYLENE																	
DICHLOROBROMOMETHANE																	
CHLOROETHANE																	
SEMIVOLATILES																	
1,2-DICHLOROBENZENE				207			00	80									
1,3-DICHLOROBENZENE																	
1,4 DICHLOROBENZENE																	
NAPHTHALENE																	
DI N BUTYL PHTHALATE																	
DIETHYL PHTHALATE																	
N NITROSODIPHENYLAMINE																	
1,2,4-TRICHLOROBENZENE																	
2 CHLORONAPHTHALENE																	
BUTYL BENZYL PHTHALATE																	
BIS(2-ETHYLHEXYL)PHTHALATE																	
ISOPHORONE																	
DIMETHYL PHTHALATE																	
NITROBENZENE																	
PHENOL																	
2,4-DIMETHYLPHENOL																	
2,4 DICHLOROPHENOL																	
4-NITROPHENOL																	
2 NITROPHENOL																	
ISOPROPYLBENZENE			33	222													
BIS-2-CHLOROETHYLETHER																	
ISOPHORONE																	
FLUORANTHENE																	
PHENANTHRENE																	
PYRENE																	
ANTHRACENE																	
PESTICIDES																	
HEPTACHLOR																	
ALPHA BHC																	
DELTA BHC																	
TOXAPHENE																	
DDT																	
ENDOSULFAN I																	
ENDOSULFAN SULFATE																	
DDE																	

CONCENTRATIONS GIVEN IN ug/L (PPB)
BLANKS INDICATE COMPOUND NOT DETECTED ABOVE DETECTION LIMIT

Table 1-3

ELEVATIONS, SCREENED INTERVALS, AND TOTAL DEPTHS OF MONITORING WELLS INSTALLED AT THE CLTL SITE BY ERM IN 1981

Monitoring Wells	Ground Surface Elevation (in feet above MSL)	Total Depth (in feet below ground surface)	Elevation of Total Depth of Well (in feet with respect to MSL)	Screened Intervals (in feet below ground surface)	Range in Elevation Covered by Screened Intervals (in feet with respect to MSL)
"Shallow" Test Pit Wells:					
TP-1	8.89	9.34	-0.45	4.34 to 9.34	+4.55 to -0.45
TP-2	*	8.15	*	3.15 to 8.15	*
TP-3	*	8.72	*	3.72 to 8.72	*
TP-4	*	7.98	*	2.98 to 7.98	*
TP-6	*	8.05	*	3.05 to 8.05	*
TP-8	*	5.80	*	0.80 to 5.80	*
TP-9	5.34	5.63	-0.29	0.63 to 5.63	+4.71 to -0.29
TP-10	*	6.99	*	1.99 to 6.99	*
TP-12	6.93	9.77	-2.84	4.77 to 9.77	+2.16 to -2.84
TP-13	6.58	8.68	-2.10	3.68 to 8.68	+2.90 to -2.10
TP-14	*	7.70	*	2.70 to 7.70	*
TP-15	*	6.55	*	1.55 to 6.55	*
TP-16	10.44	13.10	-2.66	8.10 to 13.10	+2.34 to -2.66
TP-17	*	5.68	*	0.68 to 5.68	*
TP-18	*	8.23	*	3.23 to 8.23	*
TP-19	8.83	7.89	+0.94	2.89 to 7.89	+5.94 to +0.94
TP-20	*	8.21	*	3.21 to 8.21	*
TP-22	10.89	9.24	+1.65	4.24 to 9.24	+6.65 to +1.65
"Intermediate Depth" Wells					
CL-1	14.27	30	-15.73	15 to 30	- 0.73 to -15.73
CL-2	10.65	30	-19.35	20 to 30	- 9.35 to -19.35
CL-3	6.46	40	-33.54	30 to 40	-23.54 to -33.54
CL-4	8.93	46	-37.07	25 to 30	-16.07 to -21.07
CL-6	6.84	44	-37.16	29 to 44	-22.16 to -37.16

Table 1-3 (cont.)

Monitoring Well	Ground Surface Elevation (in feet above MSL)	Total Depth (in feet below ground surface)	Elevation of Total Depth of Well (in feet with respect to MSL)	Screened Intervals (in feet below ground surface)	Range in Elevation Covered by Screened Intervals (in feet with respect to MSL)
"Moderately Deep" Wells:					
CL-5	6.55	68	-61.45	30 to 32 and 66 to 68	-23.45 to -25.45 and -59.45 to -61.45
"Deep" Wells:					
DW-1	5.60	97	-91.40	95 to 97	-89.40 to -91.40
DW-2	10.63	102	-91.37	100 to 102	-89.37 to -91.37

Depth Designation in Quotations from ERM (1981)
TP = Test Pit, CL = Chemical Leaman, DW = Deep Well
* Elevation not measured as part of RI; wells no longer usable.

using mud rotary drilling methods. The purpose of installing CL-6 was two-fold: 1) to provide a new supply of water for the CLTL terminal, and 2) to act as a purge well for contaminated ground-water beneath the former settling lagoons.

After installing CL-6, ERM conducted an aquifer test analysis using CL-6 and selected surrounding ground-water monitoring wells. The purpose of the aquifer test was to provide specific capacity and aquifer characteristics leading to the evaluation of CL-6 as a long-term water supply source and purge well (ERM, 1982). Results of the aquifer test analysis appear in ERM's 1982 pump test report which is provided in Appendix B.

CLTL supervised the closure of the former primary settling lagoons and the repair of the settling tank and sump pump during the summer and fall of 1982. The following test pit wells were damaged or destroyed during the excavation of the former settling lagoons: TP-2, TP-3, TP-4 and TP-6.

Ground-water samples were collected from 18 wells during April 1984. Table 1-4 presents the results from this sampling effort. At this time it was discovered that several of the TP-series wells were no longer present. It appears that these wells were somehow destroyed and were not properly sealed, however, the TP-series wells do not penetrate a confining unit (ERM, 1981). Therefore, former TP-series wells do not provide vertical pathways for ground-water contamination.

1.3.3 CLTL Monitoring

On a quarterly basis from October 1981 through August 1983, CLTL personnel collected ground-water samples from 16 monitoring wells. CLTL personnel collected the samples using PVC bailers and submitted them to a laboratory for organic compound analysis. The analytical results from these sampling events are presented in Table 1-5.

1.3.4 U.S. Geological Survey Investigation

In 1983, the United States Geological Survey's (USGS's) Trenton, N.J. office began an investigation of the hydrogeology of the Logan Township area. As part of this study, USGS has conducted the following activities in the vicinity of the CLTL site:

- During August 1983, USGS geophysically logged several wells at the BROS site before they were cased. Techniques used in this investigation included electrical resistivity, specific potential, and gamma-gamma logging (USGS, in preparation).

Table 1-4

Priority Pollutant Organic Compounds Detected In Monitoring Wells at the CLTL Site Sampled by ERM In 1984

COMPOUND	CL-1	CL-2	CL-3	CL-4	CL-6	TP-7	TP-8	TP-12	TP-13	TP-15	TP-16	TP-17	TP-18	TP-19	TP-20	TP-22	DW-1	DW-2
	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84	Apr-84
VOLATILES																		
METHYLENE CHLORIDE		2	120	6	2100												77	
TRANS-1,2-DICHLOROETHYLENE		80	8100	1000	65000	37	10	18	430	6	1	20	4		73		4700	
CHLOROFORM																		
TRICHLOROETHENE		82	2200	630	9700		2	11	2			60	1		430		3000	4
BENZENE	25	64	5700	630	67000	40	11		310			25			24		2000	25
TOLUENE		200		10	610				2						2		45	
VINYL CHLORIDE					1500				27									
1,2 DICHLOROETHANE		10	530	50		3	2	1	3			3					95	
TETRACHLOROETHENE		320	20	120	120										4		30	
CHLOROBENZENE				7	830												13	
ETHYLBENZENE				5	150												6	
1,1-DICHLOROETHENE					90							2					0	
1,2 DICHLOROPROPANE			30		870													
TRICHLOROFLUOROMETHANE																		
1,1,2-TRICHLOROETHANE																		
DICHLOROFLUOROMETHANE																		
1,1-DICHLOROETHANE									2						1		2	
BROMOMETHANE																		
XYLENE																		
TETRAHYDROFURAN																		
1,1,1-TRICHLOROETHANE																	7	
TRANS 1,3-DICHLOROPROPYLENE																		
DICHLOROBROMOMETHANE			30						3								10	
CHLOROETHANE																		
SEMIVOLATILES																		
1,3-DICHLOROBENZENE																		
1,2-DICHLOROBENZENE																		
1,4-DICHLOROBENZENE																		
NAPHTHALENE																		
DI-N BUTYL PHTHALATE																		
DIETHYL PHTHALATE																		
N-NITROSODIPHENYLAMINE																		
1,2,4-TRICHLOROBENZENE																		
2 CHLORONAPHTHALENE																		
BUTYL BENZYL PHTHALATE																		
BIS(2-ETHYLHEXYL)PHTHALATE																		
ISOPHORONE																		
DIMETHYL PHTHALATE																		
NITROBENZENE																		
PHENOL																		
2,4-DIMETHYLPHENOL																		
2,4-DICHLOROPHENOL																		
4-NITROPHENOL																		
2 NITROPHENOL																		
ISOPROPYLBENZENE																		
BIS-2-CHLOROETHYLETHER																		
ISOPHORONE																		
FLUORANTHENE																		
PHENANTHRENE																		
PYRENE																		
ANTHRACENE																		
PESTICIDES																		
HEPTACHLOR																		
ALPHA BHC																		
DELTA BHC																		
TOXAPHENE																		
DDT																		
ENDOSULFAN I																		
ENDOSULFAN SULFATE																		
DDE																		

BLANKS INDICATE COMPOUND NOT DETECTED ABOVE DETECTION LIMIT
CONCENTRATIONS GIVEN IN ug/L (PPB)

Table [illegible]-5

Range of Concentrations of Selected Priority Pollutant Volatile Organic Compounds in Ground Water Collected at the CLTL Site by CLTL Personnel from October 1981 through August 1983

Monitoring Well	Trichloroethane	Trans-1,2-dichloroethane	Benzene	Vinyl Chloride
TP-1	32-121	59 - 129	4 - 10	<0.1
TP-6	<10	13000	195	<10
TP-9	<0.1	<0.1	<0.1	<0.2
TP-10	9 - 2000	3500 - 80000	270 - 400	<50 - 2600
TP-12	0.5-672	2 - 8000	<0.1 - 136	<0.1 - 42
TP-15	0.4-3	<0.1 - 20	<0.1 - 5	<0.2
TP-16	<0.1	<0.1 - 3	<0.1 - 8	<0.1
TP-17	<0.1-2	<0.1	<0.1 - 6	<0.1
TP-22	<0.1-5	<0.1 - 169	<0.1 - 7	<0.2
CL-1	1.4-1.5	<0.1 - 17	<0.1	<0.2
CL-2	230 - 444	<0.1 - 2000	<0.1 - 9	<0.1 - 14
CL-3	<50 - 6600	15000 - 30000	111 - 600	<0.1 - 1000
CL-4	168 - 435	290 - 2200	<0.1 - 148	<0.2 - 11
CL-5U	4.5 - 875	348 - 25000	11 - 580	<0.1 - 20
CL-5L	0.5 - 1100	6400 - 30000	<0.1 - 705	<0.2 - 325
CL-6	3400 - 64000	15000 - 31000	277 - 1100	<0.1 - 1100
DW-1	823 - 3700	1400 - 17000	36 - 155	<0.1 - 650
DW-2	3.8 - 142	7 - 1400	<0.1 - 7	<0.1 - 252
CLTL Prod. Well	<0.1 - 3900	1700 - 3200	27 - 53	<0.1 - 10

All concentrations given in ug/l (ppb)

- In November 1983, USGS conducted a surface geophysical study of the CLTL site and surrounding area. Techniques used during the investigation included electromagnetic induction, electrical resistivity and seismic refraction. (USGS, in preparation).

- In 1984, USGS collected two sets of groundwater samples from six wells (CL-1, CL-2, CL-4, TP-9, DW-1 and DW-2) at the CLTL site and submitted the samples for analysis of contaminants (USGS, in preparation). Concentrations of Priority Pollutant organic compounds which were detected during this sampling event are given in Table 1-6.

- In February 1985, USGS drilled two borings: one on the CLTL site, located just west of the intersection of Oak Grove Road and Cedar Swamp Road and one on the Gaventa property, south of Cedar Swamp Road. Figure 1-7 shows the locations of these borings. Both borings were drilled into bedrock to a depth of 293 feet. These borings indicate that the subsurface elevation of bedrock beneath the site is approximately -250 feet (MSL). Split spoon samples were collected during drilling, and the boreholes were geophysically logged with the same type of equipment used at the BROS site in 1984 (USGS, in preparation). The drillers logs of both borings show a 50-thick water-bearing sand from approximately -170 feet (MSL) to approximately -220 feet (MSL). Variable-head permeability tests also were conducted by Woodward-Clyde Consultants on samples taken from the borings. Appendix C presents these permeability data.

- Since their installation in 1985, four monitoring wells located on the Gaventa property south of Cedar Swamp Road have been monitored by USGS (Figure 1-7). USGS refers to the wells as S-9, 108, Gaventa Middle and Gaventa Deep. The EPA installed the S-9 and 108 monitoring wells, and USGS installed the Gaventa Middle and Gaventa Deep wells. This report designates the four wells on the Gaventa property USGS-A, USGS-B, USGS-C and USGS-D. The wells are finished to depths of 52 feet, 97 feet, 140 feet and 240 feet, respectively. USGS-D represents the 293-foot deep boring installed by USGS on the Gaventa property. This boring was later converted to 240-foot deep monitoring well.

- In addition, USGS periodically has submitted samples from these wells for analysis of selected physical and chemical parameters. Appendix D presents the results of this sampling.

Table 1-6

Priority Pollutant Organic Compounds Detected in Monitoring Wells at the CLTL Site Sampled by USGS in 1984

COMPOUND	CL-1		CL-4		DW-1*		DW-2		TP-9		CL-3	
	Jun 84	Oct 84	Jun 84	Oct 84	Jun 84	Oct 84	Jun 84	Oct 84	Jun 84	Oct 84	Jun 84	Oct 84
VOLATILES												
METHYLENE CHLORIDE			700	91	2000	900				27	550	81
TRANS-1,2-DICHLOROETHYLENE			1300	1700	10000	5400			240	330	200	140
CHLOROFORM			150		300	14			8	4	150	7
TRICHLOROETHENE			250	170	8400	9040	9		12	32	150	150
BENZENE				60	181	97						
TOLUENE				11		34						
VINYL CHLORIDE				70		303						12
1,2-DICHLOROETHANE			95	70		61			14	15		10
TETRACHLOROETHENE					170	40				4	820	820
CHLOROBENZENE				27		10			12	20		
ETHYLBENZENE	..	..	60			21						
1,1-DICHLOROETHENE					6000							
1,2-DICHLOROPROPANE									37	30		
TRICHLOROFLUOROMETHANE						3						
1,1,2-TRICHLOROETHANE												
DICHLOROFLUOROMETHANE												
1,1-DICHLOROETHANE												
BROMOMETHANE												
XYLENE												
TETRAHYDROFURAN												
1,1,1-TRICHLOROETHANE												
TRANS-1,3-DICHLOROPROPYLENE												
DICHLOROBROMOMETHANE												
CHLOROETHANE						9						
SEMIVOLATILES												
1,2-DICHLOROBENZENE	..	..	85	140	8	4			8	10		
1,3-DICHLOROBENZENE												
1,4-DICHLOROBENZENE	..	..			2	3	..	..				
NAPHTHALENE	..	..	10	23	79	88	..	..		8		
DI-N-BUTYL PHTHALATE												
DIETHYL PHTHALATE												
N-NITROSODIPHENYLAMINE	..	..			21	34	..	..				
1,2,4-TRICHLOROBENZENE	..	..			1	1	..	..				
2-CHLORONAPHTHALENE												
BUTYL BENZYL PHTHALATE												
BIS(2-ETHYLHEXYL)PHTHALATE												
ISOPHORONE	..	..	8	4	33	24	..	..				
DIMETHYL PHTHALATE												
NITROBENZENE	..	..			8	1	..	..				
PHENOL	..	..			3		..	..				
2,4-DIMETHYLPHENOL	..	..		3			..	..				
2,4-DICHLOROPHENOL												
4-NITROPHENOL												
2-NITROPHENOL	..	..			9	3	..	..				
ISOPROPYLBENZENE												
BIS-2-CHLOROETHYLETHER	..	..	10	8			..	..				
FLUORANTHENE	..	..					..	..	10			
PHENANTHRENE	..	..					..	..	14			
PYRENE	..	..					..	..	13			
ANTHRACENE	..	..					..	..	25			
PESTICIDES												
HEPTACHLOR												
ALPHA BHC												
DELTA BHC												
TOXAPHENE	..	..		..	10	..	..	..		..		..
DDT												
ENDOSULFAN I												
ENDOSULFAN SULFATE ..												
DDE												

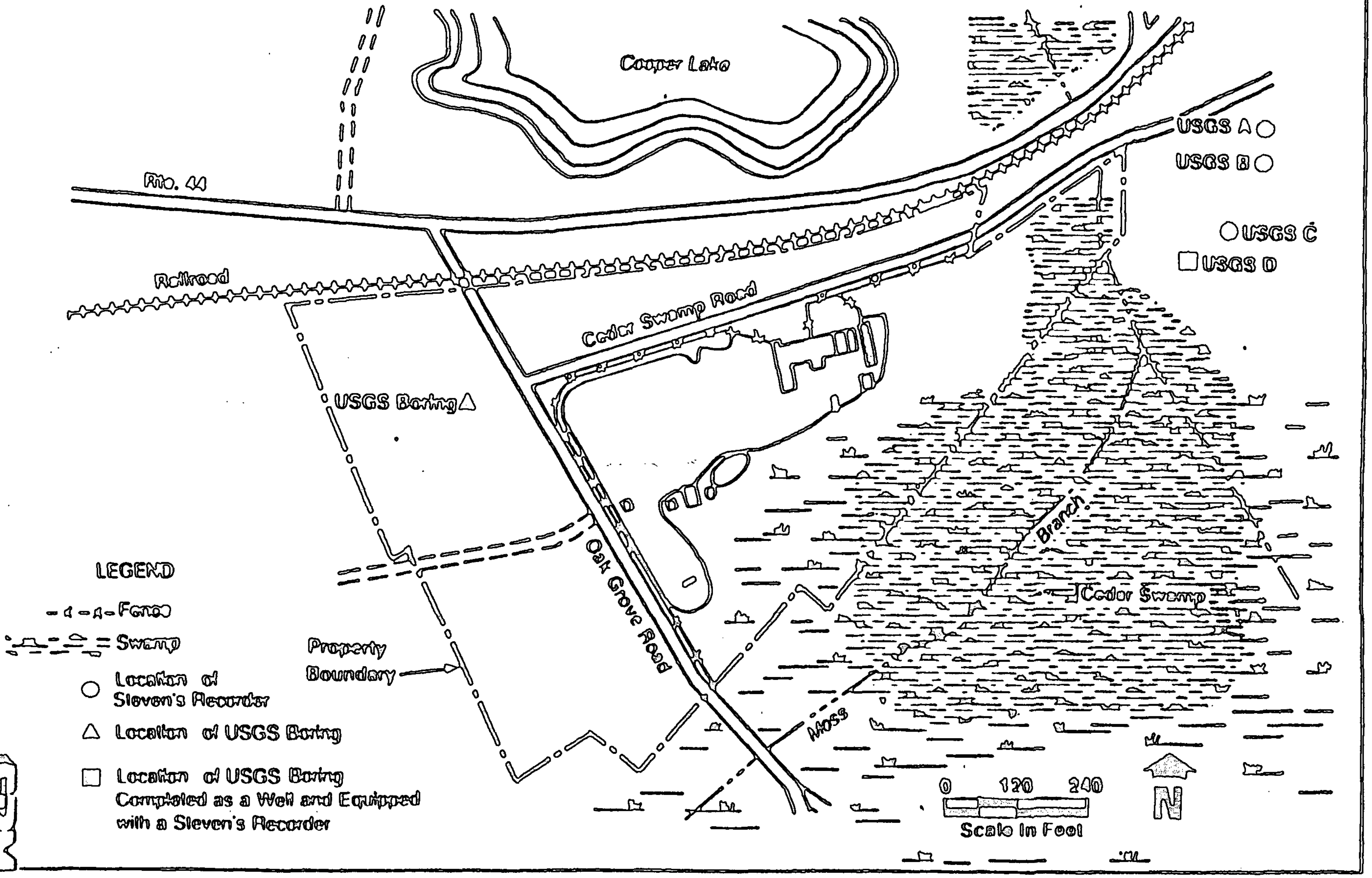
BLANKS INDICATE COMPOUND NOT DETECTED ABOVE DETECTION LIMIT

CONCENTRATIONS GIVEN IN ug/L (PPB)

*VALUES REPRESENT HIGHEST CONCENTRATION AMONG REPLICATE SAMPLES

.. PARAMETER NOT ANALYSED FOR

Figure 1-7
Location of USGS Borings and Stevens Recorders



1.3.5 Related EPA Investigations at the Bridgeport Rental and Oil Services, Inc. Site

As part of the ongoing investigations at the adjacent Bridgeport Rental and Oil Services, Inc. (BROS) Superfund site, EPA personnel collected water samples from residential wells around the BROS and CLTL sites on a monthly or bimonthly schedule between March 1983 and December 1986. Figure 1-8 shows the locations of the residential wells in the vicinity of the CLTL site which were sampled as a part of this program. These samples were analyzed for volatile organic compounds (VOCs). Table 1-7 presents a summary of these analytical results.

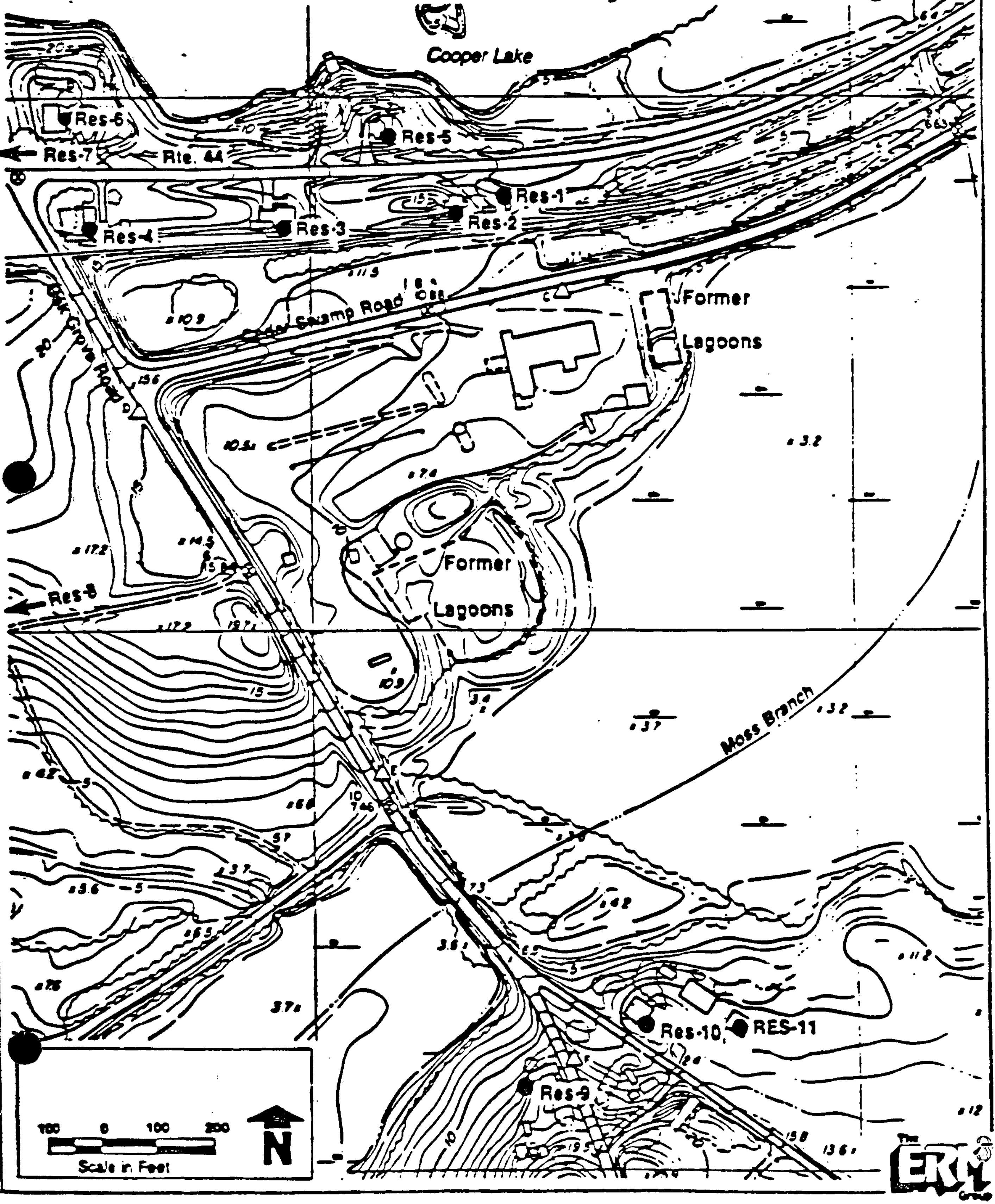
1.4 Scope of Work and Objectives of the Remedial Investigation/Feasibility Study

In 1985, the CLTL Bridgeport terminal was included on the National Priorities List (NPL) as a Superfund site and a Work Plan for the RI/FS was prepared by NUS Corporation for EPA. In 1985, CLTL agreed to undertake the RI/FS and contracted ERM to conduct the work. By mutual agreement between EPA and CLTL, the NUS Work Plan was amended and subsequently approved by EPA. An Administrative Order on Consent was signed by EPA and CLTL in July 1985. The effective date for start of the RI was set for February 10, 1986 after EPA approval of the Site Operations Plan which detailed the specific procedures to be used during the RI.

Based upon previous site investigations and activities, the following objectives of the RI were established:

- to define and locate accurately all on site waste lagoons and any other potential contaminant source areas;
- to characterize local stratigraphy and hydrogeology beneath the CLTL site;
- to determine the rate and direction of ground-water flow in the aquifer units beneath the CLTL site and to determine the hydrologic relationship between these units;
- to characterize the nature and extent of all on-site sources of contamination and to determine each source's relationship to, and effects upon, the local ground-water, soil, surface sediment and surface water;
- to determine the nature and degree of contaminant migration off site, its environmental impact and the public health hazard it represents; and

Figure 1–8
Locations of Residential Wells in the Vicinity of the CLTL Site Included in the Monthly EPA Monitoring



The ERM Group

Table 1-7

Range in Concentration of Priority Pollutant Volatile Organic Compounds in Ground Water Samples Collected by EPA from Residential Wells in the Vicinity of the Chemical Leaman Site

	Location				
PARAMETER:	Res-1	Res-2	Res-3	Res-4	Res-5
Times Sampled	15	29	28	12	16
Benzene	*	ND-37 *25X*	*	*	*
Chlorobenzene	*	ND-13 *21X*	*	*	*
1,2-dichloroethane	ND-2J *1X*	ND-93 *26X*	*	*	*
Chloroform	ND-2K *1X*	ND-2.4 *5X*	*	ND-2K *1X*	ND-2K *1X*
1,1-dichloroethylene	*	ND-2K *1X*	*	*	*
1,2-trans dichloroethylene	ND-1J,2K *2X*	21-1000 *29X*	8.3-40 *28X*	*	ND-2K *1X*
1,2-dichloropropane	*	ND-2K *4X*	*	*	*
Methylene chloride	*	ND-2K *4X*	ND-2K *2X*	ND-2.2 *1X*	*
Tetrachloroethylene	*	18-770 *29X*	ND-2K *7X*	*	ND-11 *8X*
Toluene	*	ND-6.8 *1X*	*	*	*
Trichloroethylene	3.3-45 *15X*	1.4K-40 *29X*	75-260 *28X*	*	ND-2K *3X*
Vinyl chloride	*	ND-1800 *27X*	*	*	*
2-butanone	*	*	*	*	ND-4 *1X*

EPA Qualifiers:
All concentrations in ug/l.
ND=Not Detected.
K=Detected but not quantified. Actual value known to be less than value given.
J=Estimated value.

ERM Qualifiers:
X=Number of times detected.
*=Not Detected or Not Analyzed at specific sampling events.
Verified screened intervals of these wells are not available; wells reportedly screened in intermediate subzone.

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Table 1-7, (cont.)

PARAMETER:	Location Res-6	Res-7	Res-8	Res-9	Res-10
Times Sampled	12	7	12	8	11
Benzene	*	*	*	*	*
Chlorobenzene	*	*	*	*	*
1,2-dichloroethane	*	*	*	*	*
Chloroform	*	ND-2K 1X	*	ND-2K 1X	*
1,1-dichloroethylene	*	*	*	*	*
1,2-trans dichloroethylene	*	*	*	1K	*
1,2-dichloropropane	*	*	*	*	*
Methylene chloride	*	*	*	*	*
Tetrachloroethylene	*	*	*	*	*
Toluene	*	*	*	*	*
Trichloroethylene	*	*	*	33	*
Vinyl chloride	*	*	*	*	*
2-butanone	*	*	*	*	*

EPA Qualifiers:
All concentrations in ug/l.
ND=Not detected.
K=Detected but not quantified. Actual values known to be less than value given.
J=Estimated value.

ERM Qualifiers:
X=Number of times detected.
*=Not Detected or Not Analyzed at specific sampling events.
Verified screened intervals of these wells are not available; wells reportedly screened in intermediate subzone.

- to identify remedial action objectives and remedial action alternatives for the site.

The RI/FS for the CLTL site included three phases of work consisting of 27 tasks:

Phase I - Preliminary RI activities (Tasks 1-12)
Phase II - RI site activities (Tasks 13-21)
Phase III - FS (Tasks 22 through 27)

Table 1-8 gives the tasks associated with the first two phases of the RI at the CLTL site. Plate 1 shows the locations of all environmental sampling conducted on the CLTL site as part of the RI.

1.5 Modifications to the Scope of Work and Format of the Final Draft Remedial Investigation Report

On December 5, 1986, CLTL submitted to EPA a draft RI report which presented the results of the investigation at the CLTL site. EPA's comments on the Draft RI Report identified additional work necessary to define the nature and extent of site-related contamination more completely. This work included:

- Installation of three additional monitoring wells to define the extent of ground-water contamination;
- Collection of additional groundwater samples, soil samples, surface water samples and sediment samples;
- Performance of an electromagnetic conductivity survey in Cedar Swamp, adjacent to the CLTL terminal to define the extent of site-related wetlands contamination;
- Completion of an aquifer pump test to determine factors controlling the flow of ground-water; and
- Determination of local background contaminant levels for comparison with on-site values.

Preliminary results of surface water and sediment sampling and the electromagnetic conductivity survey in Cedar Swamp conducted during this supplemental field effort indicated wetlands contamination which would require further investigation. Therefore the wetlands will be addressed as a separate operable unit for the site.

Table 1-8

Listing of Remedial Investigation Tasks for the CLTL Site

Tasks as Provided in the Amended NUS Work Plan	Description of Task	Results of Task
PHASE I TASKS		
Task 1. RI/FS Work Plan Preparation	WP, page 3-3	WP
Task 2. Project Management	WP, page 3-3	NA
Task 3. Site Reconnaissance	WP, page 3-4	RI
Task 4. Collection and Evaluation of Existing Technical Data	WP, page 3-5	RI
Task 5. Development of Site-Specific Health and Safety Plans	WP, pages 3-5 to 3-6	SOP
Task 6. Development of Site-Specific Quality Assurance Plan	WP, page 3-6	SOP
Task 7. Preparation of Site Topographic Maps	WP, page 3-6	RI
Task 8. Development of Site Operations Plan	WP, pages 3-6 to 3-7	SOP
Task 9. Procurement of Subcontractors	WP, pages 3-7 to 3-8	NA
Task 10. Procurement of Permits, Rights-of-Entry, and Other Authorizations	WP, page 3-8	NA

WP = EPA approved Work Plan, February 1985
RI = Remedial Investigation Report, Draft December 1986
NA = Not applicable or required during a Responsible Party conducted RI/FS or necessary as a reporting requirement
SOP = Site Operations Plan

Table 1-8 (cont.)

Task 11.	Performance of Community Relations and Support Functions	WP, page 3-8	NA
Task 12.	Mobilization of Field Equipment	WP, pages 3-8 to 3-9	NA
PHASE II TASKS			
Task 13.	On-Site Hydrogeologic Investigation	WP, pages 3-9 to 3-15 RI, Section 3.2	RI
Task 14.	On-Site Ground Water Sampling Programs	WP, page 3-16 RI, Section 3.3	RI
Task 15.	Off-Site Well Monitoring Program	WP, pages 3-16 to 3-17 RI, Section 3.3	RI
Task 16.	Geophysical Studies	WP, pages 3-17 to 3-18 RI, Section 3.2	RI
Task 17.	Contaminant Plume Definition and Characterization	WP, pages 3-18 to 3-19	RI, Section 4
Task 18.	Environmental Sampling Program	WP, pages 3-20 to 3-25 RI, Section 3.4(soil)	Soil Results in RI. Remaining results to be submitted in separate RI; preliminary results in Appendix E.
Task 19.	Analysis and Evaluation of Remedial Investigation Data	WP, page 3-25	RI Section 4
Task 20.	Objectives for Remedial Alternatives	WP, pages 3-25 to 3-27	NA
Task 21.	RI Report	WP, pages 3-27 to 3-28	This Document

WP = EPA approved Work Plan, February 1985
RI = RI Report, Draft, December 1986

1.6 Additional Studies Performed by EPA and Revision of the Draft Final Remedial Investigation Report

In June 1989, EPA determined that the studies conducted by CLTL were incomplete and proceeded to supplement the RI studies and revise the draft final RI report submitted by CLTL in February 1989.

In September 1989, EPA contracted with Camp Dresser McKee Federal Programs Corporation (CDM FPC) to complete the following studies:

- Re-evaluation of the site subsurface stratigraphy, using boring logs from the existing monitoring wells;
- Measurement of water levels in the 21 monitoring wells installed by CLTL during the RI. These measurements were designed to reveal any variation in water levels caused by tidal influences;
- Re-survey of the surface elevations and locations of the 21 monitoring wells;
- Development of ground-water contour maps to determine ground-water flow and vertical gradient;
- Re-survey of surface elevations of all buildings and structures at the CLTL site, and development of a topographic base map;
- Implementation of a soil boring, sampling and analysis program to more accurately define the extent of soil contamination in the areas of the former wastewater lagoons and truck/tailer parking lot.

The first four studies listed above have been completed and are included in this RI report as Appendix U. The last two studies will be included in a supplemental RI report.

SECTION 2

PHYSICAL AND ENVIRONMENTAL SETTING

2.1 Land Use

Logan Township encompasses approximately 15,360 acres in northwest Gloucester County, New Jersey. The township lies entirely within the Delaware River basin (Hochreiter and Kozinski, 1985) and consists of low, stream-dissected hills separated by broad swamps. Elevation in Logan Township ranges from just below sea level to approximately 60 feet above sea level (USGS, Bridgeport, NJ-PA Quadrangle).

Nondeveloped lands, including marshes, vegetated areas and woodlands, cover slightly more than half, or roughly 8,000 acres of Logan Township (NJDEP, 1982). Cedar Swamp, part of which flanks the CLTL site, has been designated by the Delaware Valley Regional Planning Commission as a unique environmental area. The "Tri-County 208 Waste Management Plan" recommends that the Great Cedar Swamp receive maximum protection against future development (NUS, 1985).

An additional 5,200 acres of Logan Township are covered by privately owned farms which cultivate vegetable crops and fruit orchards (NJDEP, 1982). Two plots of farmland lie to the west of Oak Grove Road, adjacent to the CLTL Bridgeport Terminal. This land belongs to Chemical Leaman; however, it has not been planted in recent years. Several working farms border Cedar Swamp to the south of the site, and a peach orchard is located east of the site beyond Cedar Swamp.

Land devoted to residential use in Logan Township totals approximately 500 acres (NJDEP, 1982). The 1980 census lists the population of Logan Township at 3,078. While much of Logan Township is sparsely populated, its primary population centers include the area of Bridgeport and two newer developments, the Pureland and Beckett residential areas, to the south.

Prior to 1987, most of the residents in the vicinity of the site maintained individual water supply wells. However, several of these wells have not been used for drinking water since the late 1970's when levels of solvents and other chemicals above drinking water standards were detected in the ground water. Some of these homes continued to use ground-water wells for bathing and washing purposes. During 1987, the homes north of the site along Route 44 were connected to an extension of the Bridgeport Municipal

Water System. Between the late 1970s and the date of completion of the Bridgeport municipal water line, CLTL provided potable water from Pureland Water Company at no cost to some homes in the area. A number of residential ground-water wells are currently in use within 2000 feet of the CLTL boundary. Recent EPA sampling of private wells southwest of the site indicates site-related volatile organic contamination in one private well.

In addition to Chemical Leaman Tank Lines, Inc., two other companies represent the bulk of the light industry in Logan Township. These include Monsanto Chemical Company, in the western section of the township; Rollins Environmental Services, west of Route 322. In addition the former Bridgeport Rental and Oil Services (BROS) company, approximately one-half mile east of the CLTL, Bridgeport Terminal.

The BROS property, a thirty acre National Priorities List Superfund site is currently being remediated by EPA. This site was a former oil processing and reclamation facility. All of the 88 storage tanks that had existed at this site have been removed. The remediation of an unlined, 13-acre lagoon containing waste oils and wastewater is scheduled to began during the summer of 1989 and should be completed in 1993 (CH2M Hill, 1989).

2.2 Climate and Meteorology

The climate in Gloucester County is humid and temperate (USDA, 1962). Most weather systems are driven to the area by prevailing westerly winds; however, during the summer months, southerly winds predominate.

Average rainfall is distributed evenly throughout most of the year. During the summer months, most precipitation falls during short, intense thunderstorms (USDA, 1962). There is little snowfall during the winter months. Therefore, snow provides little protection against freezing (USDA, 1962).

Average temperatures hover near freezing during winter months. Hot, humid air masses reach the area during the summer months, causing temperatures to rise above 90°F (NUS, 1985). Table 2-1 lists the monthly average temperature and precipitation for the Philadelphia International Airport, approximately 8 miles northeast of the CLTL site.

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TABLE 2-1

MONTHLY AVERAGE TEMPERATURE AND PRECIPITATION AT THE PHILADELPHIA INTERNATIONAL AIRPORT WEATHER STATION, PHILADELPHIA, PENNSYLVANIA

MONTH	AVERAGE TEMPERATURE (degrees F)	AVERAGE PRECIPITATION (inches)
January	31.1	2.34
February	32.3	2.93
March	41.3	3.28
April	52.0	3.36
May	61.7	3.43
June	71.8	4.43
July	76.7	3.77
August	76.0	3.99
September	69.0	3.53
October	56.7	2.88
November	45.8	3.21
December	37.2	4.19
Annual	54.3	41.3

Period of Record: 1965-1974

Source: Climatography of the United States No. 90; Airport Climatological Summary; Philadelphia International Airport

2.3 Surface Water

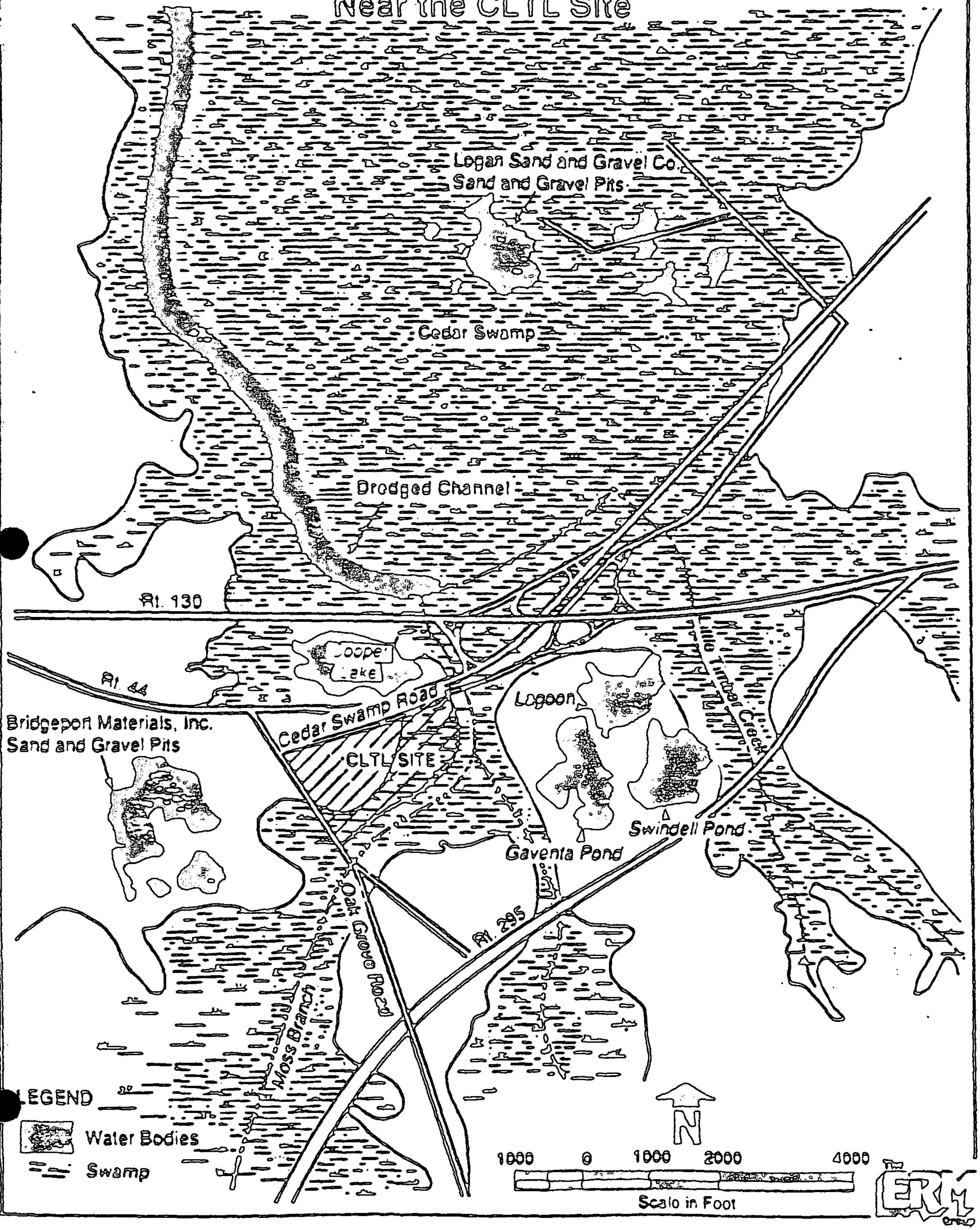
Several water bodies are located within one-half mile of the CLTL site. These include Cedar Swamp, bordering the site to the south and east; Cooper Lake, several hundred feet north of the site; Bridgeport Materials, Inc., water-filled sand and gravel pits, roughly one-half mile west of the site; and the three man-made ponds one-half mile east of the site. Figure 2-1 shows the water bodies in the vicinity of the CLTL site.

A reach of the Great Cedar Swamp flanks the site along its southern and eastern margins. Moss Branch flows north through the swamp and eventually drains into a man-made channel in the Great Cedar Swamp, north of Route 130. This man-made channel also drains the Little Timber Creek, which flows adjacent to the BROS property. The width of Cedar Swamp ranges from as much as 800 feet adjacent to the site to less than 10 feet where the Moss Branch flows through narrow culverts beneath Oak Grove Road, Cedar Swamp Road, Route 44, and Route 130. Generally, the water depth in Moss Branch is less than two feet. Water levels in Moss Branch north of Cedar Swamp Road change briefly with the tidal cycle. During high tide, Moss Branch reverses direction and flows south for a short time period in the culvert beneath Route 130, Route 44, and Cedar Swamp Road. This effect diminishes with distance from Route 130, and does not significantly alter the overall direction of flow in Moss Branch, south of Cedar Swamp Road. No flow records are available for Moss Branch.

A second, unnamed tributary discharges into Moss Branch near the southeastern margin of Cedar Swamp, adjacent to the CLTL site. Upstream, generally south, of the confluence of these two tributaries, Moss Branch drains the reach of Cedar Swamp that extends southwest of the site adjacent to Oak Grove Road, while the unnamed tributary drains the much smaller reach of Cedar Swamp that extends to the south-southeast of the site. Much of the swamp outside these two loosely defined tributaries remains inundated with less than two feet of water throughout the year. The flow rate of the Moss Branch has not been determined.

Cooper Lake, directly north of the site across Route 44, is a small (20 acres), privately-owned body of water. Originally a sand and gravel pit during the construction of U.S. 130, the lake, which is tidally influenced, is now stocked with fish. At the eastern edge of the lake, a narrow channel connects Cooper Lake to Moss Branch and the Great Cedar Swamp. The width of the channel is approximately eight feet, and water depth within the channel and the adjacent submerged area in Cedar Swamp is generally less than one foot.

Figure 2-1
Surface Water Bodies Near the CLTL Site



Bridgeport Materials, Inc., operates a sand and gravel surface mining operation just west of the CLTL property. The excavated sand and gravel pit, mostly filled with water, measures approximately 40 acres and up to 50 feet deep in places. The facility pumps approximately 30,000 gallons of water per day from the pits to wash the sand and gravel. After use, the water is returned directly to the pits.

Three man-made ponds, approximately 12 acres each, lie approximately one-half mile east of the CLTL site, on the opposite side of Cedar Swamp and the Gaventa peach orchard. The ponds are referred to as the BROS Lagoon, Gaventa Pond, and Swindell Pond (Figure 2-1). The ponds are abandoned sand and gravel mining pits, excavated between 1940 and the late 1970s (NUS, 1984).

The northernmost pond, the BROS Lagoon, is a waste lagoon used previously to dispose of wastes beginning in the early 1940s (NUS, 1984). The depth of the BROS Lagoon averages 10 to 15 feet but reaches 60 feet in some places (Goltz et al., 1983). Thus, a significant portion of the lagoon remains in contact with the ground water beneath the site which subsequently contains levels of organic and inorganic chemicals above drinking water standards (NUS, 1984). In addition, lagoon overflows and dike breaches of the BROS Lagoon in the past have led to the contamination of local surface water bodies, including portions of the Little Timber Creek and the Great Cedar Swamp (NUS, 1984).

2.4 Site Soil Types and Drainage

Two general areas of associated soil types characterize the soil within roughly one mile of the CLTL site. These are the Downer-Woodstown-Sassafras-Kleg (DWSK) Association and the Muck-Alluvial Land-Falsington-Pocomoke (MAFP) Association (USDA, 1962).

Soil of the DWSK Association occupies higher elevations in the vicinity of the CLTL site. The dominant soil of the DWSK consists of thick, well drained, sandy soil which overlies a clayey subsoil and sandy substratum. Regionally, the sandy soil of the DWSK Association occurs in a band of sandy flats, up to four miles wide, which parallels the Delaware River, but generally is separated from the river by tidal marsh and fill materials (USDA, 1962).

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Soil of the MAFP Association consists of inland wet soil which underlies tidal streams and drainage outlets. This soil consists of wet, poorly drained sandy and clayey loam to fully saturated, organic rich peat. In northern Gloucester County, soil of the MAFP occurs in the narrow wet areas that drain northward to the Delaware River.

In the vicinity of the CLTL terminal, the DWSK and MAFP Associations are further divided into specific soil types. The DWSK Association is divided into Sassafras loamy sand, 0 to 5 percent slopes (SfB); Sassafras sandy loam, 2 to 5 percent slopes (SrB); Sassafras sandy loam, 5 to 10 percent slopes (SrC); and Pits (Pg). The MAFP Association is divided into Falsington sandy loam (Fd) and Muck (Mu). Figure 2-2 shows the distribution of these soil types at the CLTL site.

Soil of the SfB, SrB, and SrC are grouped in the Sassafras Series, which consists of well-drained, coarse loamy sand to sandy loam which overlies a loose sandy substratum with well drained gravel (USDA, 1962). These soil types occur along the higher elevations at the CLTL site.

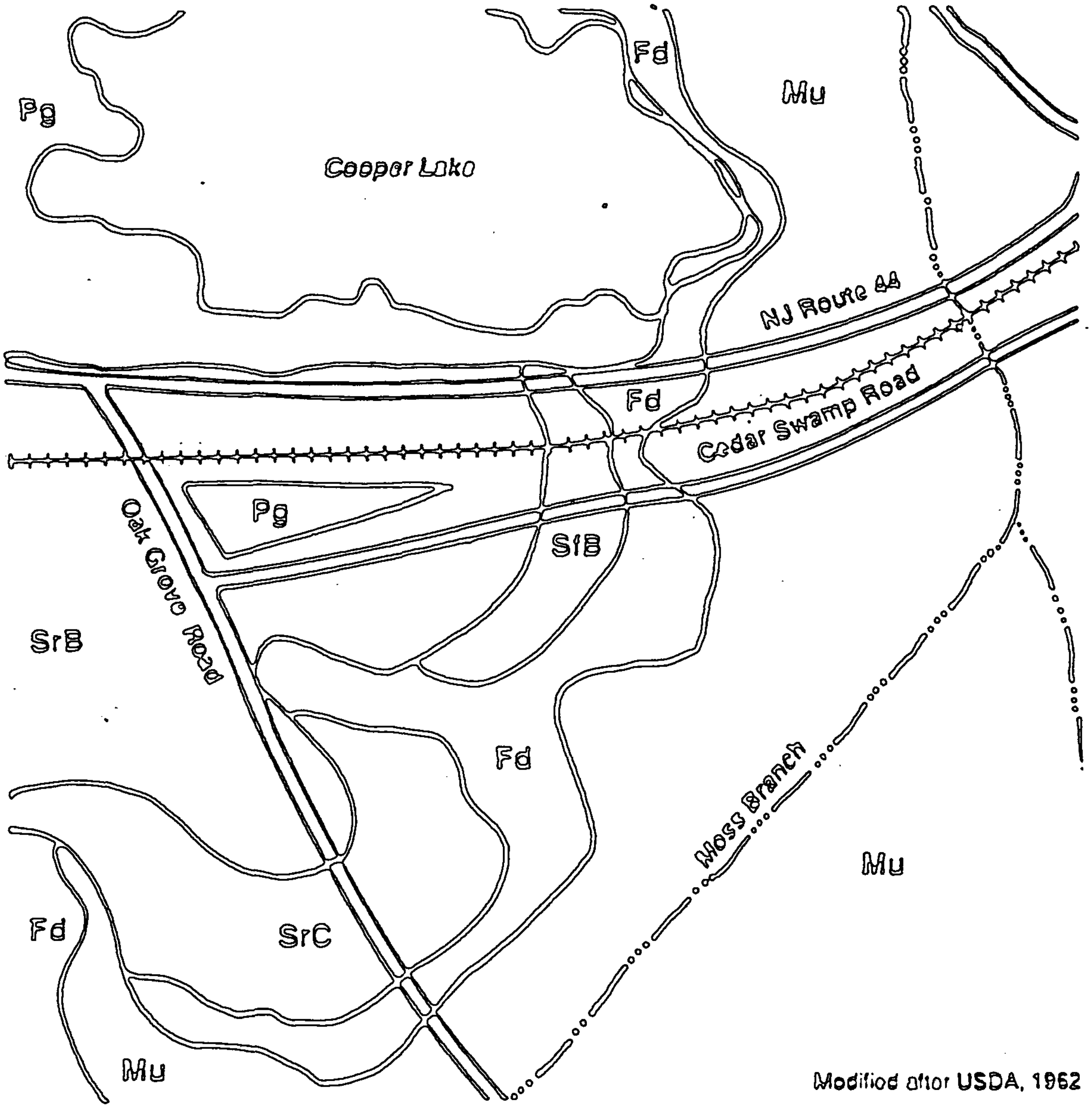
Pits (Pg) is a mappable unit representing pits greater than two feet deep excavated in the surface mining of sand and gravel beds (USDA, 1962). In the area surrounding the CLTL site, Pg occurs in areas mined for sand and gravel beds of the Sassafras and Downer series.

Soil of the Falsington sandy loam (Fd) consists of sandy clayey loam to loamy sand overlying sandy loam in the subsoil and substratum (USDA, 1962). This wet, poorly drained soil type occurs adjacent to the site along the gently sloping flats which border Cedar Swamp.

Muck (Mu) consists of fully saturated, dark brown to black, partially decomposed peat (USDA, 1962). Muck underlies much of the lower elevations adjacent to the CLTL site, including the area occupied by Cedar Swamp.

Surface water draining the CLTL site flows generally east to southeast into Cedar Swamp and eventually to Moss Branch. The highly permeable, commonly gravelly soil of the Sassafras Series, which is especially prevalent in the northern and western portions of the site, allows a considerable amount of surface water to infiltrate into the subsurface. The areas formerly occupied by the aeration and settling lagoons are located within the highly permeable soil of the Sassafras series and moderately permeable soil of the Falsington series.

Figure 2-2
Distribution of Soil Types in the Vicinity of the CLTL-Bridgeport Site



Modified after USDA, 1962

General Soil Association	Map Symbol	Name
Downer-Woodstown-Sassafras-Kleg (DWSK) Association	SfB	Sassafras loamy sand, 0-5 % slopes
	SrB	Sassafras sandy loam, 2-5 % slopes
	SrC	Sassafras sandy loam, 5-10 % slopes
	Pg	Pits
Muck-Alluvial land-Falsington-Pocomoc (MAFP) Association	Fd	Falsington sandy loam
	Mu	Muck

2.5 Regional Ecology

The United States Fish and Wildlife Service (USFWS) characterizes the CLTL site and surrounding area in the following manner: a Disturbed Upland Area, corresponding roughly to the CLTL terminal; Palustrine Forested Wetland, corresponding to the reach of the Great Cedar Swamp southeast of the CLTL terminal; and Palustrine Open Water Habitat, corresponding to Cooper Lake and its surrounding shoreline (USFWS National Wetlands Inventory Map).

Vegetation in the Disturbed Upland Area of the CLTL terminal is restricted to three areas. These include the area just west of the employee parking area, between Cedar Swamp Road and the railroad tracks; the area corresponding to the former aeration/final settling lagoons; and the area bordering the former aeration lagoons and Cedar Swamp. Vegetation adjacent to the employee parking area is dominated by rose bushes, crab apple, and cherry trees, with broom sedge, goldenrod and various grasses. The area corresponding to the former aeration/ final settling lagoons is sparsely vegetated with goldenrod, broom sedge, dogbane, phragmites, cattail, blue vervain and unidentified grasses. The area bordering the former aeration/final settling lagoons in Cedar Swamp is covered with a variety of trees including black cherry, red maple, white oak, red oak, pin oak, honey locust and black oak. The understory of shrubs and herbaceous plants includes phragmites, poison ivy, green brier, arrowwood viburnum and jewelweed.

Wildlife in the Disturbed Upland Area of the CLTL terminal inhabit the vegetated areas described above. Birds which are known to inhabit the area are listed in Table 2-2. Mammals include squirrels, rabbits, groundhogs and an occasional raccoon.

The Palustrine Forested Wetland corresponding to the reach of Cedar Swamp flanking the CLTL terminal to the south and east is a tidal freshwater wetland. The vegetation in the low lying area of Cedar Swamp adjacent to the CLTL terminal is dominated by water hemp. Other vegetation within the low lying area includes poison ivy (shrub), pin oak, black willow and several dead southern white cedar. The area covered by water hemp extends to the south and the east approximately 200 to 300 feet where the forested wetland begins. Ponded water, averaging 0.5 to 2.0 feet deep is present throughout the forested wetland area. Vegetation in the forested wetland area is dominated by red maple with abundant poison ivy (shrub), skunk cabbage, sensitive fern, rose, green brier, arrowwood viburnum, jewelweed, water hemp, elderberry, water lily and arrow-arum.

TABLE 2-2

BIRDS INHABITING THE UPLAND AREA OF THE CLTL TERMINAL

Starling

Red Winged Blackbird

Song Sparrow

Robin

Purple Finch

Black and White Warbler

Yellow Rumped Warbler

Blue Jay

Dove

Mocking Bird

Goldfinch

Grackle

Brown Thrasher

Wildlife observed in the non-forested and forested wetland area of Cedar Swamp adjacent to the CLTL terminal includes the birds listed in Table 2-3, whitetail deer, black snakes and unidentified fish in Moss Branch. Other wildlife known to inhabit this area include amphibian and reptile species such as the green frog, tree frog, northern spring peeper, bull frog, box turtle, painted turtle and snapping turtle. Mammals include whitetail deer, raccoon, muskrat, squirrel, rabbit, skunk and red fox. Fresh water fish include bluegills, pumpkinseed, suckers, brown bullhead, and black and white crappies.

Cedar Swamp, which lies generally northeast of the CLTL site between Cedar Swamp Road and Route 130 and north of Route 130, is also a Palustrine Forested Wetland. The vegetation and wildlife in this area of Cedar Swamp is similar to the vegetation and wildlife noted in the forested wetland area south and east of the CLTL terminal.

The Palustrine Open Water habitat adjacent to the CLTL site includes Cooper Lake and its surrounding shoreline, located between Route 44 and 130. Vegetation surrounding Cooper Lake includes smooth alder, Japanese honeysuckle, green brier, red maple, arrowwood viburnum, dogbane, sensitive fern, and poison ivy (shrub). A variety of fresh water fish inhabit Cooper Lake, including minnows, carp, crappies, sunfish, catfish and bass. Other wildlife known to inhabit the shoreline of the lake include snakes, salamanders, frogs, deer, raccoons, skunks, rabbits, foxes and turtles.

Cedar Swamp and Cooper Lake provide a significant shelter for migratory bird species such as canada goose, wood duck, mallard, black duck, coot, lesser scaup and other waterfowl species.

Short-nosed sturgeon are present in the Delaware River and use the river in the vicinity of the site as a migratory corridor. The species is on the Federal Endangered and Threatened Wildlife and Plants list (Federal Register, 1983). However, short-nosed sturgeon are not expected to use the Cedar Swamp near the site.

Additional endangered species suspected to inhabit the area surrounding the CLTL Terminal, as listed in NUS (1985), include the osprey, which was severely threatened in the 1960s but presently is recovering, the bog turtle and the eastern tiger salamander. The U.S. Department of the Interior, Fish and Wildlife Service has informed EPA that, with the exception of occasional transient species, no proposed or threatened endangered flora or fauna as listed by DOI are known to exist in the vicinity of the CLTL site.

TABLE 2-3

BIRDS INHABITING THE PALUSTRINE FORESTED WETLAND AND THE PALUSTRINE OPEN WATER HABITAT IN THE VICINITY OF THE CLTL SITE

White Throated Sparrow

Red Winged Blackbird

Carolina Wren

House Wren

Tree Swallow

Common Yellowthroat

Rusty Blackbird

Wood Duck

Veery

Grackle

Starling

Flicker

Cardinal

Downy Woodpecker

Black Duck

Canada Goose

Woodcock*

* Sighted by EPA Oversight Contractor (1988)

2.6 Regional Geology

The CLTL site lies within the Atlantic Coastal Plain physiographic province. The Atlantic Coastal Plain in New Jersey forms a wedge-shaped body of unconsolidated sediments that thicken from a feather edge at the Fall Line, which separates the crystalline Piedmont physiographic province from the Coastal Plain, to greater than 6,000 feet along the Atlantic Coast near Cape May, New Jersey (Gill and Farlekas, 1976). The Coastal Plain rests unconformably upon crystalline basement rocks of the Wissahickon Formation.

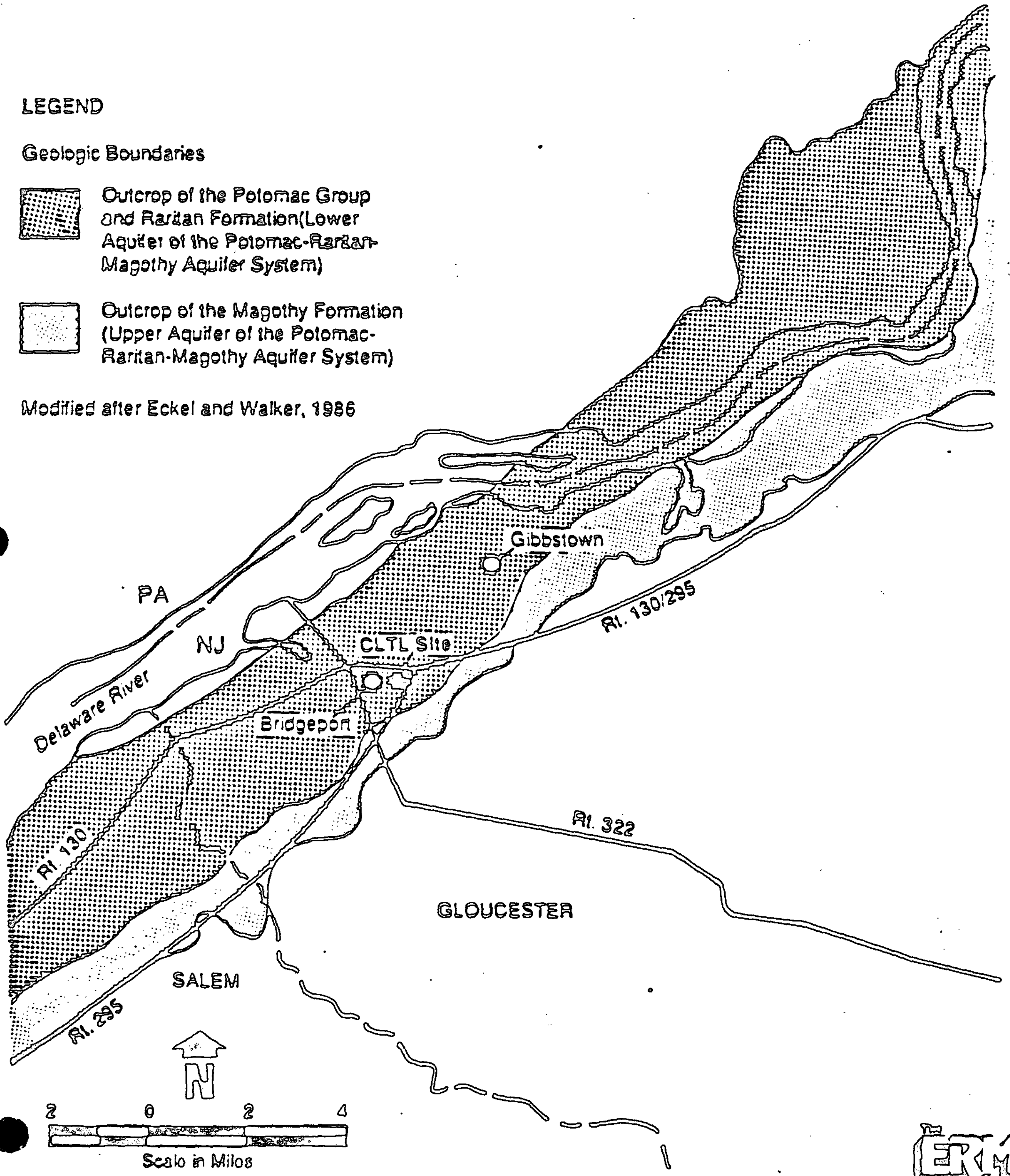
The CLTL site falls within the outcrop belt of the undifferentiated Potomac Group-Raritan Formation, just northwest of the contact between the Potomac Group-Raritan Formation and the slightly younger Magothy Formation (Eckel and Walker, 1986). Figure 2-3 shows the location of the CLTL site in relation to this geologic contact. The Potomac Group and the Raritan and Magothy Formations range in age from early to late Cretaceous and are the basal units of the Coastal Plain in southern New Jersey (Gill and Farlekas, 1976). These units crop out in a northeast trending band that parallels the Delaware River in southern New Jersey. The strata dip to the southeast from 10 to 60 feet/mile (Zapecza, 1984). At higher elevations in the vicinity of the CLTL site, nearly flat-lying Quaternary age deposits of the Cape May Formation disconformably overlie the Potomac Group and the Raritan and Magothy Formations (Andres, 1984).

The Potomac Group consists of alternating variegated clay, silt, sand, and gravel. The overlying Raritan Formation is characterized by alternating light gray, reddish-white and variegated clay and fine to coarse grained sand and silt.

Interbedded light to dark gray clay and quartz sand characterize the Magothy Formation. The Cape May Formation consists of thick quartz sand and light colored clay (Walker, 1983).

Because of the lithologic similarity of these units and the laterally discontinuous nature of the beds, no attempt is made to differentiate between the Potomac Group and the Raritan Formation and, if present, the younger Magothy and Cape May Formations in the vicinity of the CLTL site. Deep boreholes installed by USGS indicate the thickness of the Cretaceous and Quaternary strata beneath the site approaches 260 feet (USGS, in preparation).

Figure 2-3
Regional Geologic Setting of the CLTL Site



ERM

2.7 Regional Hydrogeology

The interbedded clay, silt, sand and gravel of the Potomac Group and the Raritan and Magothy Formations comprise the Potomac-Raritan-Magothy aquifer system. In the outcrop area, the Potomac-Raritan-Magothy aquifer system also includes the disconformable Quaternary deposits of the Cape May Formation, commonly present at the surface. The Potomac-Raritan-Magothy aquifer system is the primary water source for southern and central New Jersey (Luzier, 1980).

Published reports have variously interpreted two, three or four aquifers within the Potomac-Raritan-Magothy aquifer system. In part, the lateral heterogeneity of the sand, silt and clay units within these strata is to blame for these various interpretations. This report will follow the interpretation given by Walker (1983), which identifies a lower and upper aquifer in the Potomac-Raritan-Magothy aquifer system.

In southern New Jersey, the lower aquifer of the Potomac-Raritan-Magothy aquifer system includes the interbedded gravel, sand, silt and clay of the Potomac Group and the Raritan Formation and the disconformable Cape May Formation, which commonly caps the sequence in the outcrop area (Walker, 1983). According to published geologic maps, the CLTL site falls within the outcrop area of the lower aquifer of the Potomac-Raritan-Magothy aquifer system (Figure 2-3).

The upper aquifer of the Potomac-Raritan-Magothy aquifer system includes the sand silt and clay of the Magothy Formation and, in the outcrop area, younger surficial deposits of the Cape May Formation (Walker, 1983). The upper aquifer of the Potomac-Raritan-Magothy aquifer system crops out less than one mile southeast of the CLTL site (Figure 2-3).

Recent studies have addressed the decline in water levels in the Potomac-Raritan-Magothy aquifer system over the last 30 years (see Luzier, 1980; Vowinkel and Foster, 1981; Fusillo and Voronin, 1981; Walker, 1983; Eckel and Walker, 1986). Each study recognizes large cones of depression centered in the major industrial and population centers of the Camden and Middlesex-Monmouth County areas. These and other local significant withdrawals from the aquifer system have changed the flow direction of ground water within the system. Whereas the aquifer previously discharged into the Delaware River and streams dissecting the outcrop area, in many places, these water bodies now recharge the aquifer system (Fusillo and Voronin, 1981).

SECTION 3

FIELD INVESTIGATION

3.1 Introduction

3.1.1 Summary of Field Investigations

EPA listed the CLTL Bridgeport, New Jersey terminal as a National Priorities List Superfund site in 1985. Field investigations performed at the facility prior to the site's inclusion on the National Priorities List have been summarized in Section 1.3 of this RI report and by ERM (1981). The investigations described in Sections 3 and 4 of this RI were performed subsequent to the listing on the National Priorities List. These separate field efforts fall into the following categories:

- A field investigation designed to meet the objectives defined in the RI/FS Work Plan prepared for the EPA by NUS Corporation (Table 1-8).
- A supplementary field effort required by EPA in November 1987. This supplementary field effort included the installation of three additional monitoring wells; the collection of additional ground-water, soil, surface water and sediment samples; the conduct of an electromagnetic conductivity survey in Cedar Swamp; and the completion of a aquifer pump test at the site.
- An additional field study conducted by EPA's contractor, CDM FPC, in September 1989 which included re-measurement of ground water levels and a re-survey of surface elevations of 21 monitoring wells.

3.1.2 CLTL-Related Wetlands Contamination

Preliminary results of surface water and sediment sampling and the electromagnetic conductivity survey in Cedar Swamp conducted during the supplementary field effort in 1987 (Plates 2 and 3) suggest portions of the wetlands adjacent to the active terminal area of the CLTL site have been contaminated with organics by CLTL's past wastewater disposal practices. In addition, surface water and sediment samples in the wetlands in the vicinity of the CLTL terminal show elevated concentrations of metals. A separate RI/FS for the wetlands operable unit will be required to determine the nature and extent of contamination in the wetlands area. Appendix E includes the preliminary results from wetlands samples collected with a brief explanation of the wetlands sample collection methods, a short summary of the sampling results, and a map showing sample locations.

A preliminary air quality survey of the CLTL site was conducted using portable oxygen and lower explosive limit (LEL) meters to identify zones of oxygen deficiency and to monitor the explosive potential of the atmosphere. In addition, flame ionization detectors (FID) and photoionization detectors (PID) were used to monitor for the presence of volatile organics vapors. Results of this survey showed no detectable volatile organic concentrations within the study area. Explosimeter and oxygen measurements indicated normal background levels of 0 percent LEL and 19.5 percent oxygen, respectively.

3.2 Hydrogeologic Investigation

3.2.1 Purpose and Scope

The purpose of conducting the hydrogeologic investigation was two-fold:

1. to install ground-water monitoring wells, screened at various depths and distributed at locations throughout the site, which would provide an understanding of the subsurface hydrogeology and allow the repeated collection of ground-water samples from discrete water-bearing units; and

2. to conduct a series of physical tests using monitoring wells screened in the various water-bearing subzones which would lead to an interpretation of the subsurface hydrogeologic framework as it relates to ground-water flow dynamics, ground-water contaminant plume configurations, and other parameters which bear upon the occurrence, and ultimate recovery, of contaminants in ground water beneath the site.

The hydrogeologic investigation included the following tasks:

1. The installation of 21 ground-water monitoring wells at the CLTL site (in addition to the 18 TP-series wells, 6 CL-series wells, and 2 DW-series wells installed in 1981);

2. The performance of slug tests on selected ground-water monitoring wells;

3. The completion of three water level studies; and

4. The performance of a aquifer pump test of the CLTL production well.

3.2.2 Monitoring Well Placement

Two major hydrogeologic units exist within the undifferentiated Potomac Group-Raritan Formation in the vicinity of the CLTL site:

1. A lower hydrogeologic unit which occurs from approximately 200 to 250 feet below land surface and is confined below by the Wissahickon Formation and above by one or more continuous clay units approximately 60 to 70 feet in total thickness; and

2. An upper hydrogeologic unit which consists of approximately the upper 150 feet of the undifferentiated Potomac Group-Raritan Formation and, where present, the thin veneer (<10 feet) of the overlying Cape May Formation.

The screened intervals in the monitoring wells installed by ERM at the CLTL site fall within the upper hydrogeologic unit of the undifferentiated Potomac Group-Raritan Formation. Available data indicate the presence of three to four water-bearing subzones within the upper hydrogeologic unit of the undifferentiated Potomac Group-Raritan Formation in the vicinity of the CLTL site. Each subzone is different lithologically. However all four subzones are hydrologically connected and behave together as one aquifer. Each subzone exhibits subtle hydrological differences. Although the extent to which each subzone behavior will vary somewhat in degree. In places, discontinuous clay units of variable thickness and lateral extent separate these water-bearing subzones. Plate 4 depicts this interpretation of the upper hydrogeologic unit of the undifferentiated Potomac Group-Raritan Formation beneath the CLTL site. This fence diagram was developed using geologic logs from monitoring wells installed at the site (Appendices A, F and G). From shallowest to deepest, clay units beneath the CLTL site include the following:

- Thin, discontinuous, generally white to medium gray clay units which occur in most monitoring wells between the subsurface elevations of approximately 0 feet and -20 feet (MSL). Although these clay units range up to 11 feet in thickness, most clay units in this interval measure approximately 5 feet.

- A series of generally white to medium gray clay units, encountered in most monitoring wells between the subsurface elevations of approximately -20 feet and -60 feet (MSL), which range in thickness from a few inches to as much as 11 feet. These clay units are not continuous beneath the site; however, they may be of sufficient thickness and lateral extent to influence contaminant migration.

- Two variegated to red clay units, which range in thickness from a few feet to as much as 38 feet. One or both of these clay units occur beneath the central and eastern portions of the site. The top of the upper of these clay units occurs as shallow as approximately -60 feet (MSL), while the lower variegated to red clay is encountered as deep as approximately -125 feet (MSL). Although not present in wells installed at the western part of the site, these clay units appear to be the most extensive of the clay units encountered in wells installed at the site as part of the RI.

Because of the variable depth, thickness and lateral extent of the clay units beneath the CLTL site, the water-bearing subzones cannot be defined based solely upon stratigraphic position with respect to the clay units. Instead, a definition that rests primarily upon subsurface elevation and secondarily upon stratigraphic position must be employed. Figure 3-1 represents a schematic cross section that illustrates the relationship between the water-bearing subzones beneath the site. The following definitions apply to the water-bearing subzones:

- Shallow Subzone: Occurs between the ground surface and a subsurface elevation of -20 feet (MSL). Encompasses the shallowest of the clay units described above.

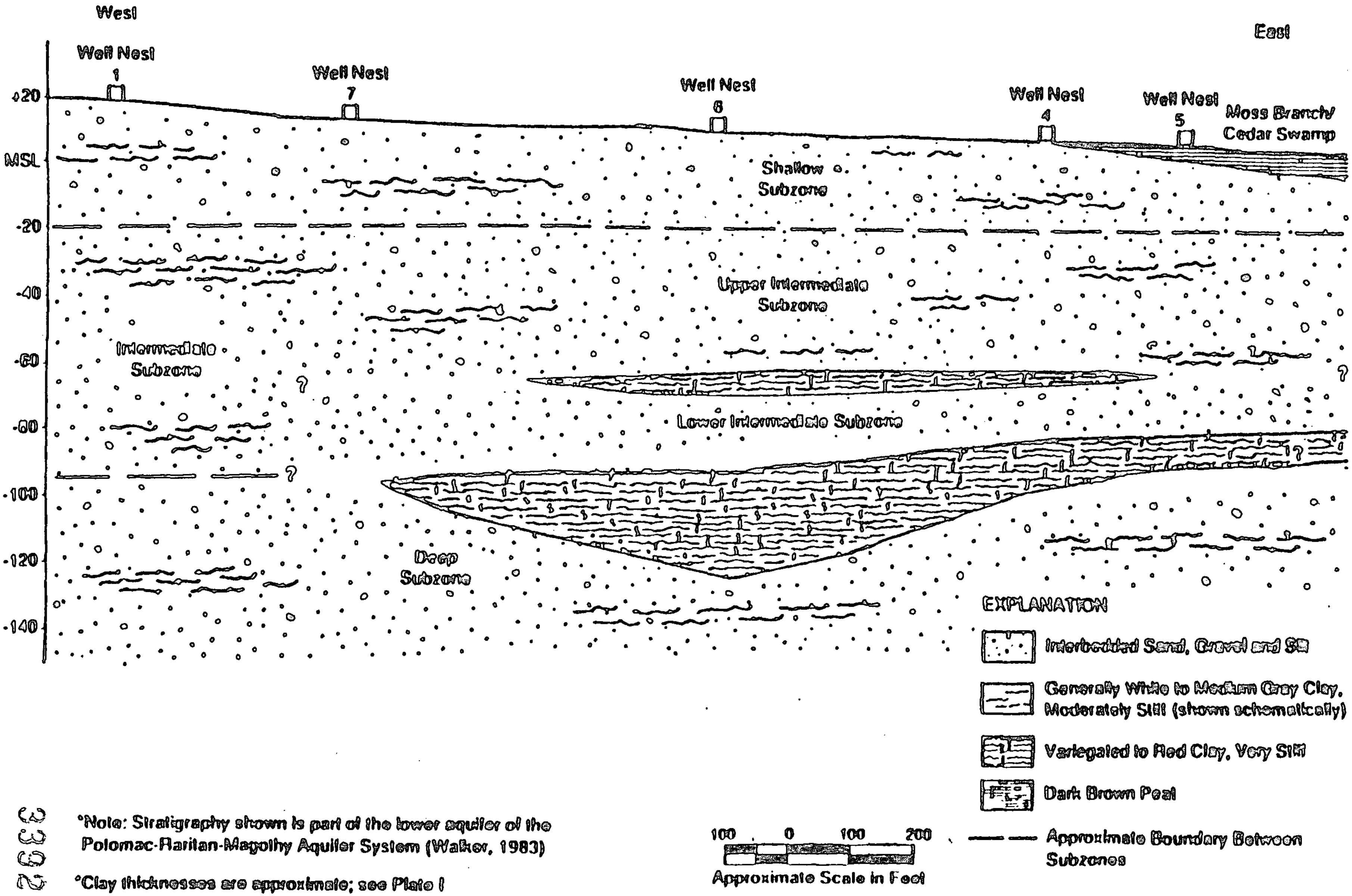
- Intermediate Subzone: Occurs between the subsurface elevations of -20 feet (MSL) and approximately -95 feet (MSL). Beneath the central and eastern portions of the site, the intermediate subzone may be subdivided into an upper and lower intermediate subzone. The shallower of the two variegated to red clay units (described above), which occurs at a subsurface elevation of roughly -60 to -70 feet (MSL), separates the upper and lower intermediate subzones.

- Deep Subzone: Occurs beneath the intermediate subzone, between the subsurface elevations of -95 feet (MSL) and approximately -150 feet (MSL). In most well nests (excluding well nests 1 and 2), the lower of the two variegated to red clay units (described above) separates the deep subzone from the intermediate subzone.

Twenty-one monitoring wells were installed at the CLTL site in two separate phases of drilling: 18 wells installed during the period from March to May 1986, and 3 wells installed during November 1987. Plate I shows the locations of these wells.

Figure 3-1

Schematic Geologic Cross Section
Showing the Various Water Bearing Subzones Beneath the CLTL Site



*Note: Stratigraphy shown is part of the lower aquifer of the Potomac-Raritan-Magothy Aquifer System (Walker, 1983)

*Clay thicknesses are approximate; see Plate I

Well locations and screened intervals were selected that would augment the data available from existing site monitoring wells, residential wells (Res-1, Res-2, and Res-3), and monitoring wells installed at the adjacent BROS site and on the Gaventa property (USGS-A, -B, -C, and -D). The wells installed as part of the hydrogeologic investigation range in total depth from 15 to 155 feet below ground surface, and the screened intervals of the wells range in subsurface elevation from +3.4 feet (MSL) to -139.6 feet (MSL). Most of the wells installed as part of the hydrogeologic investigation are located near the periphery of the site in an effort to determine the lateral extent of contamination beneath and surrounding the site.

Several well nests were installed. Individual wells in each nest are finished at elevations which allow discrete monitoring of the separate water-bearing subzones. General depths were selected for wells prior to drilling and were modified to fit hydrogeologic conditions as drilling progressed. Six wells (1A, 2A, 3A, 4A, 7A and 8A) are screened in the shallow subzone, eleven wells (1B, 2B, 2C, 2D, 3B, 4C, 5A, 6B, 7B, 9C and 10C) in the intermediate subzone, and four wells (1C, 4D, 6A and 10D) in the deep subzone. Access roads were built to well nests 2, 3 and 4 prior to the start of drilling. Materials for these roads came from the Bridgeport Materials, Inc., sand and gravel pit to the west of the site. Table 3-1 lists the screened intervals, total depths, and elevations for the wells installed as part of the RI.

3.2.3 Monitoring Well Installation

Drilling and well installation were performed by a New Jersey-licensed well driller, under the observation of an ERM geologist and in the presence of an EPA oversight contractor Camp, Dresser and McKee (CDM). J.E. Fritts and Associates of Kirkwood, New Jersey, installed 18 wells during the period from March to May 1986, and Parratt-Wolff, Inc., of Syracuse, New York, installed 3 additional wells during November 1987. The wells were installed in accordance with the New Jersey Department of Environmental Protection (NJDEP) specifications, or using modified methods approved by NJDEP and EPA.

Split spoon samples were taken at five-foot intervals, or at lithologic changes, using the Standard Penetration Method (ASTM D1586-67) and were cataloged and stored for future reference in moisture-tight jars. During the period from March to May 1986, the driller collected undisturbed samples of selected confining clay layers with Shelby tubes. These samples were collected in accordance with ASTM D1587-83 and were analyzed by Valley Forge Testing of Devon, Pennsylvania, for permeability using the

TABLE 3-1

SCREENED INTERVALS AND TOTAL DEPTHS FOR MONITORING WELLS INSTALLED AS PART OF THE REMEDIAL INVESTIGATION AT THE CLTL SITE

Monitoring Well	Ground Surface Elevation (in feet above MSL)	Screened Interval (in feet below ground surface)	Range in Elevation of Screened Interval (in feet with respect to MSL)	Total Depth (in feet below ground surface)	Elevation of Total Depth of Well (in feet with respect to MSL)
SHALLOW SUBZONE WELLS:					
1A	17.39	14 to 19	+ 3.39 to - 1.61	19	- 1.61
2A	6.25	14.5 to 19.5	- 8.25 to -13.25	20.5	-14.25
2B	6.30	28 to 38	-21.70 to -31.70	38	-31.70
3A	6.34	17.5 to 22.5	-11.16 to -16.16	23	-16.66
4A	6.41	18 to 23	-11.59 to -16.59	23.5	-17.09
7A	13.29	20.5 to 25.5	- 7.21 to -12.21	25.5	-12.21
8A	9.19	8 to 13	+ 1.19 to - 3.81	15	- 5.81
INTERMEDIATE SUBZONE WELLS:					
Upper Intermediate Subzone					
1B	17.81	60 to 70	-42.19 to -52.19	70.5	-52.69
2C	6.48	55 to 60	-48.52 to -53.52	60	-53.52
3B	6.16	49 to 59	-42.84 to -52.84	60	-53.84
5A	7.59	50 to 60	-42.41 to -52.41	60	-52.41
7B	14.16	50 to 60	-35.84 to -45.84	60	-45.84
9C	9.05	60 to 70	-50.95 to -60.95	72	-62.95
10C	4.35	40 to 50	-35.65 to -45.65	50	-45.65
Lower Intermediate Subzone					
2D	6.28	87 to 97	-80.72 to -90.72	150	-143.72
4C	7.96	72 to 82	-64.04 to -74.04	82	-74.04
6B	10.74	87 to 97	-76.26 to -86.26	120	-109.26

TABLE 3-1 (continued)

Monitoring Well	Ground Surface Elevation (in feet above MSL)	Screened Interval (in feet below ground surface)	Range in Elevation of Screened Interval (in feet with respect to MSL)	Total Depth (in feet below ground surface)	Elevation of Total Depth of Well (in feet with respect to MSL)
DEEP SUBZONE WELLS:					
1C	17.67	130 to 140	-112.33 to -122.33	143	-125.33
4D	7.93	108 to 118	-100.07 to -110.07	155	-147.07
6A	10.37	145 to 150	-134.63 to -139.63	150	-139.63
10D	4.36	113 to 123	-108.64 to -118.64	125.5	-121.14

falling head method. Appendix H presents the results of the permeability analysis. A Foxboro organic vapor analyzer (OVA) Model #128 (flame ionization detector) was used to scan split spoon samples, Shelby tubes, and drill cuttings in order to detect the presence of organic vapors. Appendix F contains the geologic and construction logs of monitoring wells installed during the RI.

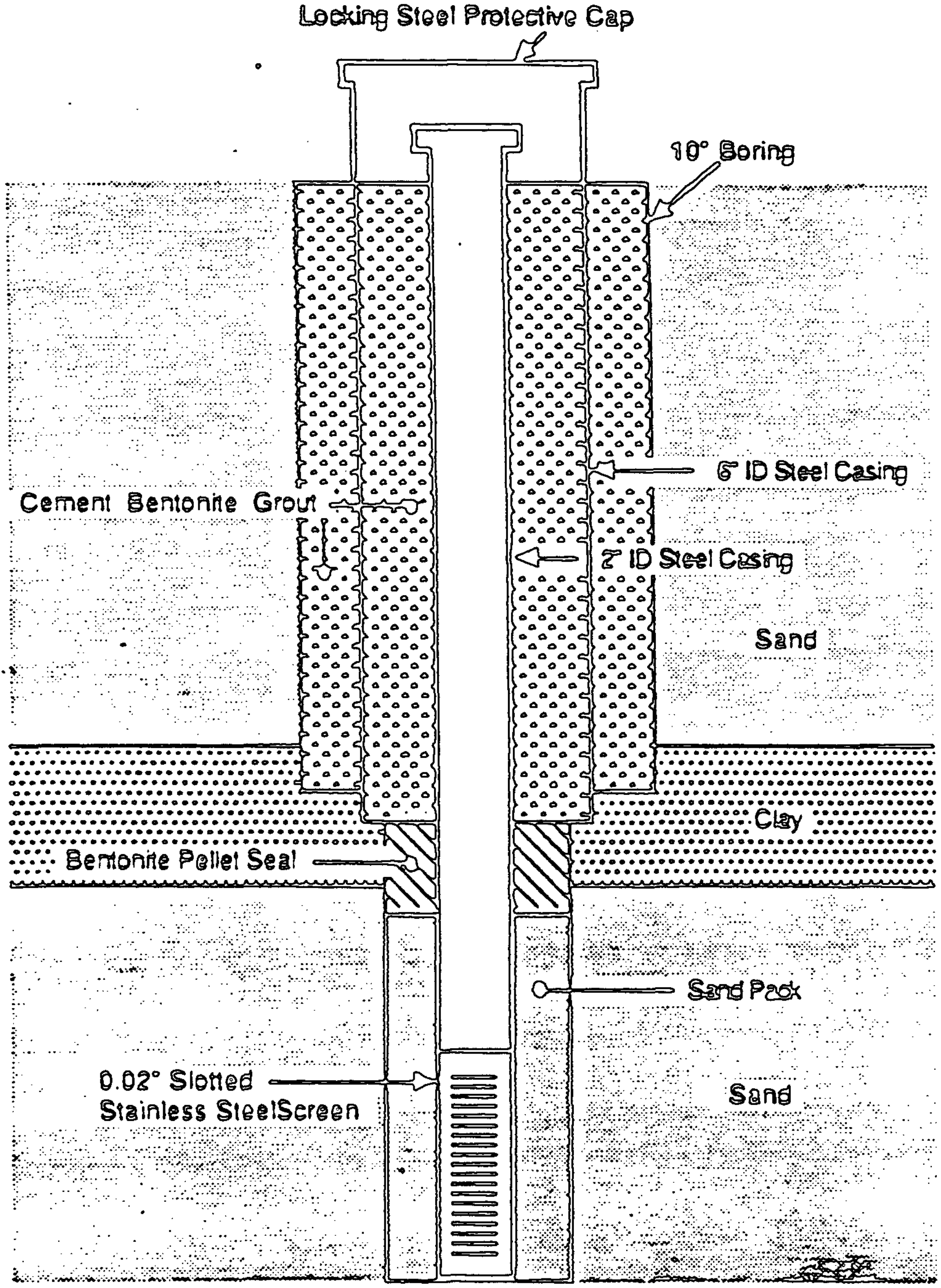
To minimize the potential for cross contamination between borings, drilling equipment was steam cleaned initially and between borings. In addition, split spoon samplers were washed with mild, soapy water between uses in the same boring. Prior to installation, the casings and screens were thoroughly steam cleaned to remove any manufacturing-related contaminants. Where necessary, a solution of sodium hydroxide and water was used to remove any oily residue found on the machined threads of the carbon steel pipe. The sodium hydroxide solution was subsequently removed by rinsing with clean water.

Well cuttings and drilling materials were disposed off site. Equipment decontamination took place within the curbed concrete wastewater loading pad, which drains into the wastewater holding tank. Decontamination wastewater was handled with the terminal's wastewater for treatment and disposal.

The intermediate and deep subzone monitoring wells were installed using the mud rotary drilling method. Four of the deepest wells (1C, 2D, 4D and 6B) were drilled using a four-inch guidehole to characterize the site geology and to determine the appropriate depths for installation of the other wells. Upon reaching the total depth, USGS logged each of these boreholes using the following logging tools: a caliper log, an electric log, and a gamma ray log. Appendix G presents copies of the field prints from USGS logs.

Each of the intermediate and deep subzone wells installed during the period from March to May 1986 was constructed using the method described below. To prevent interconnection between the water-bearing zones and possible cross contamination during drilling, a 6-inch ID carbon steel casing was installed in a 10-inch ID borehole, then pushed 1 to 2 feet into the clay unit overlying the zone in which the well was to be completed. The casing was then tremie-grouted into place with a cement/bentonite mix. Next, a 6-inch diameter borehole (actual dimensions were slightly less than 6 inches) was drilled to the desired depth through the 6-inch casing. The wells were completed with 2-inch, threaded, carbon steel casing and a 5- or 10-foot section of wire-wrapped, 316 stainless steel, 0.10-inch slot screen. The annular space around the screen was packed with a #2 Jessie Morie

Figure 3-2
Intermediate and Deep Subzone Monitoring Well Construction Schematic

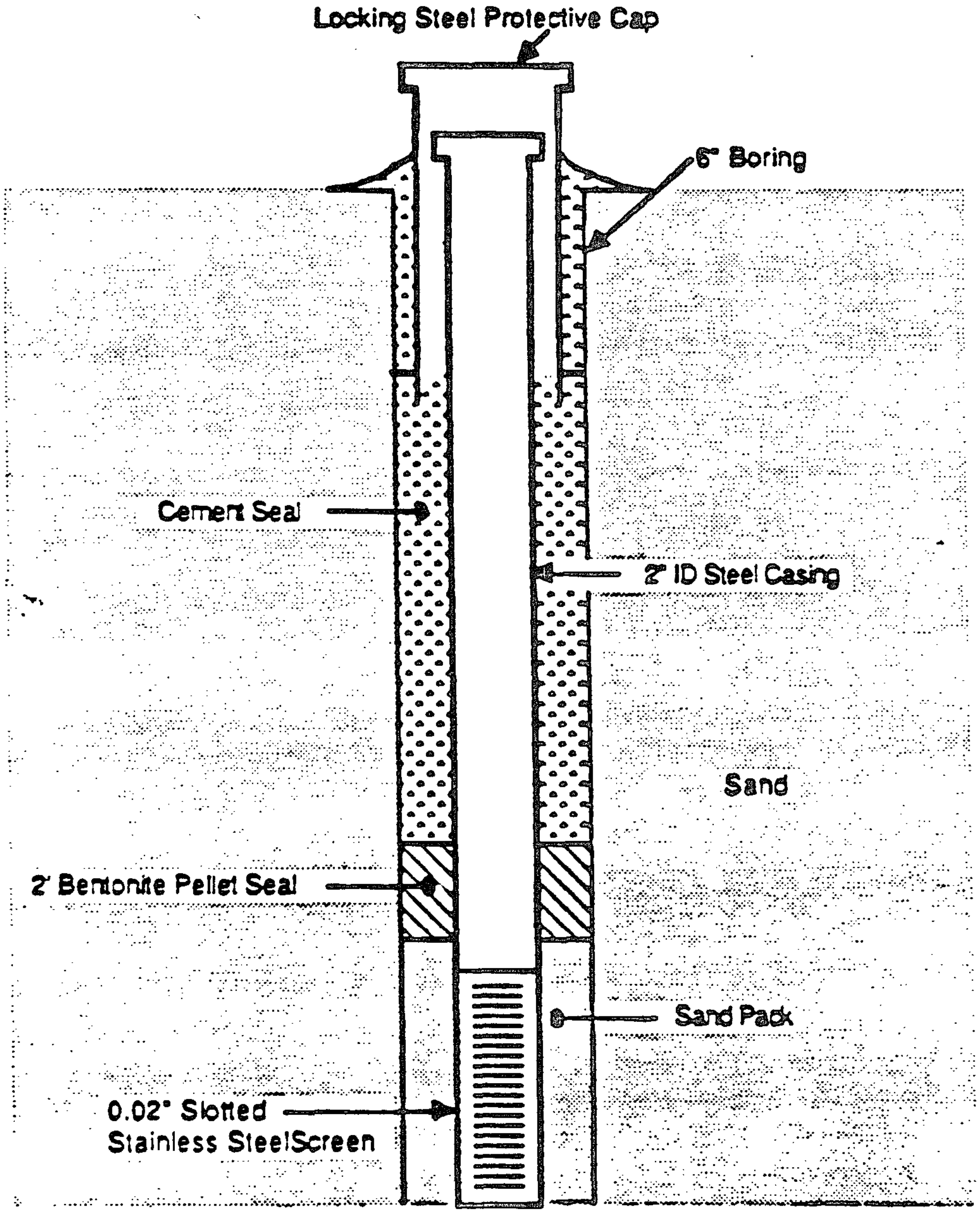


Pertains to Intermediate and Deep Subzone Wells Installed at CLTL Site by ERM as Part of RI.

Not drawn to scale.

See text for construction modifications in wells 9C, 10C, and 10D.

Figure 3-3
Shallow Subzone
Monitoring Well Construction Schematic



Pertains to Shallow Subzone Wells
Installed at CLTL Site by ERM as Part of RI

Not drawn to scale.

sand to a minimum of two feet above the top of the screen. A one- to two-foot layer of bentonite pellets was placed on top of the sand, and the annular space was grouted to the ground surface with a cement-bentonite slurry. Figure 3-2 represents a schematic cross sectional drawing of the intermediate and deep subzone monitoring well construction details.

Two intermediate subzone wells, 9C and 10C, and one deep subzone well, 10D, were installed in November 1987 using a track-mounted mud rotary drilling rig. The track-mounted drilling rig was necessary to access wells 10C and 10D, located in Cedar Swamp (Plate 1). Mechanical limitations of the track-mounted rig required that six-inch casing be set inside an eight-inch borehole (as compared to a 10-inch borehole for the other intermediate and deep wells). This outer casing was set to 34 feet (-29.6 feet MSL) in well 10D, followed by a string of four-inch, threaded PVC pipe set into a clay unit at 94 feet (-89.6 feet MSL). This additional string of casing was installed to prevent interconnection between several distinct water-bearing units (separated by clay units) above the zone in which deep subzone well 10D was completed (Appendix F). Both the six-inch and four-inch casings were tremie grouted in place with a cement/bentonite mix.

The wells were completed by drilling inside the six-inch or four-inch ID casing to the desired well depth. The wells were finished with well screens using the same techniques described above; however, the driller was unable to sand pack the screened interval in wells 9C and 10D, as the formation collapsed around the screen soon after it was installed. The well was completed with the natural sand pack around the screen.

The six shallow wells (1A, 2A, 3A, 4A, 7A and 8A) installed during the period from March to May 1986 were completed using a hollow stem auger drilling rig. Four-inch inside diameter (ID) hollow stem augers were used. These wells range in depth from 15 to 25.5 feet below ground surface (-1.61 to -17.09 feet MSL). Each well consists of a two-inch ID, threaded carbon steel casing and five feet of wire wrapped, 316 stainless steel, 0.020-inch slot screen. The annular space around the screens was packed with #2 Jessie Morie sand to a minimum of two feet above the top of the screen. A two- to three-foot thick bentonite pellet seal was installed over the sand pack. The remaining annular space was filled with a cement/bentonite grout poured to within three feet of ground level. Figure 3-3 shows a monitoring well construction schematic for the shallow subzone wells installed as part of the RI.

To prevent infiltration of surface water and provide security, a six-inch steel protective casing with a hinged and locking cap was cemented into place over each of the shallow wells. The cement seal extends approximately three feet below land surface. For the intermediate and deep wells, the six-inch casing was extended approximately two feet above the ground surface, grouted at the surface, and a hinged and locking cap was attached; the three wells located on Cedar Swamp Road (4C, 4D and 5A) are flush mounted in manhole boxes to avoid damage. Each of the wells with locking caps was equipped with master-keyed padlocks.

Upon completion, each well was developed using compressed air and/or pumping until free of sand. The ground water removed during well development was placed in a 1,000-gallon tank truck supplied by the driller or in 55-gallon drums loaded onto a flat bed truck and subsequently transferred to the wastewater holding tank. CLTL personnel combined the development water with the terminal's wastewater for off-site treatment and disposal.

Several weeks after installation of the first 18 monitoring wells, it was discovered that the pH levels at certain wells (1B, 2D, 4D, 6A, 6B and 7B) were higher than expected for this area. These wells were redeveloped by pumping with a centrifugal pump until the observed pH fell within the normal range (4.1 to 8.3) for this area (Fusillo and Voronin, 1981).

The casing elevation and location for each newly installed well and for each of the previously installed wells was surveyed to the nearest one-hundredth of a foot by J. M. Stewart, Inc., a New Jersey-licensed surveyor. The vertical datum used was the New Jersey Geodetic Monument #4985 (elevation 17.104 feet North American Vertical Datum - MSL). Horizontal coordinates are referenced to a site datum. The elevations were determined at a permanently marked reference point on the lip of each of the two-inch casings. Each of the wells was resurveyed by J.M. Stewart in October 1986 to ensure that casings had not settled in the interim. In April 1988, J.M. Stewart surveyed the top of the casing elevation and location of wells 3A and 3B and newly installed wells 9C, 10C, and 10D. In January 1989, J.M. Stewart surveyed CL-2, 7A, DW-2, and the CLTL production well. Appendix I presents copies of the surveyor's well location and elevation data

It is noted, however, that EPA has determined that the elevation data used on the topographic base maps conflict with some of the ground-water level information. In some cases, the reported ground-water elevations in the wetlands area were one foot higher than the swamp surface at a time when the wetlands were reported to be dry. Clearly a discrepancy exists because the swamp should be wet if shallow ground-water levels are higher than the swamp surface. As a result of this discrepancy, EPA resurveyed the 21 monitoring well surface elevations in September 1989. The resurvey data is presented in Appendix U.

3.2.4 Piezometer Installation

In 1986, a series of piezometers was to have been installed in Cedar Swamp to evaluate the dynamics of ground-water flow in the vicinity of Moss Branch. The piezometers were to consist of a length of plastic tubing slotted at one end and placed in a length of steel pipe. The steel pipe was to be driven by sledge hammer to the desired depth below the surface. The steel pipe would then be removed, leaving the tubing at the desired depth. Piezometers were to have been installed at depths of 3, 6, 15, 25 and 35 feet. Unfortunately, after several attempts at installation by EPA and ERM personnel, the effort was abandoned. It was concluded that deposits of vegetative debris, silt, and peat underlying the proposed locations extend well below the surface. This made the installation of the piezometers by the method described impossible.

3.2.5 Slug Tests

During June 1986, slug tests were performed on 14 of the 18 monitoring wells installed during 1986 (Table 3-1). The slug tests were performed to evaluate the hydraulic conductivity of the aquifer in which the well is screened.

The tests were performed by rapidly pouring a volume of distilled water, the slug, into the well to effect a change in water level between 1 and 3 feet. The subsequent recovery of the water level was monitored with an In-Situ Hermit SE1000B electronic data logger coupled with an In-Situ pressure transducer. Each test proceeded until the water level recovery was at least 90% complete.

The slug test data were evaluated by two methods: 1) the method of Nguyen and Pinder (1985); and 2) the Hvorslev (1951) method. The calculated hydraulic conductivity results are presented in Section 4.2.1. A more detailed description of the analytical methods, data plots, and the Nguyen and Pinder (1985) paper are presented in Appendix J.

3.2.6 Continuous Water Level Studies

In July 1986, electronic water level recording instruments were installed in several wells and water levels were recorded every fifteen minutes for eight days. A review of these ground-water elevation data showed that the water-bearing subzones ground-water elevations were affected by tidal influences. However, no precipitation or barometric pressure data were collected and no steel tape measurements were used to verify the electronic water level recording instruments. Measurements obtained using a steel measuring tape are considered to be the most reliable method of measuring ground-water elevations and are capable of measuring elevations to the nearest 0.01 foot. Although use of steel tape was explicitly required in the EPA approved work plan, CLTL failed to use this more accurate method of measurement. EPA believes that not considering precipitation or barometric pressure data and not utilizing steel tapes for water level measurements compromises the precision of the measurements at this site since the ground-water gradients are relatively flat. As a result, the July 1986 data were not used in this report.

CLTL conducted two additional eight-day rounds of water level measurements in August 1986 and February 1987. These studies, which were not part of the RI Work Plan, were not approved or overseen by EPA. These studies did not include the collection of precipitation or barometric pressure data and adequate checks on the accuracy of the electronic water level recorders were not provided. Furthermore, due to these deficiencies EPA considers these results to be inconclusive. However, these data are provided for the reader's information in Appendix K. Figures 3-4 and 3-5 show the wells monitored during the August 1986 and February 1987 water level studies.

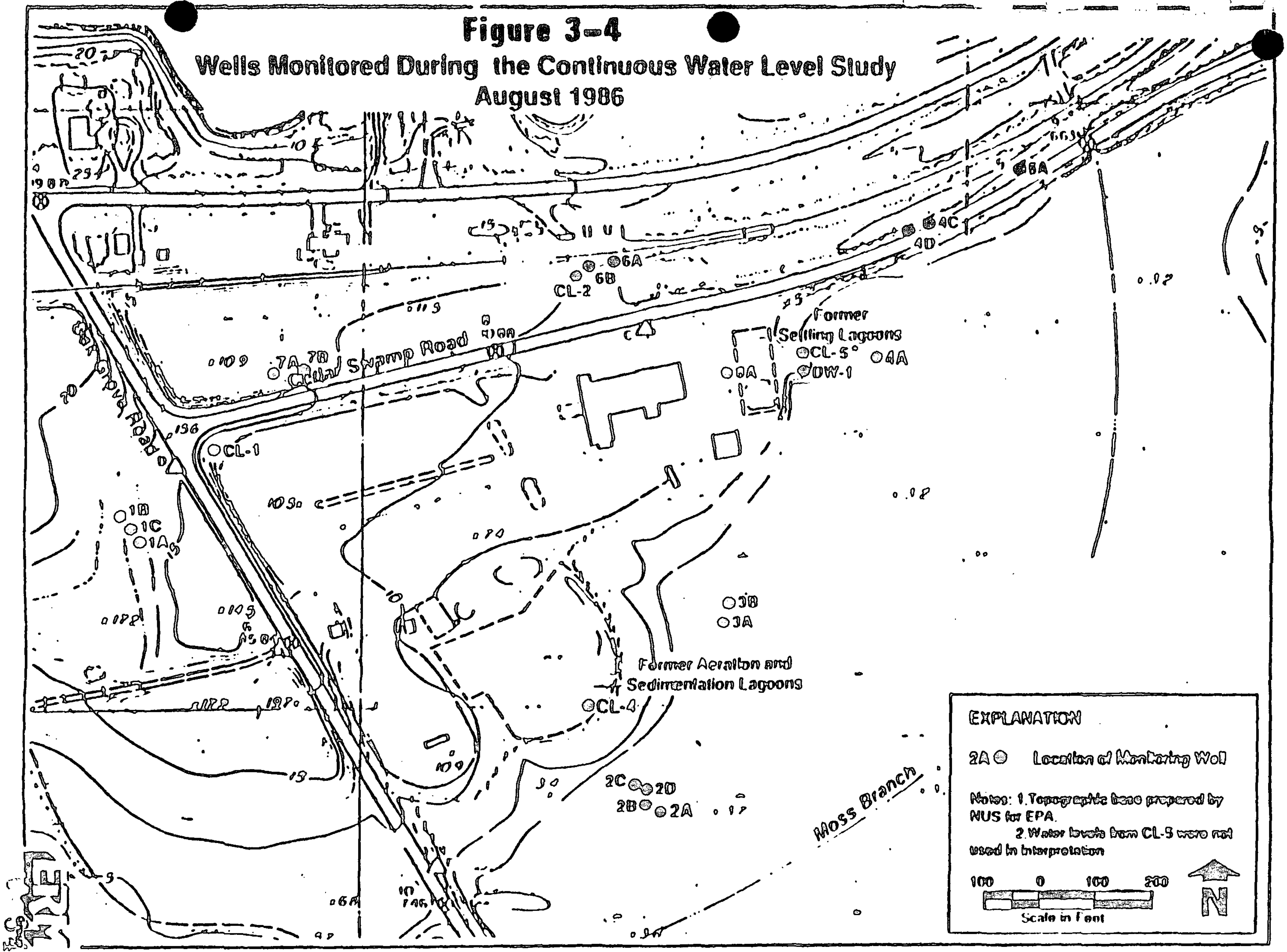
Another set of water level data was collected in April 1988 during a pump test at the site which included the collection of precipitation and barometric pressure data. Hand depth to water meters which had been calibrated to steel tape measurements were used to check the accuracy of the electronic water level recorders. This set of ground-water elevation data was used in analyzing the water level measurement data in this report because it represents the most complete and verifiable data set collected by ERM.

3.2.6.1 Water Level Measurements Collected by EPA

In November and December 1989, CDM FPC working as the contractor to EPA, collected a series of water level measurements in the 21 ground-water monitoring wells installed by ERM in 1986 and 1987, and also in the Upper and Lower Moss Branch, to establish the effect of tidal variations on the water-bearing subzones.

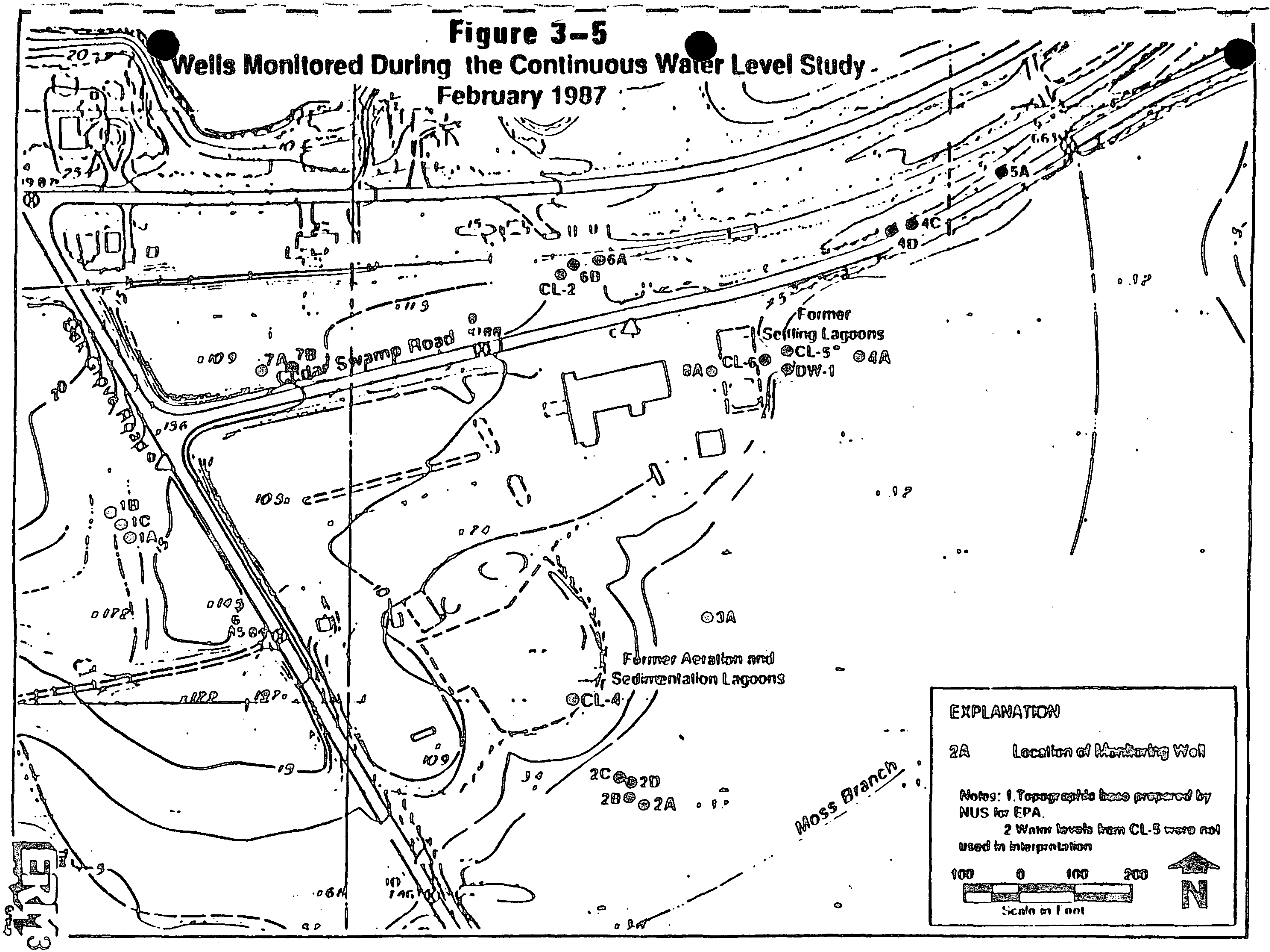
Figure 3-4

Wells Monitored During the Continuous Water Level Study August 1986



Notes: 1. Topographic base prepared by NUS for EPA.
2. Water levels from CL-5 were not used in interpretation

Figure 3-5
Wells Monitored During the Continuous Water Level Study
February 1987



Depth to water measurements were taken at pre-determined times in the tidal cycle. Four rounds of water level measurements were taken on November 16, 1989. Each round was taken so that the midway point of the round would fall at a desired time in the tidal cycle. The first round was taken so that the midway point of measurement fell at low tide. The second round was taken so that the midway point fell between low and high tide; the third round was taken so that the midway point fell at high tide; and the fourth round was taken so that the midway point fell between high and low tide. A fifth, random round of water level measurements was taken on December 26, 1989. All water level measurements were taken using a Luftkin steel water level tape graduated to 1/100 of a foot.

Subsequent to conducting the first round of water level measurements, the surface elevations and locations of the 21 monitoring wells were resurveyed by Ludgate Engineering, a subcontractor to CDM FPC. Well elevations were measured to the hundredth of a foot. The surveyed surface elevations are presented in Table 3-9. The results of the five rounds of water level measurements are presented in Table 3-10.

3.2.7 Aquifer Test

During late April 1988, the CLTL production well and 25 surrounding monitoring wells were monitored with electronic water-level recording instruments for a period of five days.

The purpose of the test was to assist in defining the hydrogeologic characteristics of the aquifer. The aquifer test was divided into three phases: a pre-pump test phase, during the 2 days immediately prior to the pump test; the pump test, which lasted 25.5 hours; and the post-pump test phase, during the 2 days immediately after the pump test.

3.2.8 Step Drawdown Test

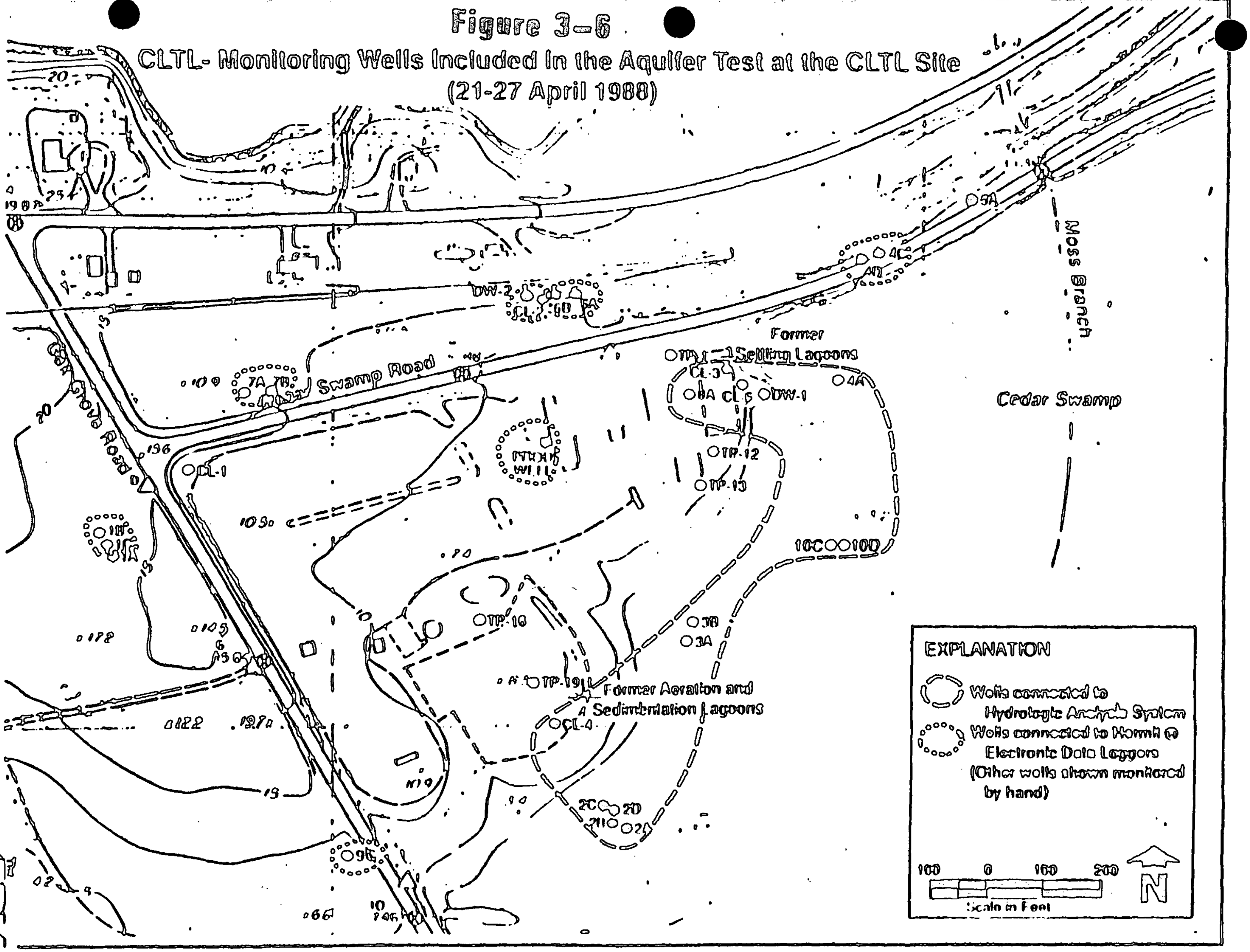
A step drawdown test of the CLTL production well took place roughly 2 weeks prior to the aquifer test. The purpose of the step drawdown test was to determine the sustainable pump rate of the CLTL production well.

During the step drawdown test, ERM pumped the CLTL production well for 20 to 30 minutes at 10, 20, 30 and 40 gallons per minute and for a total of 40 minutes at 50 gallons per minute. At each pumping rate, the water level in the CLTL production well stabilized after 10 to 15 minutes of pumping. The water level in the well bore remained well above the pump intake even at a

3405

Figure 3-6

CLTL- Monitoring Wells Included in the Aquifer Test at the CLTL Site (21-27 April 1988)



pumping rate of 50 gallons per minute, the maximum flow rate for the pump assembly. A pumping rate of 50 gallons per minute was selected as the pumping rate for the pump test phase of the aquifer test. Appendix L lists the water level data collected during the step drawdown test. All water pumped during the step drawdown test was collected in CLTL tank trucks and subsequently used in facility operations.

3.2.9 Monitoring Equipment Used in the Aquifer Test

In order to monitor water levels during the 5 days of aquifer testing, pressure transducers were installed in a total of 25 monitoring wells at the CLTL site. Figure 3-6 shows the location of the monitoring wells equipped with pressure transducers and their respective electronic data loggers. Additionally, one pressure transducer was installed in Moss Branch, southeast of the CLTL terminal. The eleven pressure transducers installed in monitoring wells on the north side of Cedar Swamp Road and on the west side of Oak Grove Road were connected to six, two-input Hermit electronic data loggers. The remaining 15 pressure transducers were connected to a single Hydrologic Analysis System (In Situ, Inc., Model SE 200) centrally located on the access road to well nest 3. In addition, a precipitation gauge and a recording barograph were installed at the CLTL site to monitor rainfall and atmospheric pressure during the test. The pressure transducers, electronic data loggers, and precipitation and barometric gauges remained in place for the full duration of the aquifer testing (five days).

3.2.10 Pre-Pump Test Phase

The pre-pump phase of the aquifer test began at 2030 hours on April 21, 1988 and lasted until 0010 hours on April 24, 1988. This phase of testing was designed to monitor water levels in monitoring wells at the CLTL site for at least two full tidal cycles (24 hours 50 minutes each) before the pump test. For the pre-pump test phase, the electronic data loggers and the Hydrologic Analysis System were programmed to collect water level data at 10-minute intervals.

During most of the first tidal cycle of the pre-pump test phase, the CLTL production well pump cycled on and off under normal operation, providing the CLTL terminal with water. Toward the end of the first tidal cycle, CLTL extracted their pump assembly from the CLTL production well and installed a new Grundfos SP-8-5 submersible pump with 1-1/2 horsepower motor in the well. The pump was attached to a 90-foot length of 1.5-inch (ID) flexible discharge hose connected to a Meter-Master flow meter at the

3407

surface. A backflow pressure gauge was installed on the intake side of the flow meter. A 50-foot long discharge hose extended from the flow meter to a 1-1/2 inch ID PVC "T". Two 20-foot hoses were connected to the "T", each equipped with a gate valve 5 feet from the end of the hose.

The water produced in the pump test was discharged continuously into one of two waiting tankers parked next to the CLTL production well. The use of gate valves at the end of the two discharge hoses, one directed into each tanker, allowed both valves to be opened when one tanker was nearly full and begin filling the empty tanker without affecting the back pressure on the pump.

After installing the pump assembly in the CLTL production well, a pressure transducer was installed in the CLTL production well, connected to a Hermit electronic data logger. The installation of the pump and transducer in the CLTL production well was completed toward the end of the first tidal cycle of the pre-pump test phase. This allowed one full tidal cycle of uninterrupted monitoring of the aquifer with no pumping of the production well prior to the pump test phase.

3.2.11 Pump Test Phase

The pump test phase directly followed the pre-pump test phase. Beginning at 0010 hours on April 24, 1988, the production well was pumped at a constant rate of 50 gallons per minute until 0140 on April 25, 1988. Immediately prior to the pump test phase, the electronic data loggers were reset to start collecting water level data on a logarithmic time scale beginning when the pump was turned on. Four complete rounds of depth to water measurements were collected by hand from the monitoring wells, including those equipped with electronic data loggers: one round several hours before the beginning of the pump test; one round immediately prior to the pump test; one round approximately mid-way through the pump test; and one just prior to the end of the pump test. In addition, water level measurements were collected by hand in monitoring wells not equipped with electronic data loggers on an hourly basis for the first six hours of the pump test.

The pump test generated a considerable volume of water (approximately 75,000 gallons). The water was pumped into waiting tankers using the assembly described previously and subsequently was used by the CLTL terminal.

3.2.12 Post-Pump Test Phase

Water levels were measured in the aquifer during the post-pump test phase which began when the pump in the CLTL production well was shut off at the end of the pump test phase. Just prior to shutting off the pump, the electronic data loggers were reset to monitor the recovery of the aquifer on a logarithmic time scale. The post-pump phase lasted from 0140 on April 25, 1988 until approximately 0900 on April 27, 1988. During the second full tidal cycle of the post-pump test phase, ERM removed the pressure transducer and pump assembly in the CLTL production well to allow CLTL to reinstall their submersible pump and riser pipe in the event that the CLTL terminal needed water. CLTL reinstalled their pump on April 27, 1988, after the post-pump test phase ended.

No water level measurements were taken at Cooper Lake before, during or after the pump test, and questions regarding the accuracy of surface elevations in the vicinity of the wetlands limit the use of Moss Branch surface water elevation data.

3.3 Ground-water Sampling

3.3.1 Purpose and Scope

As part of the field investigation for the RI, ground-water samples were collected from selected monitoring wells at the CLTL site during three separate sampling efforts.

The overall purpose of the ground-water sampling effort was to characterize the nature and extent of ground-water contamination in the vicinity of the CLTL site. Each of the 21 wells installed at the site as part of the RI was sampled at least once; 18 were sampled twice, and 3 of these were sampled a third time. Most of the wells remaining from the 1981 ERM study were sampled twice. The three residential wells north of the site and the four USGS wells east of the site were sampled once to extend the areal distribution of the sampling effort beyond the property boundaries of the CLTL site. Table 3-2 lists the wells included in the groundwater sampling efforts and the dates on which they were sampled. Figure 3-6 shows the location of these wells.

TABL[illegible]-2

MONITORING WELLS INCLUDED IN THE GROUND WATER SAMPLING EFFORT FOR THE REMEDIAL INVESTIGATION AT THE CLTL SITE

Monitoring Well	Range in Elevation Covered by Screened Interval (in feet with respect to MSL)*	Screened Interval (in feet below ground surface)	Total Depth (in feet below ground surface)	Elevation of Bottom of Well (in feet with respect to MSL)*	Sampling Effort		
					June 1986	September 1986	March 1988
SHALLOW SUBZONE:							
1A	+3.5 to - 1.5	14 to 19	19	- 1.5	X	X	
2A	-8.5 to -13.5	14.5 to 19.5	20.5	-14.5	X	X	
2B	-21.5 to -31.5	28 to 38	38	-31.5	X	X	
3A	-11 to -16	17.5 to 22.5	23	-16.5	X	X	
4A	-11.5 to -16.5	18 to 23	23.5	-17	X	X	
7A	- 7 to -12	20.5 to 25.5	25.5	-12	X	X	
8A	+ 1 to - 4	8 to 13	15	- 6	X	X	
CL-1	- 0.5 to -15.5	15 to 30	30	-15.5	X	X	
CL-2	- 9.5 to -19.5	20 to 30	30	-19.5	X	X	
CL-4	-16 to -21	25 to 30	46	-37	X	X	
TP-1	+ 4.5 to - 0.5	4.34 to 9.34	9.34	- 0.5	X	X	
TP-12	+ 2 to - 3	4.77 to 9.77	9.77	- 3	0	+	
TP-13	+ 3 to - 2	3.68 to 8.68	8.68	- 2	0	0	
TP-16	+ 2.5 to - 2.5	8.1 to 13.1	13.1	- 2.5	X	+	
TP-19	+ 6 to + 1	2.89 to 7.89	7.89	+ 1	0	0	
TP-22	+ 6.5 to + 1.5	4.24 to 9.24	9.24	+ 1.5	0	0	
INTERMEDIATE SUBZONE:							
Upper Intermediate Subzone							
1B	-42 to -52	60 to 70	70.5	-52.5	X	X	
2C	-48.5 to -53.5	55 to 60	60	-53.5	X	X	X
3B	-43 to -53	49 to 59	60	-54	X	X	
5A	-42.5 to -52.5	50 to 60	60	-52.5	X	X	
7B	-36 to -46	50 to 60	60	-46	X	X	
9C	-51 to -61	60 to 70	72	-63			X
10C	-35.5 to -45.5	40 to 50	50	-45.5			X
CL-3	-23.5 to -33.5	28 to 38	40	-33.5	X	X	
CL-6	-22 to -37	29 to 44	44	-37	X	X	

TABLE 3-2 (continued)

Monitoring Well	Range in Elevation Covered by Screened Interval (in feet with respect to MSL)*	Screened Interval (in feet below ground surface)	Total Depth (in feet below ground surface)	Elevation of Bottom of Well (in feet with respect to MSL)*	Sampling Effort June 1986	 September 1986	 March 1986
Upper Intermediate Subzone (continued)							
USGS-A	°	42 to 52	52	°	X		
USGS-B	°	87 to 97	97	°	X		
Res-1	°	?	65	°	X		
Res-2	°	?		°	X		
Res-3	°	?		°	X		
Lower Intermediate Subzone							
2D	-80.5 to -90.5	87 - 97	150	-143.5	X	X	
4C	-64 to -74	72 - 82	82	- 74	X	X	
6B	-76.5 to -86.5	87 - 97	120	-109.5	X	X	
DW-1	-89.5 to -91.5	95 - 97	97	- 91.5	X	X	X
Prod Well	-77 to -89	87 - 99	99	- 89		X	
DEEP SUBZONE:							
1C	-112.5 to -122.5	130 - 140	143	-125.5	X	X	
4D	-100 to -110	108 - 118	155	-147	X	X	X
6A	-134.5 to -139.5	145 - 150	150	-139.5	X	X	
10D	-108.5 to -118.5	113 - 123	125.5	-121			X
USGS-C	°	130 - 140	140	°	X		
USGS-D@	°	230 - 240	293	°	X		

Explanation:
X - Well Sampled
O - Insufficient Water for Sample
+ - Well Sampled for Volatiles Only
@ - Completed below deep subzone
* - Elevations rounded to nearest 1/2 foot. See Tables 1-3 and 3-1 for more precise elevations.
° - Elevation not surveyed as part of RI

3.3.2 Ground-water Sampling Methods

The ground-water sampling process began with the measurement of the depth to water in each well using a battery-powered depth to water meter. [Note: The type and accuracy of the meter used was not reported by CLTL.] Measurements were taken from the permanently marked reference point on the side of the well casing.

At least three well volumes were evacuated, when possible, from each well prior to sampling. A variable flow rate, self-priming centrifugal pump with 3/4 inch polypropylene tubing was used for evacuation. The use of the centrifugal pump in conjunction with a foot valve at the end of the suction hose prevented backflow of ground-water into the well. The pump tubing was replaced between wells. The use of new tubing and a new foot valve in each well reduced the potential for cross contamination between wells. Ground water pumped from the wells in the evacuation process was properly containerized and disposed of in the wastewater holding tank.

For nearly all of the wells, the recharge rate of the well was high enough to allow the evacuation of three well volumes. During the first sampling effort, monitoring well 6A recharged at a rate less than 0.2 gallons/minute and was pumped to a level just above the screen interval and allowed to recover. Two other wells, 4D and 9C, were evacuated using a submersible, diaphragm-type pump because of their low recharge rate. As shown in Table 3-2, most of the shallow test pit wells did not yield a sufficient volume of water for proper evacuation and sampling. Several of these wells yielded only enough ground water to submit samples for analysis of volatile organic compounds (VOCs). It was concluded that water level and ground water quality from the test pit wells is unreliable due to their unorthodox installation method.

During the first sampling effort, up to six well volumes were evacuated from some wells to allow the pH to fall within the established range for the area prior to sampling. During well evacuation, periodic pH measurements were taken to ensure that equilibrium had been obtained for the well and that representative samples of water from the aquifer were obtained.

Dedicated, stainless steel, bottom-loading bailers were used for sample collection. One-inch diameter bailers were used to sample the existing two-inch PVC wells in order to accommodate the narrow annulus created by interior couplings; two-inch diameter bailers were used in the remaining wells. A tripod-mounted fishing reel and single strand polypropylene monofilament line were used to raise and lower the bailers. The line was discarded after each well was sampled.

TABLE 3-3

RI EQUIPMENT DECONTAMINATION PROCEDURE

STEP 1	DETERGENT WASH
STEP 2	TAP WATER RINSE
STEP 3	10% NITRIC ACID RINSE
STEP 4	TAP WATER RINSE
STEP 5	ACETONE OR METHANOL RINSE
STEP 6	DISTILLED WATER RINSE
STEP 7	AIR DRY

TABLE 3-4

PRIORITY POLLUTANT LIST OF CONSTITUENTS

VOLATILE ORGANICS

BENZENE
BROMOMETHANE
BROMODICHLOROMETHANE
DIBROMOCHLOROMETHANE
BROMOFORM
CARBON TETRACHLORIDE
CHLOROBENZENE
CHLOROETHANE
1,1-DICHLOROETHANE
1,2-DICHLOROETHANE
1,1,1-TRICHLOROETHANE
1,1,2-TRICHLOROETHANE
1,1,2,2-TETRACHLOROETHANE
1,1-DICHLOROETHYLENE
TRANS-1,2-DICHLOROETHYLENE
TRICHLOROETHYLENE
TETRACHLOROETHYLENE
1,1,2,2-TETRACHLOROETHYLENE
2-CHLOROETHYL VINYL ETHER
CHLOROFORM
CHLOROMETHANE
TRICHLOROFLUOROMETHANE
ETHYLBENZENE
METHYLENE CHLORIDE
1,2-DICHLOROPROPANE
1,3-DICHLOROPROPENE
TOLUENE
VINYL CHLORIDE
ACROLEIN
ACRYLONITRILE
TRANS-1,3-DICHLOROPROPANE
CIS-1,3-DICHLOROPROPANE

BASE NEUTRAL EXTRACTABLE ORGANICS

1,3-DICHLOROBENZENE
1,4-DICHLOROBENZENE
HEXACHLOROETHANE
1,2-DICHLOROBENZENE
BIS(2-CHLOROISOPROPYL) ETHER
HEXACHLOROBUTADIENE
1,2,4-TRICHLOROBENZENE
NAPTHALENE
BIS(2-CHLOROETHOXY) METHANE
2-CHLORONAPTHALENE
ACENAPHTHYLENE
ISOPHORONE
FLUORENE
2,6-DINITROTOLUENE
1,2-DIPHENYTHYDRAZINE
2,4-DINITROTOLUENE
N-NITROSODIPHENYLAMINE
ANTHRACENE
DIMETHYL PHTHALATE
DIETHYLPHTHALATE
FLUORANTHRENE
PYRENE
DI-N-BUTYLPHTHALTE
CHRYSENE
BIS(2-EHTYLHEXYL)PHTHALATE
BENZO(A)ANTHRACENE
BENZO(B)FLUORANTHENE
BENZO(K)FLUORANTHENE
BENZO(A)PYRENE
INDENO(1,2,3-CD) PYRENE
DIBENZO(A,H)ANTHRACENE
BENZO(G,H,I)PERYLENE
N-NITROSODIMETHYLAMINE
N-NITRODOSI-N-PROPYLAMINE
4-CHLORO-PHENYL-PHENYL ETHER
HEXECHLOROBENZENE
4-BROMOPHENYL PHENYL ETHER
PHENANTHRENE
3,3-DICHLOROBENZIDINE

ACID EXTRACTABLES

2-CHLOROPHENOL
PHENOL
2,4-DICHLOROPHENOL
2-NITROPHENOL
P-CHLORO-M-CRESOL
2,4,6-TRICHLOROPHENOL
2,4-DIMETHYLPHENOL
2,4-DINITROPHENOL
4,6-DINITRO-O-CRESOL
4-NITROPHENOL
PENTACHLOROPHENOL

PESTICIDES/PCBS

ALDRIN
DIELDRIN
4,4'-DDT
4,4'-DDE (P,P'-DDE)
4,4'-DDD (P,P'-TDE)
ALPHA ENDOSULFAN
BETA ENDOSULFAN
ENDOSULFAN SULFATE
ENDRIN
ENDRIN ALDEHYDE
HEPTACHLOR
ALPHA BHC
BETA BHC
GAMMA BHC (LINDANE)
DELTA BHC
TOXAPHENE
CHLORDANE
PCB-(AROCLOR)-1221
PCB-(AROCLOR)-1232
PCB-(AROCLOR)-1242
PCB-(AROCLOR)-1248
PCB-(AROCLOR)-1254
PCB-(AROCLOR)-1260
PCB-(AROCLOR)-1016

CLASSICAL PARAMETERS

CYANIDE
PHENOLS

METALS

COPPER
CHROMIUM
LEAD
MERCURY
NICKEL
SELENIUM
SILVER
THALLIUM
ZINC
ANTIMONY
ARSENIC
BERYLLIUM
CADMIUM

° Approximate list for 1986, does not include modifications since 1986

Unfortunately, the monofilament line was nicked easily and several bailers were lost down the wells during sampling. Most were retrieved; however, one bailer remains in monitoring well 1B and two bailers remain in DW-1.

After sampling, the bailers were tagged with the appropriate well number and stored in plastic bags for future use. Each bailer was decontaminated prior to and after sampling using the method outlined in Table 3-3.

Residential wells were sampled directly from the tap (Res-3 and Res-2 were sampled from the influent tap to the carbon filter system; Res-1 had no filtration system) after allowing the well pump to run for several minutes. These wells were sampled at the same time that EPA collected their monthly sample (Section 1.3.5).

3.3.3 Ground-water Sample Analysis

With the exception of samples collected from two shallow test pit wells, noted above, ground-water samples were analyzed for the list of constituents shown on Table 3-4, plus up to 40 additional identifiable peaks. In addition, the samples were analyzed for the following water quality parameters: total organic carbon (TOC), total organic halogen (TOX), total dissolved solids (TDS) and chemical oxygen demand (COD). The Site Operations Plan (SOP) and the Quality Assurance Project Plan (QAPP) attached to the SOP present the analytical methods used for the analyses. Lancaster Laboratories, Inc., of Lancaster, Pennsylvania, a New Jersey-certified laboratory, performed the laboratory analyses of ground-water collected for ERM as part of the RI.

During the first ground-water sampling effort in June 1986, EPA's oversight contractor (GCA) collected replicate samples from monitoring wells 1A, 3B, 6B, 7A and CL-4, and ERM collected matrix spike and matrix spike duplicate samples from CL-4 and the Res-2 well. During the second ground-water sampling effort in September and October 1986, EPA's oversight contractor (GCA) collected replicate samples from monitoring wells 1B, 2D, 3A, 4A, 7B, DW-1 and CL-6, and ERM collected matrix spike and matrix spike duplicate samples from 2C and 3B.

Field measurements for pH, specific conductance and temperature were taken from the wells upon completion of well evacuation and prior to sample collection. During the first sampling effort, field measurements were obtained by submerging meter probes directly into the monitoring wells. Field measurements of ground water from the residential wells were taken by inserting the probes into aliquots of ground water collected from each well.

Table 3-5

Sample Containers and Preservation Requirements for Water Samples Collected as Part of the Remedial Investigation at the CLTL Site

Analysis	Sample Container	Preservation
Priority Pollutants:		
EPA 624 Volatiles	2-40 Vials with Teflon tm screw cap	HCl to pH<2, cool to 4°C
EPA 625 Base/neutrals and Acid/extractables	2-Amber glass liter	Cool to 4°C
EPA 608 Pesticides and PCB's	1-Amber glass liter	Cool to 4°C
EPA Priority Pollutant Metals	1-polyethylene liter	HNO_3 to pH<2, Cool to 4°C
Classical Parameters:		
EPA 420 Total Phenols	1-glass liter	H_2SO_4 to pH<2, cool to 4°C
EPA 335 Total Cyanide	1-polyethylene liter	NaOH to pH>12, cool to 4°C
Traditional Water Quality Parameters:		
COD	1-glass 100ml	H_2SO_4 to pH<2, cool to 4°C
TDS	1-polyethylene 1/2 gallon	cool to 4°C
TOC	1-glass 100ml	H_2SO_4 to pH<2, cool to 4°C
TOX	1-glass liter (no headspace)	cool to 4°C

3.3.4 Field Analysis and Sample Collection, Preparation, Preservation and Storage

The ground-water samples collected for laboratory analysis were preserved and stored according to the U.S. EPA recommended methods of analysis shown on Table 3-5. Total organic halogen (TOX) and VOC samples were collected first to minimize degradation of the sample by exposure of the ground water to turbulence and the atmosphere. Samples collected for metals analysis were not filtered. A set of matrix spike and matrix spike duplicate samples were collected for each set of 20 ground-water samples, and travel blanks were submitted on a daily basis.

Each sample bottle was appropriately labeled and stored with ice packs in an insulated cooler until delivery to Lancaster Laboratories. Blue ice was used to keep all samples cool. Samples were shipped for analysis within 24 hours. The SOP and QAPP provide additional details on chain-of-custody and sample handling procedures.

3.4 Soil Sampling and Investigation

Although the soil sampling was initially intended to characterize the nature and extent of soil contamination at the CLTL site, the results of the CLTL soil sampling effort indicated that additional sampling would be required.

3.4.1 Purpose and Scope

Soil sampling for the RI included the collection and description of one set of soil samples from the following sample types: 1) subsurface soil boring samples, designated B-1 through B-26; 2) bucket auger samples, designated AG-1 through AG-4; and 3) shallow soil samples, designated S-1 through S-19. The soil samples for the RI were collected from one background area and from locations in the vicinity of the suspected source areas at the CLTL site. Shallow and subsurface soil sampling locations are shown on Plate 1.

3.4.2 Soil Sample Analysis

Soil samples described in the following sections were analyzed for contaminants (Table 3-4) plus up to 40 identifiable peaks. In addition, the samples were analyzed for the following parameters: TOC, TOX, and COD. The SOP and the QAPP attached to the SOP present the analytical methods for the analyses.

Lancaster Laboratories performed the laboratory analyses of soil samples collected as part of the RI.

TABLE 3-6
Subsurface Soil Boring Sampling Completed for the Remedial Investigation at the CLTL Site

Location	Total Depth (feet)	Sample Interval Submitted for Analysis (feet below ground surface)	Date Collected
Subsurface Borings			
B1	8	0-1, 2-3, 4-5*	2/10/86
B2	8	0-1, 2-3*, 4-5	2/12/86
B3	10	9.5-10	2/12/86
B4	12	5-6	2/13/86
B5	12	1-2*, 11-12	2/13/86
B6	17	7-8, 16-17	2/13/86
B7	12	11-12	2/14/86
B8	12	11-12	2/14/86
B9	14	9-10, 13-14	2/17/86
B10	10	5-6, 6-7, 9-10	2/21/86
B11	12	7-8, 9-10	2/14/86
B12	8	3-4, 7-8	2/17/86
B13	14	3-4, 7-8, 9-10, 11-12, 13-14	2/17/86
B14	10	3-4, 7-8D, 8-10*	2/19/86
B15	8	3-4*, 7-8	2/20/86
B16	10	3-4, 7-8*, 9-10	2/20/86
B17	12	7-8*, 11-12	2/20/86
B18	8	2-3, 3-4, 7-8	2/21/86
B19	10	0-1, 7-8*, 9-10	2/24/86
B20	8	1-2, 7-8*	2/24/86
B21	8	3-4S, 5-6, 7-8*	2/25/86
B22	10	3-4, 5-6, 7-8*, 9-10	2/25/86
B23	8	1-2, 3-4, 5-6, 7-8*	2/25/86
B24	8	3-4, 5-6, 7-8*	2/26/86
B25	8	3-4, 5-6, 7-8*	2/26/86
B26	8	3-4S, 5-6D, 7-8*	2/27/86

S = Matrix Spike
D = Duplicate
* = Sample Split with EPA Oversight

3.4.3 Subsurface Soil Boring Sampling

A total of 26 subsurface soil borings, labelled B-1 through B-26, were included as part of the RI investigation. The subsurface boring samples were taken in four general areas: the approximate area of the former aeration and final settling lagoons southwest of the CLTL terminal building; the former final settling lagoon overflow area; the area of the former primary settling lagoons; the fallow field west of the site (background or control area.) Plate 1 shows the location of the subsurface borings at the CLTL site.

Eight borings were located roughly 50 feet apart within each of the three areas on site. The presence of concrete fill material in the lagoons southwest of the CLTL terminal building area made it difficult to install subsurface borings in the central portions of these lagoons. Two borings were installed in the background area.

The borings were completed by J.E. Fritts and Associates of Kirkwood, New Jersey, in the presence of EPA's oversight contractor (GCA). Continuous split spoon samples were collected at each location using two-inch diameter stainless steel spoons equipped with sand traps following the method ASTM-D1586-67. Because the soil encountered in the borings was very cohesive, it was possible to collect samples at most locations without auguring, by driving the split spoon sampler with a 140-pound hammer. One sample, B6, was augured and sampled through the auger to avoid problems created by running sand. Roughly half of the borings were installed using the truck-mounted rig. Because of access problems created by soft, swampy soil incapable of supporting the truck-mounted rig, the remainder of the borings were driven with a 140-pound hammer mounted on a portable tripod.

Boring depths ranged from 8 to 17 feet below the surface. Field personnel described the soil in the split spoons lithologically and scanned the sample visually and with a Foxboro OVA for evidence of organic contamination. Appendix M presents the geologic logs of the subsurface soil borings. Selected samples were submitted for laboratory analysis from each of the 26 borings. In borings that showed evidence of contamination, at a minimum, the uppermost sample within the apparently contaminated zone and the deepest sample from the boring were submitted for analysis. Table 3-6 lists the boring depths, the samples submitted for analysis, and the samples split with EPA's oversight contractor.

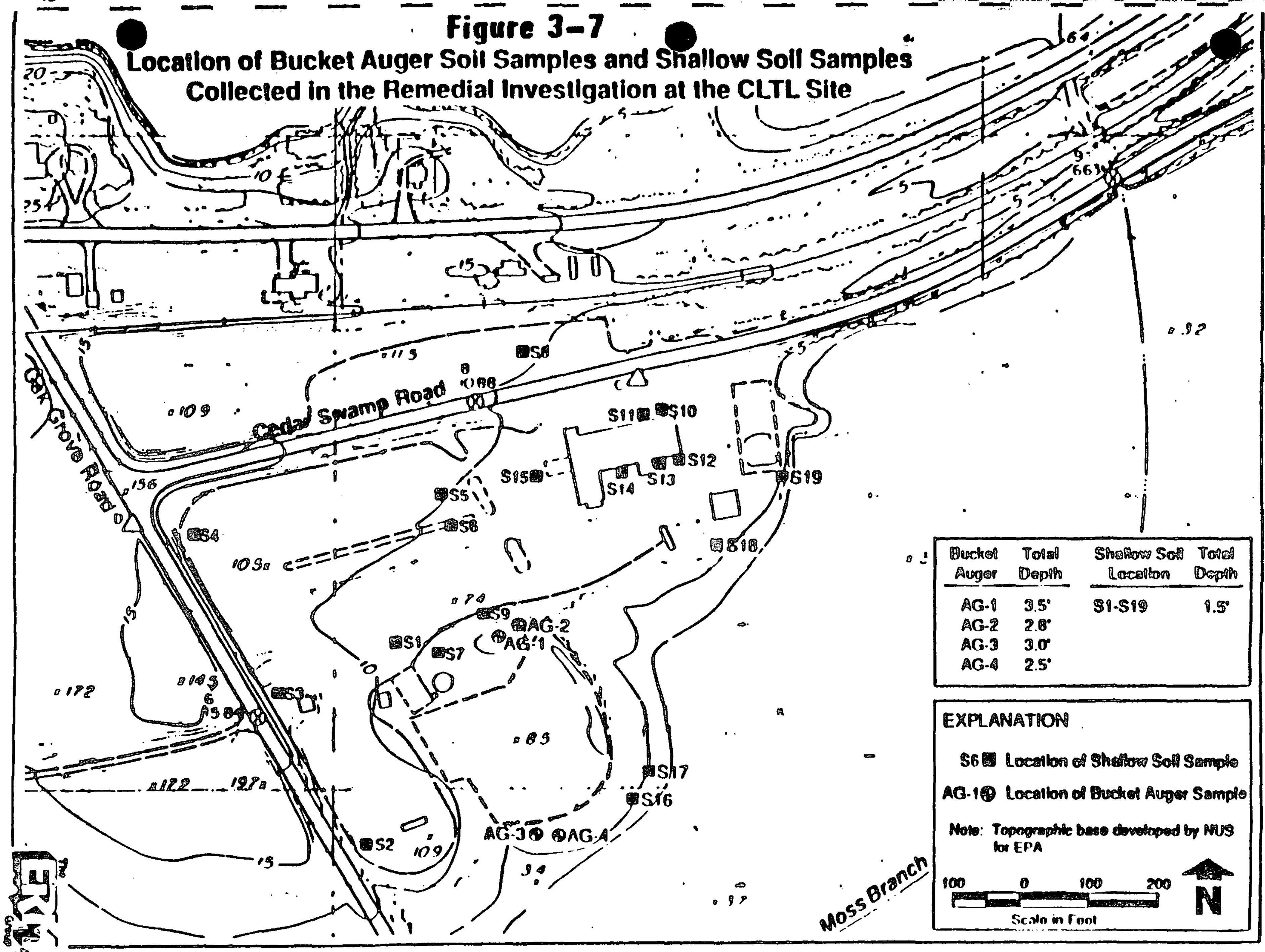
TABLE 3-7
Bucket Auger Sampling Completed for the Remedial Investigation at the CLTL Site

Location	Total Depth (feet)	Sample Interval Submitted for Analysis (feet below ground surface)	Date Collected
Bucket Auger			
AG-1	3.5	0.5-1.0, 3.0-3.5*	3/10/88
AG-2	2.8	0.5-1.0, 2.2-2.8	3/10/88
AG-3	3	0.5-1.0, 2.5-3.0	3/10/88
AG-4	2.5	0.5-1.0, 2.0-2.5*^	3/10/88

* = Sample Split with EPA Oversight
^ = Matrix Spike and Matrix Spike Duplicate Collected

Figure 3-7

Location of Bucket Auger Soil Samples and Shallow Soil Samples Collected in the Remedial Investigation at the CLTL Site



Bucket Auger	Total Depth	Shallow Soil Location	Total Depth
AG-1	3.5'	S1-S19	1.5'
AG-2	2.8'		
AG-3	3.0'		
AG-4	2.5'		

EXPLANATION

S6 ■ Location of Shallow Soil Sample

AG-1 ⊕ Location of Bucket Auger Sample

Note: Topographic base developed by NUS for EPA

The portion selected for VOC and TOX analysis was placed in a laboratory pre-cleaned, four-ounce glass jar with a teflon-lined lid. The remaining sample was homogenized in a stainless steel bowl using a stainless steel spoon before being placed in a laboratory pre-cleaned, one-liter glass jar with a teflon-lined lid. These samples were stored in a styrofoam insulated cooler with ice packs until shipment to the laboratory. The SOP and QAPP present additional details on chain-of-custody and sample handling procedures.

To avoid possible cross contamination between borings, drilling equipment and split spoon samplers were steam cleaned between borings. Additionally, the split spoon samplers were decontaminated using the procedure outlined in Table 3-3 between each use. Following the completion of the soil sampling program, J.M. Stewart, Inc., a New Jersey-licensed surveyor, surveyed the location of each boring.

3.4.4 Bucket Auger Sampling

During March 1988, soil samples were collected from four bucket auger holes labelled AG-1 through AG-4. Two of the bucket auger locations (AG-1 and AG-2) lie in the containment area east of the wastewater holding tank, and the remaining bucket auger locations (AG-3 and AG-4) lie just inside the tree line, south of the former aeration lagoons. Figure 3-7 shows the bucket auger sampling locations.

The bucket auger samples range in depth from 2.5 to 3.5 feet beneath the ground surface and were collected using a hand-held bucket auger. The soil in each auger hole was described lithologically and scanned visually and with a Foxboro OVA for signs of organic contamination. Appendix N presents a geologic description of the soil encountered in each bucket auger hole.

Two samples from each bucket auger hole were submitted for analysis. These were collected from 0.5 to 1.0 foot below the surface and within 1 foot of the water table. Table 3-7 lists the sample depths of each bucket auger along with the matrix spike and matrix spike duplicate samples and samples split with EPA's oversight contractor (CDM). The portion selected for VOC and TOX analysis was placed in a laboratory pre-cleaned, four-ounce glass jar with a teflon-lined lid. The remaining sample was homogenized in a stainless steel bowl using a stainless steel spoon before being placed in a laboratory pre-cleaned, one-liter glass jar with a teflon-lined lid. These samples were stored in a styrofoam insulated cooler with ice packs until shipment to the laboratory.

TABLE 3-8
Shallow Soil Sampling Completed for the Remedial Investigation at the CLTL Site

Location	Total Depth (feet)	Sample Interval (feet below ground surface)	Date Collected
Shallow Soil Samples			
S1	1.5	0.5*-1.5	2/28/86
S2	1.5	0.5*-1.5	2/28/86
S3	1.5	0.5*-1.5	2/28/86
S4	1.5	0.5-1.5	2/28/86
S5	1.5	0.5-1.5	2/28/86
S6	1.5	0.5-1.5	2/28/86
S7	1.5	0.5-1.5	2/28/86
S8	1.5	0.5-1.5	2/28/86
S9	1.5	0.5-1.5	2/28/86
S10	1.5	0.5-1.5	4/3/86
S11	1.5	0.5-1.5	4/3/86
S12	1.5	0.5-1.5	4/3/86
S13	1.5	0.5-1.5	4/3/86
S14	1.5	0.5-1.5	4/3/86
S15	1.5	0.5^-1.5	4/3/86
S16	1.5	0.5-1.0	3/11/88
S17	1.5	0.5-1.0	3/11/88
S18	1.5	0.5-1.0	3/11/88
S19	1.5	0.5*-1.0	3/11/88

* = Sample Split with EPA Oversight
^ = Matrix Spike and Matrix Spike Duplicate Taken

To avoid possible cross contamination within and between bucket auger holes, field personnel decontaminated the bucket auger using the wash and rinse procedure described in Table 3-3 prior to collecting each sample. Following completion of each auger hole, the hole was backfilled with cuttings beginning with those taken from the deepest part of the hole and finished with cuttings from the shallowest part of the hole. In April 1988, J.M. Stewart, a New Jersey-licensed surveyor, surveyed the location of each bucket auger hole.

3.4.5 Shallow Soil Sampling

ERM collected shallow soil samples at the CLTL site in February and April of 1986 and again in March of 1988. The 1986 shallow soil sampling included 15 samples, labelled S-1 through S-15, collected from the gravel truck parking lot/driveway area and other high traffic areas at the CLTL terminal. The 1988 shallow soil sampling included four additional samples, labelled S-16 through S-19, collected from natural depressions downgradient of the former aeration lagoons (S-16 and S-17) and the enclosed settling tank (S-18), and at one location adjacent to the former settling lagoons (S-19). Figure 3-7 and Plate 1 show the shallow soil sampling locations at the CLTL site.

Over the years, the truck parking lot/driveway area and other high traffic areas at the CLTL terminal have been treated with a dust suppressant, and, as a result, are covered with a hard, two- to six-inch thick buildup of asphalt-like material. Field personnel used a pick and shovel to remove the asphalt-like material overlying the shallow soil; the surficial 0.5 foot at locations S-16 through S-19 was removed easily with a bucket auger. The shallow soil samples submitted for analysis were collected between 0.5 and 1.5 feet below the asphalt-like surface material.

The soil sample to be submitted for laboratory analysis was collected using a hand-held bucket auger. Each sample was scanned visually and with a Foxboro OVA for signs of possible organic contamination. Appendix O presents the lithologic description of soil encountered in each shallow borehole.

The portion selected for VOC and TOX analysis was placed in a laboratory pre-cleaned, four-ounce glass jar with a teflon-lined lid. The remaining sample was homogenized in a stainless steel bowl using a stainless steel spoon before being placed in a laboratory pre-cleaned, one-liter glass jar with a teflon-lined lid. These samples were stored in a styrofoam insulated cooler with ice packs until shipment to the laboratory. The SOP and

QAPP present additional details on chain-of-custody and sample handling procedures. Table 3-8 lists the shallow soil samples collected along with the samples split with EPA's oversight contractor and the matrix spike and matrix spike duplicate samples collected.

To avoid possible cross contamination within and between each shallow hole, prior to collecting each sample, the bucket auger was decontaminated using the wash and rinse procedure outlined in Table 3-3. Following completion of the shallow soil sampling program, J.M. Stewart, a New Jersey-licensed surveyor, surveyed each shallow soil sampling location. The locations of soil samples S-10 through S-14 are approximated, as CLTL did not provide surveyed locations for these samples locations.

3.4.6 Supplemental Soil Sampling to be Conducted by EPA

EPA is conducting a supplemental soil boring and sampling program at the CLTL during the winter and early spring of 1990, to further delineate soil contamination in and around the former wastewater lagoons. This soil boring/sampling/analysis program included the following:

- Three soil borings will be drilled along the center axis of each of the three former settling lagoons which were located east of the terminal building. These soil borings will be drilled to at least a depth of 24 feet. Continuous split spoon samples will be taken to a depth of 12 feet to confirm the extent and completeness of CLTL's excavation of these lagoons. These samples will be visually inspected to determine if staining or sludges are present. The samples will also be screened for VOCs with an Organic Vapor Analyzer (OVA) and a photoionization detector. Samples taken from the upper 12 feet of the boring which exhibit visual staining, sludge layers or levels of VOCs above 1 ppm, or above the established background level, will be sent to a CLP laboratory for Target Compound List (TCL) analyses. Soil samples will be taken at three-foot intervals from depths of 15 to 24 feet and submitted for TCL analyses. In the event that contamination is detected below 24 feet, screening will continue and samples taken until the screening process shows the soils to be visually "clean" and the OVA and photoionizer detector shows concentrations of VOCs to be below 1 ppm or background levels. Four perimeter borings will be drilled along the edge of the three former settling lagoons to a depth of 24 feet to confirm the boundaries of these lagoons. Samples will be collected from the perimeter borings at three-foot intervals and screened for contamination as described above.

- Three soil borings will be drilled along the center axis of a possible former settling lagoon located south of the active terminal area. These soil borings will be drilled to a depth of 15 feet. Continuous split spoon samples will be taken and screened for possible TCL analyses as described above. Four perimeter borings will be drilled along the edges of the possible former settling lagoon to a depth of 15 feet. Samples will be collected form the perimeter borings at three-foot intervals and screened for contamination as outlined above.

- Five soil borings will be drilled along the center axis of the two aeration lagoons and final settling lagoon located south of the active terminal building, adjacent to the wetlands area. These borings will be drilled to a depth of 21 feet. Split spoon soil samples will be taken continuously from the surface to a depth of 10 feet and then at three-foot intervals to a depth of 21 feet. Samples will be screened and retained for TCL analyses as described above. Six perimeter borings will be drilled for each lagoon with two borings on the "long" side and one boring on the "short" side of each lagoon. These perimeter borings will be drilled to a depth of 21 feet, sampled every three feet and screened as outlined above.

- Approximately 25 shallow soil samples will be taken in the active terminal/parking lot area in a grid to be established by EPA. Soil samples will be taken at a depth of 6 to 12 inches and each sample will be analyzed for TCL.

The results of the EPA soil boring/sampling/analysis program will be compiled in a supplemental remedial investigation report.

3.5 Wetlands Sampling and Investigation

Although the wetlands investigation was originally envisioned to be part of the RI, analysis of preliminary sediment and surface water sampling results indicated that additional investigation would be required to define the nature and extent of wetlands contamination. EPA has decided to complete the investigation of the nonwetlands portion of the site and address the wetlands as a separate study or operable unit. Although some of the wetlands data are discussed in this RI, such as the analytical results of ground-water samples obtained in the well points, a complete discussion of these data will be provided in a future report. All available wetland sampling data are provided in Appendix E.

The interpreted results of the electromagnetic survey conducted in the wetlands are shown on Plates 2 and 3. Plate 6 shows all wetland, lake and stream sediment, surface water and well point sample locations.

TABLE 3-9

MONITORING WELL ELEVATIONS

Well No.	Ground	Outer Casing	Inner Casing
1A	17.86	19.58	19.39
2A	6.60	8.78	8.67
3A	6.66	9.82	9.66
4A	6.47	8.94	8.75
7A	13.90	16.19	15.87
8A	9.98	11.98	11.64
1B	18.04	20.05	19.90
2B	6.57	8.75	8.48
2C	6.75	8.76	8.49
2D	6.64	8.71	8.63
3B	6.38	9.23	8.94
4C	--	--	8.08
5A	--	--	7.73
6B	11.23	12.46	12.42
7B	14.58	16.60	16.41
9C	9.32	11.23	11.01
10C	4.79	6.07	5.95
1C	18.06	20.05	19.34
4D	--	--	7.99
6A	10.84	12.88	12.75
10D	4.72	6.22	6.15

Note: Monitoring wells 4C, 5A, and 4D are flush-mount wells, and, therefore only inner casing elevations are reported.

TABLE 3-10

FIRST ROUND

WELL NO.	TIME	DEPTH TO WATER (FEET)
1A	0926	11.85
1B	0924	14.89
1C	0920	14.54
2A	0939	03.74
2B	0937	03.60
2C	0936	03.72
2D	0931	04.25
3A	0912	04.81
4C	0850	03.90
4D	0851	03.88
5A	0848	03.59
6A	0836	08.54
6B	0837	08.35
7A	0833	10.98
7B	0830	11.76
8A	0841	06.88
9C	0825	06.01
10C	0901	01.39
10D	0902	01.98
Upper Moss Branch	0945	07.15
Lower Moss Branch	0846	01.69

SECOND ROUND

WELL NO.	TIME	DEPTH TO WATER (FEET)
9C	1123	06.25
7B	1127	11.70
7A	1129	10.98
6A	1132	08.48
6B	1134	07.89
8A	1136	06.92
4A	1139	03.92
5A	1143	03.46
4C	1145	03.79
4D	1147	03.76
10C	1155	01.32
10D	1156	01.96
3B	1201	04.28
3A	1203	04.81
1C	1210	14.48
1B	1211	14.85
1A	1213	11.86
2C	1221	03.72
2D	1224	04.15
2B	1226	03.59
2A	1227	03.75
Upper Moss Branch	1234	07.14
Lower Moss Branch	1142	01.64

TABLE 3-10

(cont'd)

THIRD ROUND

WELL NO.	TIME	DEPTH TO WATER
9C	1415	06.18
7B	1419	11.60
7A	1420	11.00
6A	1421	08.17
6B	1423	08.09
8A	1426	06.88
4A	1427	03.96
5A	1432	03.08
4C	1434	03.44
4D	1435	03.52
10C	1441	01.25
10D	1440	01.81
3B	1447	04.23
3A	1449	04.81
1C	1455	14.38
1B	1456	14.82
1A	1457	11.88
2C	1504	03.70
2D	1505	04.14
2B	1506	03.63
2A	1508	03.78
Upper Moss Branch	1514	07.12
Lower Moss Branch	1430	0.57

FOURTH ROUND

WELL NO.	TIME	DEPTH TO WATER
9C	1742	06.14
7B	1745	11.49
7A	1748	10.96
6A	1750	08.24
6B	1753	07.68
8A	1756	06.82
4A	1759	03.94
5A	1807	03.23
4C	1811	03.35
4D	1813	03.52
3B	1820	04.19
3A	1821	04.77
1C	1848	14.46
1B	1850	14.87
1A	1845	11.87
2C	1828	03.69
2D	1830	04.19
2B	1832	03.59
2A	1835	03.75
Lower Moss Branch	1805	0.95
Upper Moss Branch	1856	07.07

TABLE 3-10

(cont'd)

WELL NO.	TIME	DEPTH TO WATER (FEET)
1A	1139	12.12
1B	1145	15.54
1C	1142	15.22
2A	1129	04.25
2B	1125	04.10
2B(1)	1127	04.10
2C	1120	04.29
2D	1123	04.90
3A	1114	05.38
3B	1112	04.85
4A	1059	04.50
4C	1048	04.40
4D	1046	04.47
5A	1052	04.05
6A	1035	09.11
6B	1038	08.90
7A	1026	11.55
7B	1024	12.30
8A	1055	07.54
9C	1019	06.80 (?)
10C	1104	01.90
10D	1106	02.57
10D(1)	1107	02.57

(1) Measurement taken twice as a QA check

(2) (?) Reading taken is suspect due to blockage in well

SECTION 4

RESULTS AND DISCUSSION

4.1 Hydrogeology

The hydrogeologic investigations at the CLTL site have mainly focused on the first 150 feet of unconsolidated sands, silts and clays below the site, located within the upper zone of the Potomac-Raritan-Magothy Aquifer System. The base of this zone of investigation is defined by a locally continuous clay layer. Based on the ground-water sampling conducted to date, the CLTL site-related ground-water contamination appears to be restricted to this zone above the locally continuous clay layer.

The objectives of the hydrogeologic investigation are to:

1. define the nature and extent of ground-water contamination;
2. to identify hydrogeologic factors that control or influence the migration of contaminants away from CLTL former wastewater lagoons; and
3. to determine aquifer characteristics needed to evaluate the feasibility of various ground-water remediation alternatives.

4.1.1 Regional Hydrogeology

The Potomac-Raritan-Magothy Aquifer System is the major water-supplying formation in Logan Township. Barksdale (1958), Hardt and Hilton (1969) provided basic information on the geology of the Potomac Group-Raritan Formation. In general this aquifer system can be described as a group of water bearing zones separated by discontinuous confining units, each having extremely variable vertical and horizontal extent.

The Potomac-Raritan-Magothy Aquifer System can be divided into an unconfined, water table aquifer, a shallow leaky artesian aquifer and a deeper artesian aquifer. The confining layer that separates the shallow and the deep artesian aquifers is found at elevations of 75 feet below MSL near the Delaware River to 160 feet below MSL at the southeastern portion of the township. The total thickness of the shallow artesian and the water table aquifer ranges from 100 to 180 feet.

Commonly, the uppermost zone of saturation is referred to as a water table aquifer. Recharge to the water table aquifer occurs throughout the township by the infiltration of rainfall into porous, permeable and unsaturated sands, silts and gravels exposed at the surface. Topographic lows such as streams, swamps and lakes are discharge points for the water table aquifer. In addition to discharging to surface water bodies, the water table aquifer also recharges the shallow artesian aquifer system because there is generally a downward hydraulic gradient throughout the Township. The confining layers found below the water table aquifer usually cannot be traced very far laterally which indicates that they do not provide a barrier to the downward migration of ground-water contaminants (NJDEP, DWR, 1982).

The shallow artesian system can consist of several water bearing zones separated by clay layers or alternatively, a single water bearing zone. It is assumed that all of the water bearing zones are hydraulically connected, at least on a regional scale.

Previous work has concluded that the shallow artesian system is recharged by vertical leakage from the water table and discharges into the Delaware River, some of its tributaries and pumping wells. In areas where heavy pumping is occurring, such as at the Monsanto facility in Bridgeport, the opposite case may exist, that is the river system may be recharging the aquifer.

4.1.2 Public Water Supply Systems

The Potomac-Raritan-Magothy aquifer system is the major source of water for the Bridgeport area. Increased pumpage in the area, during the past thirty years have caused regional declines in water levels. At the Monsanto facility, approximately 3 miles west of the CLTL site, water levels have declined approximately thirty feet since the early 1960's. Such major changes in water levels have almost certainly changed ground-water recharge and discharge flow patterns.

The public wells serving the Logan Township area are owned by the Pennsgrove Water Supply Company and the Pureland Water Company. The Pennsgrove Water Supply Company well is located near the intersection of the Pennsylvania-Reading Seashore Lines railroad and Mechanic Street, 1 mile west of the CLTL site. This public water well draws 50,000 gallons per day from a depth of 89 feet below ground level. This well services approximately 180 connections and a total estimated population of 550 people in the Bridgeport area (NJDEP, DWR, 1982).

The two Pureland Water Company wells are located on opposite sides of Interstate Highway 295 east of its intersection with Route 662 (High Hill Road), approximately two miles southwest of the CLTL site. These wells service approximately 700 connections with a total estimated population of over 2000 people (NJDEP, DWR, 1982).

There is no evidence at this time that the ground-water contamination problem that has been identified at the CLTL Superfund site has adversely affected the water quality of any of the public water supply wells.

Private Water Wells - In the northern portion of Logan Township, most newer private wells use the shallow artesian aquifer. However, many older wells still use the water table aquifer. A few private wells use the deep portions of the shallow artesian aquifer as do local large capacity industrial supply wells. Recently there has been a shift towards the use of deeper wells due to contamination of the shallower aquifer zones (NJDEP, DWR, 1982).

The wells that have the greatest effect on water levels in the Logan Township area are the Pennsgrove Water Supply Company's Bridgeport well, the Pureland Water Company's wells along Interstate Highway 295 and the pumping well at the Monsanto facility. The drawdowns that result from the pumping of residential wells are generally very limited, however, the combined effect of the pumping of several residential pumping wells concentrated within a certain area could influence local ground-water flow conditions (NJDEP, DWR, 1982).

4.1.3 Description of Aquifer Subzones

Four aquifer subzones were defined above the locally continuous layer of clay based on the depth at which these monitoring wells are open to the aquifer (screened interval) and the type of ground-water level changes that have been observed in response to tidal influences and production well pumping. Other than a small clay lens in the eastern part of the site, there generally are no well differentiated stratigraphic changes that define the vertical extent of these aquifer subzones. The change in the aquifer characteristics from one aquifer subzone to the next is probably a gradational one as no continuous confining layers or high permeability layers have been identified. The aquifer subzones described in this RI are referred to as the shallow, upper intermediate, lower intermediate and deep aquifer subzones and are described below. All four of these subzones lie within the upper zone of the undifferentiated Potomac Group-Raritan Formation.

The shallow subzone is defined as the unconsolidated sediments between the ground surface and -20 feet MSL. Geologic logs of monitoring wells and subsurface borings installed at the CLTL site (Appendices F and M) indicate that the shallow subzone consists primarily of fine to coarse grained, tan to light brown quartz sand and fine to coarse grained quartz gravel with trace amounts of sand-sized feldspar, very fine grained lignite and heavy minerals, intermixed with varying amounts of brown to orange, fine to medium grained quartz silt. Generally, silt- and sand-sized particles in the shallow subzone are subangular to subrounded and moderately well sorted.

Peat layers were encountered in some of the ground-water monitoring wells installed in the wetlands area adjacent to the CLTL site. The peat layers encountered in these wells ranged from 2 to 9 feet thick. No peat was encountered in some of the wetland wells.

Laterally discontinuous white to medium gray clay layers are found throughout the shallow subzone ranging in thickness from less than an inch to several feet. Laboratory analysis of shallow aquifer unit clay samples collected with Shelby tubes indicated that these clays have an approximate hydraulic conductivity of 1.65 x 10-5 cm/s (Appendix H). An analysis of water levels measured in ground-water monitoring wells in the shallow aquifer subzone indicate that these clay layers do not significantly effect the flow of ground water in this unit.

Monitoring well 2-B had been considered to be within the upper intermediate subzone but is now classified as a shallow subzone well because it does not show water level changes related to tidal influences which is seen in all other intermediate subzone wells. In addition, its screened interval is considerably shallower than the other upper intermediate subzone monitoring wells.

Slug tests conducted in shallow subzone monitoring wells determined average hydraulic conductivities of 1.33 ft/day (Nguyen and Pinder method) and 5.7 ft/day (Hvorslev method)(Table 4.1). In general these values appear to underestimate the hydraulic conductivity of this subzone. A hydraulic conductivity in the range of 30 to 50 ft/day would be more typical for the types of sands and gravels described in the shallow subzone well logs.

The Nguyen and Pinder method of deriving hydraulic conductivity values appears to underestimate these values for all of the aquifer subzones. Therefore, only the Hvorslev derived values, which consider the effect of the sand pack around the well screens, are discussed in this report.

Table 4-1

Hydraulic Conductivity Values Determined by Slug Testing at the CLTL Site

					Nguyen and Pindor				Hvorslev		
Variable Units	Sand Pack Length L ft	Screen Length l ft	Boring Radius R ft	Screen & Casing Radius r ft	C3	C4	Hydraulic Conduct. K 1 ft/day	Specific Storage S 1/ft	Time Lag To sec	r^2ln(l/r) / 2 L To K 2 ft/day	r^2ln(L/R) / 2 L To K3 ft/day
Shallow											
1A	7	5	0.25	0.083	2.21	35.3	1.86	0.44	120	2.0	1.2
2A	7.5	5	0.25	0.083	3.8	80	1.88	0.76	7.5	32.5	18.0
3A	7.5	5	0.25	0.083	2.59	72.7	1.06	0.52	38	6.8	3.7
4A	7	5	0.25	0.083	1.95	42.5	1.37	0.39	52	4.7	2.7
7A	8.5	5	0.25	0.083	1.4	89.8	0.46	0.28	42	5.8	2.9
average							1.33	0.48		10.4	5.7
Upper Int.											
1B	39	10	0.25	0.083	2.13	50	0.63	0.21	5.3	28.9	7.3
2C	9	5	0.25	0.083	na	na	na	na	3.2	76.2	37.0
3B	20	10	0.25	0.083	na	na	na	na	2.6	54.8	25.1
7B	35	10	0.25	0.083	2.08	50	0.62	0.21	12	11.9	3.5
average							0.62	0.21		47.7	21.9
Lower Int.											
2D	15.50	10.00	0.25	0.083	2.03	60.00	0.50	0.20	15	9.5	5.3
4C	51	10	0.25	0.083	2.84	50	0.85	0.28	9.5	15.0	3.3
6B	16	10	0.25	0.083	na	na	na	na	33.5	4.3	2.3
average							0.67	0.24		9.6	3.6
Deep											
1C	19	10	0.25	0.083	2.78	78.9	0.52	0.28	10	14.3	6.8
4D	17	10	0.25	0.083	na	na	na	na	52	2.7	1.4
average							0.52	0.28		8.5	4.1

Notes:

K 1 : Hydraulic Conductivity by the Nguyen & Pindor (1985) method (Assumes no sand pack

K 2 : Hydraulic Conductivity by the Hvorslev (1951) method (Assuming no sand pack)

K 3 : Hydraulic Conductivity by the Hvorslev (1951) method (Assuming sand pack of length L and radius R)

NA: Slug Test data not analyzed using this method

Appendix J provides additional calculations, data plots and reference material for slug tests.

Monitoring wells 2B, 5A, and 8A were slug tested, however, data from these wells was not suitable for analysis.

Slug tests performed: June 1986

The shallow aquifer subzone exhibits the highest water levels observed on-site and its water levels respond to precipitation events but, unlike the deeper aquifer subzones, does not respond to tidal influences.

The intermediate aquifer was divided into two distinct subzones after a review of the pump test water level data indicated that a clay layer in the central portion of the site formed a fairly effective hydraulic barrier between the upper and lower parts of the intermediate subzone.

The upper intermediate aquifer subzone is defined as occurring between -20 feet and approximately -65 feet MSL. Well log descriptions of upper and lower intermediate aquifer subzone monitoring wells indicate the sediments comprising these subzones are generally the same as those found in the shallow subzones consisting of medium to coarse grained quartz sand and gravel with lesser amounts of feldspar, lignite and heavy minerals that occur in moderately well sorted beds.

White to medium gray, moderately stiff discontinuous clay layers up to several feet thick were encountered throughout the site in the upper intermediate aquifer subzone. Laboratory determined hydraulic conductivities of these clays range from 2.04 x 10-7 cm/s to 7.99 x 10-5 cm/s (Appendix H).

Approximate hydraulic conductivity values of 0.62 ft/day (Nyugen and Pinder method) and 21.9 ft/day (Hvorslev method)(Table 4-1) were derived from slug tests conducted in upper intermediate subzone monitoring wells. Again, the Hvorslev method appears to provide values that are closer to the 30 to 50 ft/day range that would be expected for the types of sediments described in the upper intermediate subzone well logs.

The lower intermediate subzone is defined as occurring between approximately -65 feet and -95 feet MSL. The sands and gravels that are found in the lower intermediate subzone are generally the same as the shallow and upper intermediate subzones.

The lower intermediate aquifer unit is characterized by variegated and red clay units that extend over much of the central and eastern parts of the CLTL site where the presence of these clays mark the boundary between the upper and lower intermediate aquifer subzones. Laboratory determined hydraulic conductivities for these clays range from 5.5 x 10-7 cm/s to 1.3 x 10-4 cm/s (Appendix H).

Slug tests performed in lower intermediate subzone monitoring wells determined approximate hydraulic conductivities of 0.67 ft/day (Nguyen and Pinder method) and 3.6 ft/day (Hvorslev method)(Table 4-1). Considering the fact that sediments in the lower intermediate subzone are essentially the same as those found in the upper intermediate subzone, which had an average slug test derived hydraulic conductivities of 22 ft/day, it would appear that these slug test derived values underestimate the hydraulic conductivity of this subzone. The pump test conducted by NUS (1984) at the adjacent BROS Superfund site, which tested an equivalent aquifer subzone, determined a hydraulic conductivity of 43 ft/day and transmissivity of 45,000 gpd/ft.

The deep subzone is defined as occurring between approximately -95 feet and -150 feet MSL with the locally continuous layer of clay forming the base of this unit. Four ground-water monitoring wells were installed in the deep aquifer unit. The sediments that comprise the deep aquifer unit are generally the same as those of the shallow and intermediate units although the deep unit sediments appear to be a little more fine-grained. A layer of red clay ranging from 10 to 38 feet thick marks the upper boundary of the deep aquifer unit. White to gray clay units predominate throughout the rest of the deep aquifer unit.

Slug tests conducted in the deep subzone monitoring well 1-C determined a hydraulic conductivity (K) value of 0.52 ft/day (Nguyen and Pinder method) and 4.1 ft/day (Hvorslev method) (see Table 4-1). These slug test derived values appear to underestimate the hydraulic conductivities of the deep subzone sediments which, based on the well log descriptions, would be expected to have hydraulic conductivities in the range of 20 to 40 ft/day.

Observed changes in water level elevations due to tidal influences are approximately 0.1 foot, about one half of the amount of tidal variation observed in the lower intermediate and deep aquifer subzone. The amount of observed tidal influence on water levels in ground-water monitoring wells is an indirect indicator of how confined the aquifer unit is at the depth of the screened interval of the well. Generally, the degree of observed tidal influences on water level elevations increases with depth at the CLTL site.

4.1.4 Development of Water Level Maps

The relatively flat water levels/potentiometric surfaces at the CLTL site require precise water level measurements in order to define the direction of ground-water flow in each of the aquifer subzones. Measurement errors as low as 0.1 to 0.3 feet could significantly effect conclusions regarding ground-water flow patterns.

The quality of the previous sets of ground-water elevation data obtained by CLTL was reviewed before developing ground-water elevation maps. Only the most recent set of water level measurements obtained as part of the April 1988 pump test were selected to be used to develop ground-water elevation maps. These measurements were the only measurements which were cross checked with another ground-water elevation measuring device that had been calibrated to steel tape ground-water elevation measurements.

A preliminary comparison of the April 1988 water level elevations made by hand using an electric depth to water meter with the elevations collected by the Hermit automatic data recorders identified inconsistencies which suggested that difficulties were experienced with some of the data recorders. In some cases, the two data sets differed by a constant static shift. In these instances a constant static shift was applied to the electronic data logger values so that they would more closely agree with the hand depth to water meter measurements.

CLTL's contractor (ERM) attempted to correct some of these data by applying two different static shifts to the same well over different time intervals. EPA does not agree with this approach because the need to apply two different static shifts indicates that the difference between the electric data loggers and the steel tape measurements changed over time. Therefore, the accuracy of the electric data loggers measurements obtained in between the times when steel tape measurements were taken cannot be predicted.

In other cases ERM applied a constant static shift to electric data logger recordings for which no constant static shift could be calculated, because the data logger values were greater than the hand depth to water meter during one measurement, but less than the hand meter values at the next measurement. Although the use of an average positive or negative static shift in these cases would correct some of the values, it could actually increase the error for other values.

It was determined that 9 of the 25 water level elevation recordings made by the electric data loggers can be utilized with confidence as accurate indicators of ground-water elevations. The water level maps developed in this RI will rely mainly on the hand depth to water meter measurements which were calibrated to steel tape measurements before the aquifer pump test began. It is noted, however, that the draft RI did not state what type of electric hand depth to water meter was used nor the accuracy of this type of instrument.

No surface water level measurements were taken at Cooper Lake and no accurate surface water level measurements are available for Moss Branch during the April 1988 round of ground-water level measurements. Without these data no definite conclusions can be made concerning surface water/ground-water interaction.

Questions also exist concerning the elevation of the surface of the organic mat of the wetlands area adjacent to CLTL. Surface water elevation data will be collected during the wetlands operable unit RI which will address the nature and extent of CLTL-related contamination in the adjacent wetlands.

The April 1988 pump test results were only used in a qualitative manner due to numerous questions concerning the pump test data. The problems with the pump test data include: 1) the pump test was begun without oversight by EPA contractors; 2) some of the electric data loggers appear not to have been functioning properly; 3) questions on the reliability of some of the hand depth to water meter measurements (no description of the type or manufacturer of the water level meter was provided); 4) questions on the accuracy of the rain gauge data; 5) surface water level measurements were not taken; and 6) the pump test was begun during or immediately after a period of rainfall.

One anomaly associated with the pump test data is that the reported water levels measured in the CLTL production well immediately before and after the pump test are higher than ground-water elevations measured in monitoring wells screened in the same aquifer subzone. Ground-water levels in the production well would be expected to be relatively low due to the cone of depression that might develop in the ground-water elevations as a result of long-term pumping as well as pumping during the pump test. This discrepancy suggests that some error was involved with these measurements. The April 1988 pump test data produced by CLTL are provided in Appendices P, Q and R, however only the hand depth to water level measurements presented in Appendix Q (Table Q-10) were utilized in developing ground-water elevation maps after they were converted from depths from top of well casing to depths relative to mean sea level.

4.1.4.1 Ground-water Level Measurements Conducted by EPA

EPA's contractor, CDM FPC conducted four rounds of ground-water level measurements in November 1989 and one round in December 1989. A morning rain storm event passed through the CLTL site area while the November water level measurements were being taken. This rainfall may have had a small effect on the water level measurements. Weather conditions during the December 1989 water level measuring event were dry. As mentioned in Section 3.2.6.1, all water level measurements were taken with a Luftkin steel water level tape measure graduated to 1/100 of a foot. The water level measurements, and the delineation of ground-water flow directions for the various subzones, are discussed in Section 4.1.5, below.

4.1.5 Ground-water Flow Patterns

The ground-water flow patterns at the CLTL site are difficult to define because the ground-water levels/potentiometric surfaces are nearly flat and generally show less than 0.3 to 0.5 feet relief across the CLTL site.

The CLTL site is located in an area of extremely low topography where land elevations are generally less than ten or twenty feet above mean sea level (MSL). The site is surrounded by wetlands or lakes which have elevations of three to five feet above MSL. In this type of situation it can be expected that ground-water flow patterns in shallow aquifer units will be controlled to a large extent by the configuration of the surrounding surface water bodies. If the water table aquifer were to rise in the vicinity of the CLTL site in response to added infiltration from a severe rainstorm, the water table aquifer would discharge to the surrounding surface water bodies taking the most direct path from topographic highs to the topographic lows occupied by the surface water bodies. Conversely, during dry periods, surface water bodies may recharge the water table aquifer. The direction of ground-water flow in the shallow water table aquifer would therefore not be in one direction but rather in a number of directions dependent on climactic as well as topographic conditions.

Ground-water contamination has been detected in monitoring wells throughout the CLTL site. Ground-water contamination appears to have migrated away from the former wastewater lagoons radially in all directions and there does not appear to be a preferred direction of ground-water contaminant migration.

The extent of ground-water contamination can be used as a secondary indicator of the direction of ground-water flow. Site-related contaminants have been detected as deep as 123 feet below MSL. Residential wells north of the CLTL site are contaminated and the residents have been provided with an alternate drinking water supply. The most highly contaminated zones of ground water are located in the immediate vicinity of the former wastewater lagoons.

4.1.5.1 Shallow Subzone

Water levels measured in the shallow aquifer subzone are approximately 0.3 feet higher than those measured in the intermediate subzones and approximately 0.5 feet higher than ground-water elevations measured in the deep subzone. This indicates that a downward hydraulic gradient exists across the CLTL site and demonstrates the potential for ground-water contamination to migrate to deeper portions of the aquifer system.

A map of measured ground-water elevations (April 23, 1988) for the shallow subzone is shown on Figure 4-1. This map indicates that shallow subzone ground water flows northwest. Contour maps showing ground-water elevations in the shallow subzone for the November and December 1989 water level measurements are presented in Appendix U as Figures 5-1 to 5-5. These maps indicate that ground-water flow is generally to the north-northeast. Even though there is some variation in the direction of ground-water flow for each of the six rounds of water level measurements, the general direction of ground-water flow in the shallow aquifer for all of the rounds is towards Cooper Lake.

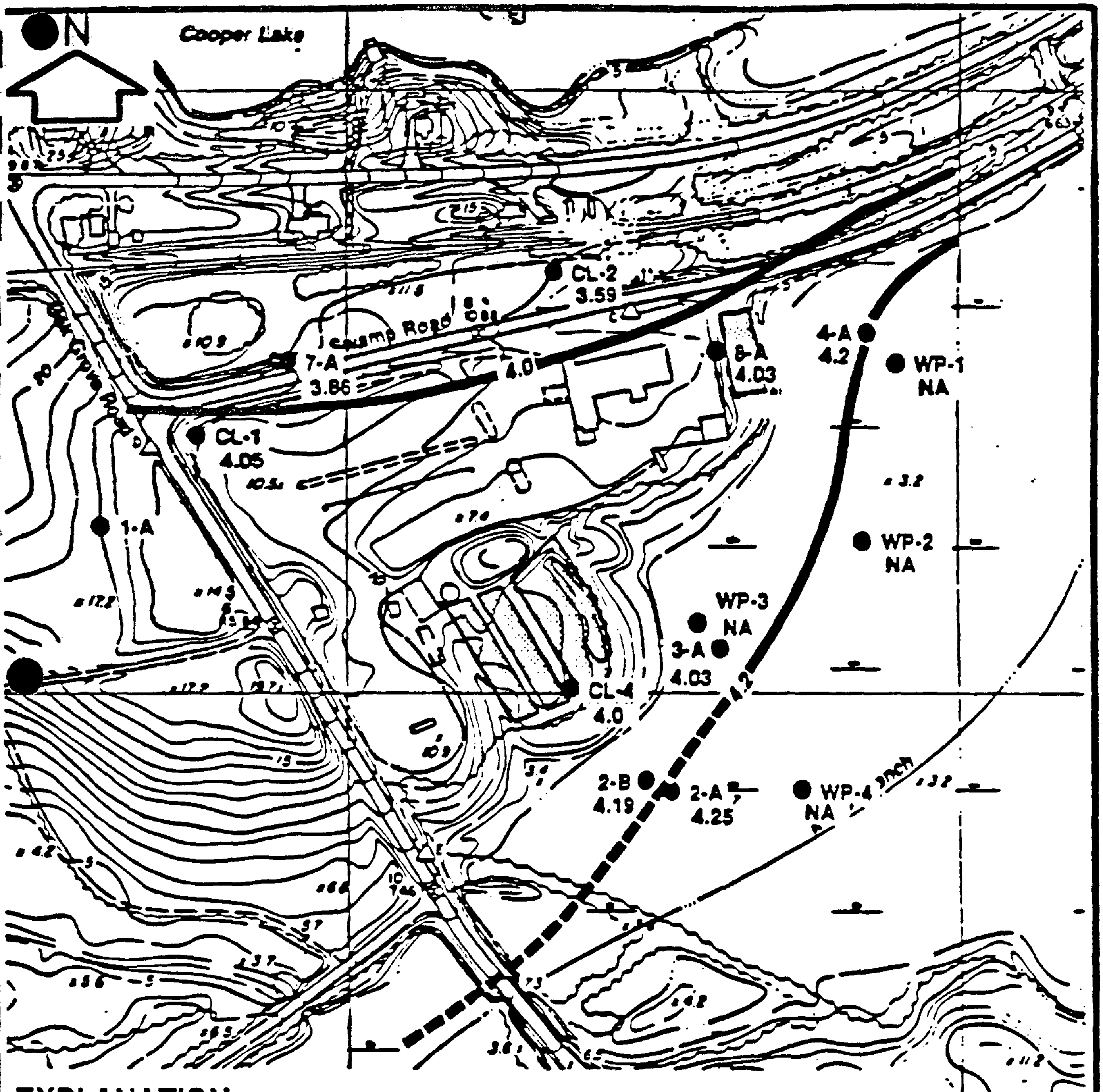
There is approximately 0.2 feet difference in measured water level elevations across the site. The ground-water velocity is estimated to be 0.32 ft/day or 117 ft/year (given an average hydraulic gradient of 0.002 and assuming a porosity of 0.25 and a hydraulic conductivity of 40 ft/day (1.4×10^{-2} cm/sec).

4.1.5.2 Upper and Lower Intermediate Subzone

No clear pattern of ground-water flow is discernable for the upper and lower intermediate subzones during the April 1988 round of water level measurements, although the data suggests a possible northward direction of ground-water flow (Figure 4-2). A total of 0.45 feet difference exists between measured upper intermediate subzone ground-water elevations across the site. However, no consistent pattern in changes in ground-water elevations is observed from well to well. For example, the highest (well 2-C) and the lowest (well 3-B) upper intermediate subzone ground-water elevations were both measured in wells in the wetlands which are only 400 feet apart.

Similar problems exist with the lower intermediate subzone ground-water level data (Figure 4-3) for which a direction of ground-water flow is extremely difficult to determine. A careful inspection of figure 4-3 shows that well DW-1 is anomalous in that it has the highest water level elevation (3.88 feet msl). An inspection of the drilling log for well DW-1 (Appendix A) reveals that this well is screened in a clay layer. Water may be perched atop of this clay layer accounting for the high elevation reading in well DW-1. If the water level elevation reading in well DW-1 is disregarded, ground-water flow in the lower intermediate subzone is in an easterly direction.

Drillers logs for intermediate subzone wells in Appendices A and F show that it is extremely difficult to separate the intermediate subzone into upper and lower units based on the variability of clays, silts and sands in this subzone. For this



EXPLANATION

●	Shallow Subzone Monitor Wells
▬ 4.3 ▬	Ground Water Elevation Contour Line (feet msl), (Dashed Where Inferred)
4.03	Measured Ground Water Elevation (feet msl)
NA	Not Available

100 0 100 200

Scale in Feet

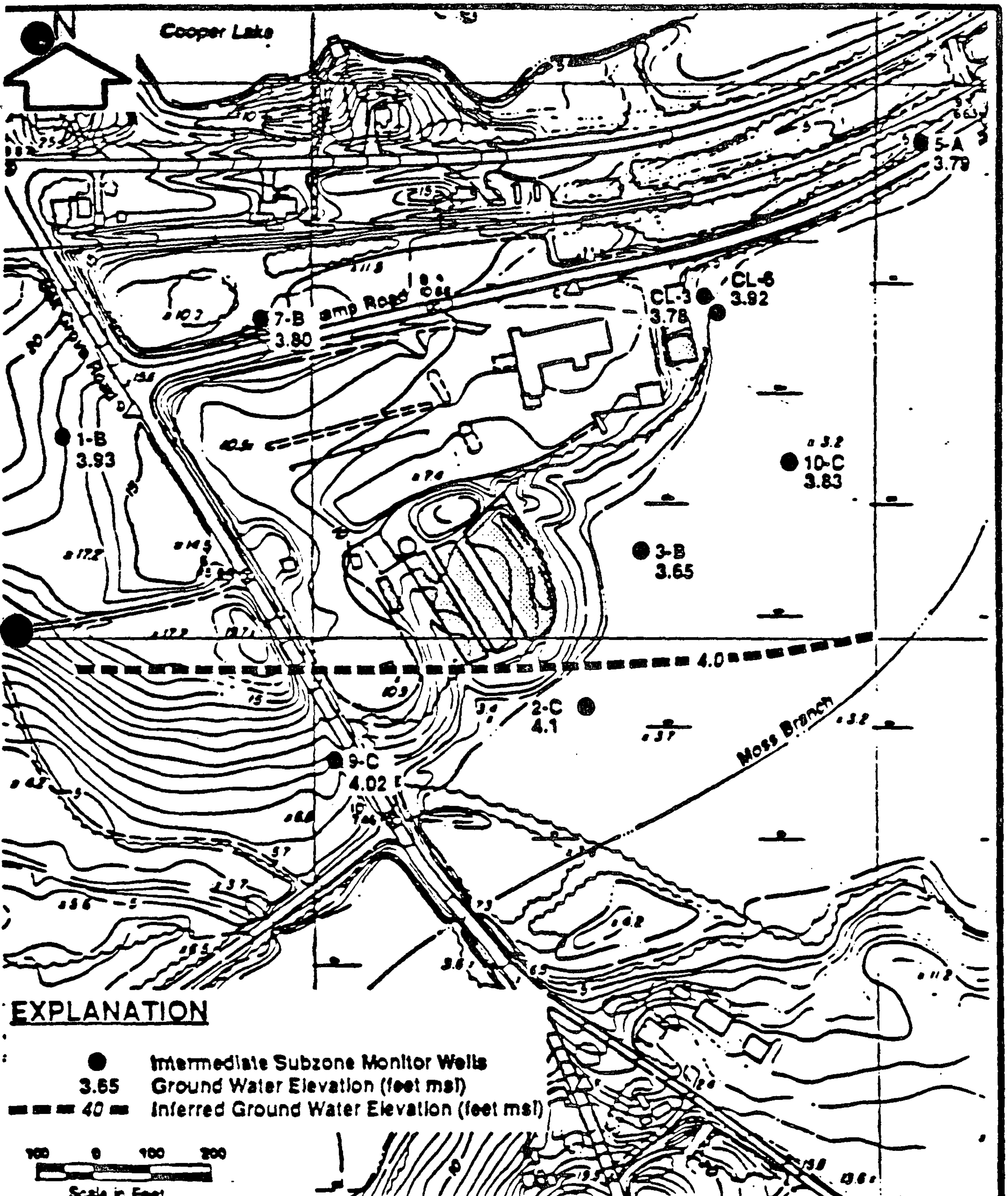
EPA Figure 4-1

Environmental Protection Agency

CDM

Camp Dresser & McKee

CLTL Shallow Subzone Ground Water Elevations
April 23, 1988, Approx. 20:00 Hrs.



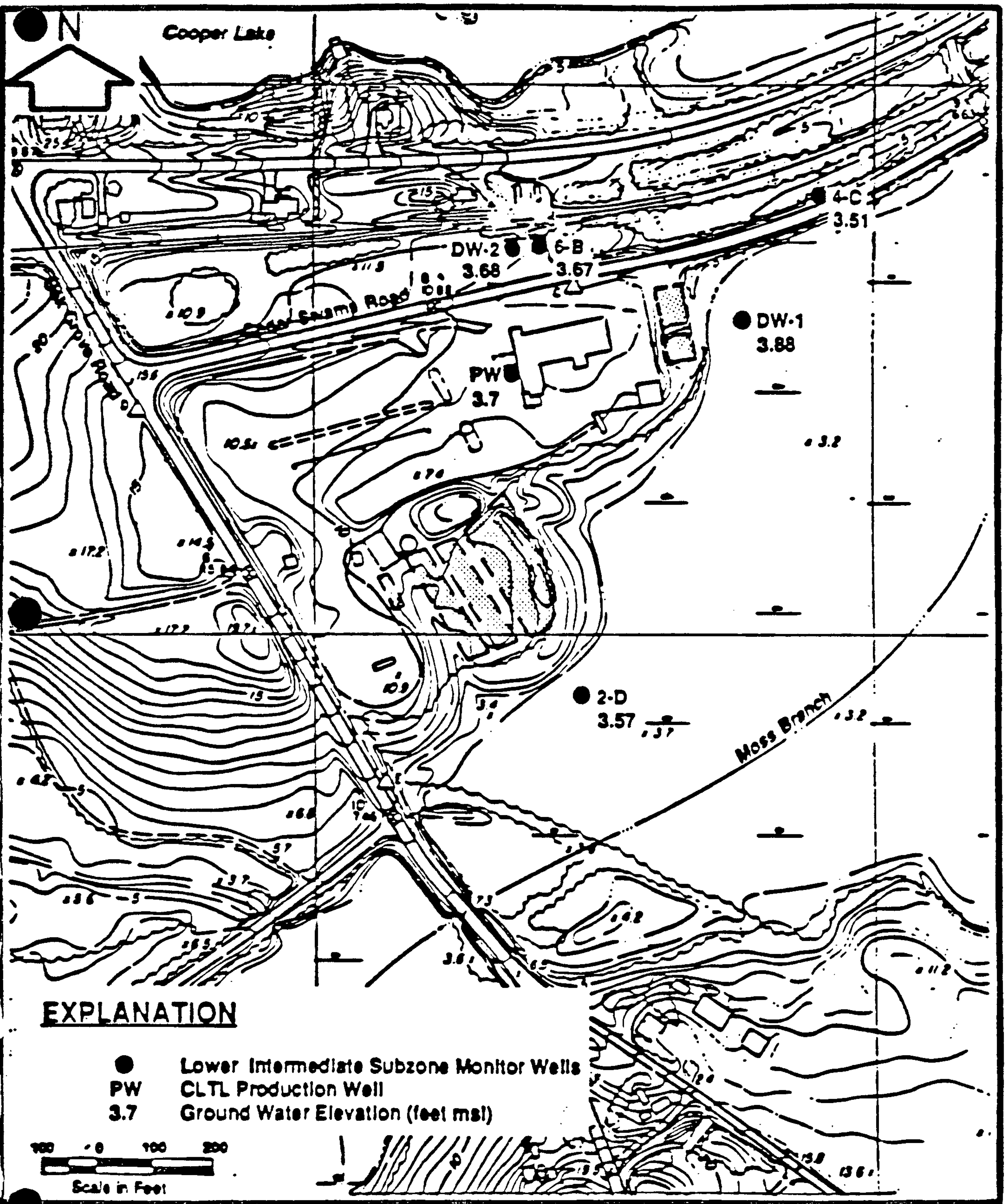
EPA **Figure 4-2**

Environmental Protection Agency

CDM

Camp Dresser & McKee

CLTL Upper Intermediate Subzone Ground Water Elevations April 23, 1988, Approx. 20:00 Hrs.



EXPLANATION

● Lower Intermediate Subzone Monitor Wells
PW CLTL Production Well
3.7 Ground Water Elevation (feet msl)

EPA **Figure 4-3**
Environmental Protection Agency
CDM
Camp Dresser & McKee

CLTL Lower Intermediate Subzone
Ground Water Elevations
April 23, 1988, Approx. 20:00 Hrs.

reason CDM FPC combined the upper and lower units into a single intermediate subzone when determining the ground-water elevations during the November and December 1989 measuring event. Figures 5-6 to 5-10 in Appendix U show ground-water level elevations measured by CDM FPC for the intermediate subzone. As shown in these figures, the flow direction in the intermediate subzone is in a north-northeasterly direction, toward Cooper Lake and Cedar Swamp. Both the April 1988 data, along with the November and December 1989 data show that ground water in the intermediate subzone is moving toward Cooper Lake and/or Cedar Swamp.

Tidal effects are measurable in the intermediate subzone. As shown in figures 5-6 through 5-10 of Appendix U, the change in water level elevation between high and low tide ranged from 0.02 feet in well 2C to 0.50 feet in well 5A.

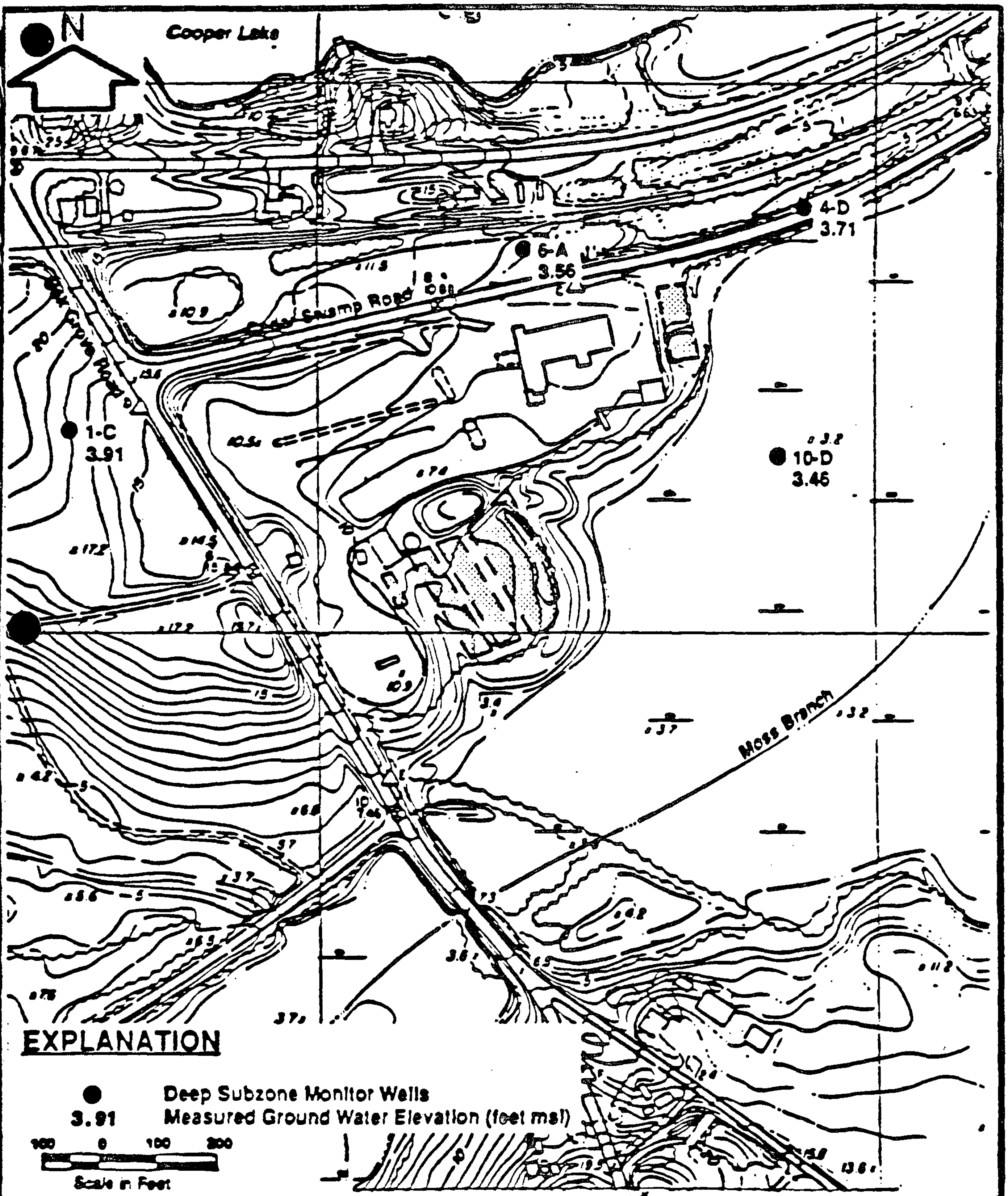
Another explanation for the difficulty in interpreting the ground-water elevation data is that, like the shallow subzone, the upper and lower intermediate subzone piezometric surfaces appear to be essentially flat. The observed nonsystematic variations in measured upper and lower intermediate subzone ground-water elevations across the site may reflect very localized ground-water level conditions due to stratigraphic changes or they may reflect measurement error.

The ground-water gradient in the intermediate subzone is approximately 0.045 feet/100 feet. A minimum ground-water velocity of 20 ft/year can be estimated based on the fact that the CLTL wastewater lagoons were active 27 years ago and in that time CLTL-related contamination has migrated at least 800 feet away from the former wastewater lagoons based on existing monitoring well information.

The apparent radial distribution of ground-water contaminants detected in the intermediate subzone may be explained by the stratigraphic changes in this zone across the site. In addition, ground-water mounding probably occurred around the vicinity of the wastewater lagoons while the lagoons were still active.

4.1.5.3 Deep Subzone

Four monitoring wells are screened in the deep subzone at the CLTL site. From the April 1988 data (Figure 4-4) it would appear that ground water in the deep subzone is flowing radially from wells 1-C, 4-D and 6-A toward well 10-D which is difficult to explain. The November and December 1989 data is easier to interpret. As shown in figures 5-11 to 5-15 of Appendix U, water level measurements taken by CDM FPC in November and December 1989 indicate that flow directions in the deep subzone are to the east-northeast.



EPA **Figure 4-4**

Environmental Protection Agency

CDM

Camp Dresser & McKee

CLTL Deep Subzone Ground Water Elevations
April 23, 1988, Approx. 20:00 Hrs.

Flow directions in the deep subzone appear to be influenced by tidal episodes. The first round of water level readings taken at low tide (figure 5-11 of Appendix U) show a northeasterly direction of flow. The second round of water level measurements, (figure 5-12 of Appendix U) taken between low and high tides indicate a change in flow direction to the east. By the high tide cycle (figure 5-13 of Appendix U) the flow direction has changed to a east-southeasterly direction. The fourth round of measurements (figure 5-14 of Appendix U) show an easterly direction of flow, similar to the second round. The difference in water levels between low and high tide on November 16, 1989 ranged from 0.16 to 0.37 feet.

The gradient across the site for the deep subzone aquifer is approximately 0,058 feet per 100 feet. It should be noted that, because only four wells are screened in the deep subzone aquifer, more wells may be needed to better define the flow directions in this subzone.

4.1.6 Ground-water Quality

The analytical results describing ground-water quality are grouped into four separate categories: organic compounds; inorganic constituents (metals); classical parameters (cyanide and phenols) and water quality indicator parameters (Total Organic Carbon, Total Organic Halogen, Chemical Oxygen Demand, and Total Dissolved Solids); and tentatively identified organic compounds (TICs). Table 3-4 presents a summary of the parameters which were analyzed in ground water from the CLTL site.

For wells that were sampled two or three times, the discussion presented in the following sections uses the highest concentration detected in any sampling effort. These highest detected concentrations will be indicated in parentheses immediately after the name of the contaminant where they are discussed in the text.

Isoconcentration maps of total volatile organic compounds (volatile organics), total semivolatile organic compounds, and total pesticides within each subzone accompany the discussion of organic compounds in ground water. Maps showing the distribution of metals in each subzone accompany the discussion relating to inorganic constituents, classical parameters, and water quality indicator parameters. In addition, median concentrations in the Potomac-Raritan-Magothy aquifer system as reported by Fusillo and Voronin (1981) and relevant National Primary Drinking Water Standards and Secondary Drinking Water Regulations are provided for reference (Tables 4-2 and 4-3).

Table 4-2

MINIMUM, MEDIAN, AND MAXIMUM VALUES OF PERTINENT PHYSICAL AND DISSOLVED CHEMICAL PARAMETERS IN THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM REPORTED IN FUSILLO AND VORONIN (1981)

PARAMETER	MINIMUM	MEDIAN	MAXIMUM
Temperature (°C)	12.7	14.51	26.0
Specific Conductance (umhos/cm)	39	246	4,200
pH	4.4	6.6	8.3
Organic Carbon (ug/L)	0.0	1,700	108,000
Dissolved Solids (ug/L)	25,000	148,000	2,200,000
Beryllium (ug/L)	<1	<1	8
Cadmium (ug/L)	<1	2	22
Copper (ug/L)	<10	<10	930
Lead (ug/L)	<10	<10	47
Zinc (ug/L)	<4	9	600

3448

Table 4-3

U.S. PRIMARY DRINKING WATER STANDARDS AND SECONDARY DRINKING WATER REGULATIONS FOR SELECTED PRIORITY POLLUTANT INORGANIC CONSTITUENTS AND INDICATOR WATER QUALITY PARAMETERS IN GROUND WATER AT THE CLTL SITE

PARAMETER	MAXIMUM LEVEL (ug/L)
	Drinking Water Standard
Arsenic	50
Cadmium	10
Chromium	50
Lead	50
Mercury	2
Selenium	10
Silver	50
	Drinking Water Regulation
Copper	1,000
Zinc	5,000
Total Dissolved Solids	500,000

Appendix S presents the Quality Assurance/Quality Control (QA/QC) review of the analytical results. This appendix includes a comprehensive review of the data package deliverables from the laboratory including holding times, duplicate analyses, matrix spike recoveries, method blank analyses, and a number of other analyses. The tables listing analytical results in this section contain qualifiers generated as part of the QA/QC review. Although the tables provide a brief explanation of the qualifiers, the technical basis for the qualifiers is provided in Appendix S.

It should be noted, in regard to all compounds identified in the TIC analyses, that TICs are nonpriority pollutant compounds identified by finding the "best" match between the mass spectra derived from the unknown peak in the sample and a computer library search of known mass spectra. The concentrations reported for the TICs are estimated values based on assuming a 1:1 response factor to that of the closest eluting internal standard of known concentration. Therefore, the TIC is not quantitated to a reference standard of the identified compound. These factors result in an approximation of the TIC concentration and qualitative identification (Appendix S).

4.1.7 Shallow Subzone Ground-water Sampling Results

Table 4-4 presents the results of analysis for organic compounds in ground water collected from the shallow subzone monitoring wells at the CLTL site.

Ground-water sampling results from the test pit wells installed by CLTL in the shallow subzone prior to the RI field work are considered to be only qualitative indicators of water quality because they were not installed in accordance with EPA and NJDEP procedures and may not accurately reflect ground-water quality.

Contamination resulting from activities at the CLTL terminal has probably been introduced to the shallow subzone in three different ways: 1) infiltration of wastewater into the aquifer via unlined lagoons; 2) possible infiltration of past wastewater discharge from the former final settling lagoons; 3) accidental spills and leaks of chemicals and/or contaminated wastewater related to the on-going truck washing activities.

The volatile organic compounds that occur at the highest concentrations in the shallow subzone include trans-1,2-dichloroethene (15000 ppb), vinyl chloride (8900 ppb), trichloroethene (4100 ppb) and 1,2-dichloroethene (1400 ppb). Methylene chloride (20 ppb), chloroform (30 ppb), benzene (290 ppb), tetrachloroethane (830 ppb) and chlorobenzene (600 ppb) are also found in the shallow subzone. Figure 4-5 shows the

Table 4-

Priority Pollutant Organic Compounds In Ground Water Collected from Shallow Subzone Wells in the Remedial Investigation at the CLTL Site

COMPOUND	[illegible]	SHALLOW SUBZONE WELLS													
		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
		Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00
VOLATILES															
METHYLENE CHLORIDE	2			20											
TRANS-1,2-DICHLOROETHENE	10					00	10					10000	0000		
CHLOROFORM													20		
TRICHLOROETHENE	1					40							20		
BENZENE	1					00	20						200		
TOLUENE									20				210		
VINYL CHLORIDE	2					20						0000	0000		
1,2-DICHLOROETHANE	2											000	1400		
TETRACHLOROETHENE	1												70		
CHLOROBENZENE	4					20	10					000	000		
ETHYLBENZENE						10							200		
1,1-DICHLOROETHANE	2												20		
1,2-DICHLOROPROPANE													070		
FLUOROTRICHLOROMETHANE															
1,1,1-TRICHLOROETHANE													70		
CHLOROETHANE						10									
SEMIVOLATILES															
1,2-DICHLOROBENZENE				20	20	40	20					220	410		
1,3-DICHLOROBENZENE												10			
1,4-DICHLOROBENZENE												40			
NAPHTHALENE												2506	2240		
DI-N-BUTYL PHTHALATE										10		20			
DIETHYL PHTHALATE												10			
N-NITROSODIPHENYLAMINE												400	1020		
1,2,4-TRICHLOROBENZENE												110			
2-CHLORONAPHTHALENE												20			
BUTYL BENZYL PHTHALATE												700	000		
BIS(2-ETHYLHEXYL)PHTHALATE												080			
ISOPHORONE															
DIMETHYL PHTHALATE															
NITROBENZENE															
PHENOL												20			
2,4-DIMETHYLPHENOL												100			
2,4-DICHLOROPHENOL															
2-NITROPHENOL															
4-NITROPHENOL															
PESTICIDES															
HEPTACHLOR															
ALPHA BHC															
DELTA BHC															
DDT											0.2				
ENDOSULFAN I			0.1		0.02						0.11				
ENDOSULFAN SULFATE					0.4										
DDE													1.1		

(IW) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
ND CONCENTRATIONS ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT
CONCENTRATIONS REPORTED IN ug/L (PPB)
(V) ANALYZED FOR VOLATILES ONLY
(*) VOLATILE HOLDING TIME EXCEEDED
(**) EXTRACTION HOLDING TIME EXCEEDED ON ACID EXTRACTABLES AND BASE NEUTRALS; CONCENTRATIONS SUSPECT

*DRINKING WATER STANDARDS/GUIDELINES (ug/l) - NJ DRINKING WATER QUALITY INSTITUTE
OBTAINED FROM NJDEP [illegible]

APPROVED FOR
RELEASE BY
QUALITY ASSURANCE
David R. [illegible] 1-23-92
QA/QC MANAGER DATE

Table 4-4 (co.)

COMPOUND	[illegible]	SHALLOW SUBZONE WELLS (CONT)															
		CL-[illegible]		CL-[illegible]		TP-[illegible]		TP-1[illegible]		TP-1[illegible]		TP-[illegible]		TP-1[illegible]		TP-[illegible]	
		Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
VOLATILES																	
METHYLENE CHLORIDE	[illegible]			[illegible]	[illegible]			NA		NA	NA			NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]								
CHLOROFORM																	
TRICHLOROETHENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]								
BENZENE	[illegible]	[illegible]		[illegible]	[illegible]												
TOLUENE				[illegible]	[illegible]												
VINYL CHLORIDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]								
1,2-DICHLOROETHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]												
TETRACHLOROETHENE	[illegible]	[illegible]	[illegible]														
CHLOROBENZENE	[illegible]			[illegible]	[illegible]												
ETHYLBENZENE				[illegible]													
1,1-DICHLOROETHANE	[illegible]																
1,2-DICHLOROPROPANE																	
FLUOROTRICHLOROMETHANE																	
1,1,1-TRICHLOROETHANE																	
CHLOROETHANE																	
SEMIVOLATILES																	
1,2-DICHLOROBENZENE				[illegible]	[illegible]												
1,3-DICHLOROBENZENE		[illegible]															
1,4-DICHLOROBENZENE		[illegible]	[illegible]														
NAPHTHALENE				[illegible]	[illegible]												
DI-N-BUTYL PHTHALATE																	
DIETHYL PHTHALATE																	
N-NITROSODIPHENYLAMINE																	
1,2,4-TRICHLOROBENZENE																	
2-CHLORONAPHTHALENE																	
BUTYL BENZYL PHTHALATE																	
BIS(2-ETHYLHEXYL)PHTHALATE																	
ISOPHORONE																	
DIMETHYL PHTHALATE																	
NITROBENZENE																	
PHENOL																	
2,4-DIMETHYLPHENOL																	
2,4-DICHLOROPHENOL																	
2-NITROPHENOL																	
4-NITROPHENOL																	
PESTICIDES																	
HEPTACHLOR				[illegible]													
ALPHA BHC																	
DELTA BHC																	
DDT																	
ENDOSULFAN I																	
ENDOSULFAN SULFATE																	
DDE																	

(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATIONS ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT
CONCENTRATIONS REPORTED IN ug/l (PPB)
(*) ANALYZED FOR VOLATILES ONLY
(**) VOLATILE HOLDING TIME EXCEEDED
(***) EXTRACTION HOLDING TIME EXCEEDED ON ACID EXTRACTABLES AND BASE NEUTRALS; CONCENTRATIONS SUSPECT

*GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJ DRINKING WATER QUALITY INSTITUTE
OBTAINED FROM NJDEP [illegible]

APPROVED FOR
RELEASE BY
QUALITY ASSURANCE
David R Olz 1-23-89
QA/QC MANAGER DATE

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Table 4-4 ([illegible]ont.)

Priority Pollutant Organic Compounds in Ground Water Collected from Well Points Located in Cedar Swamp, Adjacent to the CLTL Terminal

COMPOUND	WP-1	WP-2	WP-3	WP-4
COLLECTION DATE	4/8/88	4/8/88	4/8/88	4/8/88
VOLATILES				
METHYLENE CHLORIDE				
TRANS-1,2-DICHLOROETHYLENE				
CHLOROFORM				
TRICHLOROETHENE				
BENZENE	10	40	140	17
TOLUENE			18	
VINYL CHLORIDE				
1,2-DICHLOROETHANE				
TETRACHLOROETHENE				
CHLOROBENZENE			8	
ETHYLBENZENE				
1,1-DICHLOROETHENE				
1,2-DICHLOROPROPANE				
FLUOROTRICHLOROMETHANE				
1,1,2-TRICHLOROETHANE				
CHLOROETHANE				
SEMIVOLATILES				
1,2-DICHLOROBENZENE				
1,3-DICHLOROBENZENE				
1,4-DICHLOROBENZENE				
NAPHTHALENE		10		
DI-N-BUTYL PHTHALATE				
DIETHYL PHTHALATE				
N-NITROSODIPHENYLAMINE		20		
1,2,4-TRICHLOROBENZENE				
2-CHLORONAPHTHALENE				
BUTYL BENZYL PHTHALATE				
BIS(2-ETHYLHEXYL)PHTHALATE		[illegible] J	340	[illegible] B
ISOPHORONE				
DIMETHYL PHTHALATE				
NITROBENZENE				
PHENOL				
2,4-DIMETHYLPHENOL		60	600	
2,4-DICHLOROPHENOL				
4-NITROPHENOL				
2-NITROPHENOL				
PESTICIDES				
HEPTACHLOR				
ALPHA BHC				
DELTA BHC				
DDT				
ENDOSULFAN I				
ENDOSULFAN SULFATE				
DDE				0.10 J

B- REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION.

J - REPORTED RESULT IS A QUANTITATIVE ESTIMATE.

NO CONCENTRATION ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT.

CONCENTRATIONS REPORTED IN ug/L (PPB).

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distribution of total volatile organics in shallow subzone ground water at the CLTL site.

Of the semivolatile organic contaminants detected in the shallow subzone ground water, 1,2-Dichlorobenzene, at levels up to 410 ppb, was the only semivolatile organic compound detected in all areas of the site. Additional types semivolatile organic compounds were detected in only 1 or 2 monitoring wells and were detected at levels of generally less than 20 ppb. Table 4-4 lists all semivolatile organic compounds detected in the shallow subzone. Figure 4-6 shows the distribution of total semivolatile organics in shallow subzone ground water at the CLTL site.

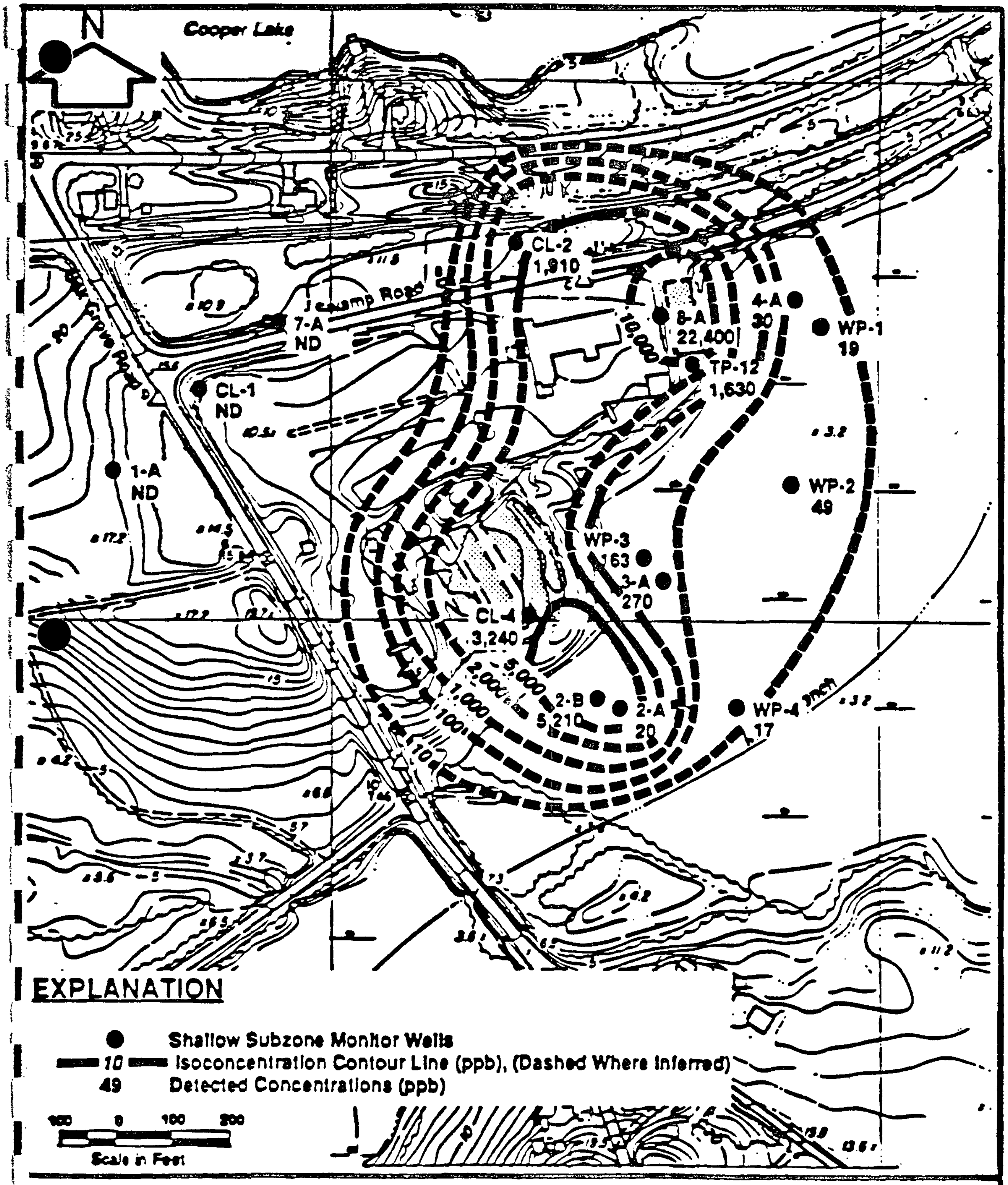
Arsenic (190 ppb), chromium (690 ppb), lead (650 ppb) and zinc (68500 ppb) were the inorganic contaminants detected in the shallow subzone ground water at the CLTL site. Table 4-5 lists the inorganic, classical and water quality contaminant parameters for the shallow subzone monitoring wells. Figure 4-7 summarizes the detected levels of these contaminants in the shallow subzone.

The high levels of inorganic contaminants detected in ground-water samples from RI well point number 3 (WP-3) may be the result of not filtering the sample. However, the following points should considered: 1) similar levels of inorganic contaminants were not detected in other unfiltered well point samples; 2) very high levels of volatile and semivolatile organics were detected in ground-water samples from WP-3; 3) WP-3 is located in the wastewater overflow area from the final settling lagoon; 4) WP-3 is located in an area of high subsurface conductivity, which may be caused by high levels of dissolved inorganics in the ground water.

Levels of TDS (970000 ppb) and TOC (120000 ppb) were highest in ground-water samples taken from shallow subzone monitoring wells along the eastern boundary of the site. These levels of TDS and TOC are approximately two orders of magnitude greater than shallow subzone monitoring well located along the western boundary of the CLTL site.

A list of TICs detected in shallow subzone ground water is provided in Table 4-6. The highest levels of TICs were detected in monitoring wells immediately adjacent to the former lagoons.

Generally the highest concentrations of ground-water contaminants were detected in RI monitoring well 8-A located along the western edge of the former primary settling lagoons. The well log for monitoring well 8-A described the sand from six feet below the ground surface to its total depth of 15 feet below the ground surface as being a fine to medium sand saturated with a black oily substance having a strong odor. The screened interval of well 8-A is located within this zone of contaminated sand. The



EPA **Figure 4-5**
Environmental Protection Agency
CDM
Camp Dresser & McKee

Total Priority Pollutant Volatile Organics
Detected In CLTL Shallow Subzone Ground Water

Table 4-5

Priority Pollutant Inorganic Constituents, Classical Parameters, and Water Quality Parameters in Ground Water Collected from Shallow Subzone Wells in the Remedial Investigation at the CLTL Site

PARAMETER	ARAR IF KNOWN*	SHALLOW SUBZONE WELLS															
		1 A		2 A		3 A		4 A		7 A		9 A		CL - 1		CL - 2	
		Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
ARSENIC	50		30				30			100	60	100	100			14	
ANTIMONY																	
BERYLLIUM										9							
CADMIUM	10																
CHROMIUM	50	300				200	120	70		600		310	60	300		80	
COPPER	1000	220		30		130	60	30		270		110	30	40	40		
LEAD	50	200								200		030					
MERCURY	2												1				
NICKEL		100		70		60	60			100							
SELENIUM	10																
SILVER	50																
THALLIUM																	
ZINC	5000	100		600	1300	2040	1100	60	60	1710	3100	1110	600	230	60	50	200
PHENOLS				6	3	60	20	60	40			310	360				7
CYANIDE **	200																
TOC		4000	1000	12000	13000	30000	64000	120000	30000	3400	2200	37000	44000	2400	2700	5000	6000
TOX				60	480	300	210	20	32		13	13000	6000	0	14	600	1100
COD **		44000	31000	37000	30000	271000 *	233000	210000	109000	42000	60000	742000	300000		10600	30000	31000
TDS **		100000	140000	306000	203000	711000	640000	532000	677000	62000	60000	[illegible] *	420000	130000	311000	373000	332000

@ COMPLETED BELOW DEEP SUBZONE
ALL RESULTS REPORTED IN ug/l (PPB)
NO CONCENTRATIONS ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT
(*) ANALYSIS HOLDING TIME EXCEEDED; CONCENTRATIONS SUSPECT
(**) ALL CYANIDE ANALYSIS HOLDING TIMES WERE EXCEEDED FOR JUNE 1988 AND SEPTEMBER 1988 AND ALL COD AND TDS ANALYSIS HOLDING TIMES WERE EXCEEDED FOR SEPTEMBER 1988. CONCENTRATIONS ARE ESTIMATED FOR THESE PARAMETERS ON THESE DATES
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
(V) ANALYZED FOR VOLATILES ONLY
(J) REPORTED RESULT IS A QUANTITATIVE ESTIMATE
(B) REPORTED RESULT IS QUALITATIVELY INVALID SINCE THE COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

* NJ GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJAC 7:9-6.0 GROUND WATER QUALITY CRITERIA
OBTAINED FROM NJDEP [illegible]

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Table C-5 (Cont.)

PARAMETER	ARAR IF KNOWN*	SHALLOW SUBZONE WELLS (CONT)													
		CL-4		TP-1		TP-12		TP-13		TP-16		TP-18		TP-22	
		Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88 o	Jun-88	Sep-88	Jun-88	Sep-88
ARSENIC	50	12	20	5	8	NA	NA	NA	NA	100		NA	NA	NA	NA
ANTIMONY															
BERYLLIUM															
CADMIUM	10														
CHROMIUM	50									50					
COPPER	1000		30							30					
LEAD	50				400										
MERCURY	2														
NICKEL		80	80												
SELENIUM	10														
SILVER	50														
THALLIUM															
ZINC	5000	80	60	30100	60900					140					
PHENOLS		53	41	8						0					
CYANIDE **	200														
TOC		16000	21000	6000	13000					30000					
TOX		2100	1000	45	110					24					
COD **		47000	70000	47000	64000					113000					
TDS **		527000 °	570000	220000	200000					202000 °					

⊙ COMPLETED BELOW DEEP SUBZONE
ALL RESULTS REPORTED IN ug/l (PPB)
NO CONCENTRATIONS ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT
(*) ANALYSIS HOLDING TIME EXCEEDED; CONCENTRATIONS SUSPECT
(**) ALL CYANIDE ANALYSIS HOLDING TIMES WERE EXCEEDED FOR JUNE 1988 AND SEPTEMBER 1988 AND ALL COD AND TDS ANALYSIS HOLDING TIMES WERE EXCEEDED FOR SEPTEMBER 1988. CONCENTRATIONS ARE ESTIMATED FOR THESE PARAMETERS ON THESE DATES.
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
(o) ANALYZED FOR VOLATILES ONLY
(J) REPORTED RESULT IS A QUANTITATIVE ESTIMATE
(B) REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

* NJ GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJAC 7:9-6.6 GROUND WATER QUALITY CRITERIA
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Table 4-5 (cont.)

Priority Pollutant Inorganic Constituents, Classical Parameters, and Water Quality Indicator Parameters Detected in Well Point Samples at the CLTL Terminal

PARAMETER	WP-1	WP-2	WP-3	WP-4
COLLECTION DATE	4/8/88	4/8/88	4/8/88	4/8/88
ANTIMONY				
ARSENIC	20	110	880	40
BERYLLIUM			65	
CADMIUM			180	
CHROMIUM		80 J	1930	
COPPER			2080	20 B
LEAD		23 J	1880 J	54 J
MERCURY			18	
NICKEL			1220	40 B
SELENIUM				
SILVER				
THALLIUM				
ZINC	90 J	60 J	9780 J	210 J
PHENOLS	6	63	163	7
CYANIDE			17	
TOC	31000	130000	81000	36000
TOX	200	250 J	1500	160
COD	430000	880000	2880000	1530000
TDS	270000 J	800000 J	820000 J	450000 J

J - REPORTED RESULT IS A QUANTITATIVE ESTIMATE.

B - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS PARAMETER WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION.

NO CONCENTRATION ENTERED FOR PARAMETERS NOT DETECTED ABOVE THE QUANTITATION LIMIT.

CONCENTRATION REPORTED IN ug/L (PPB).

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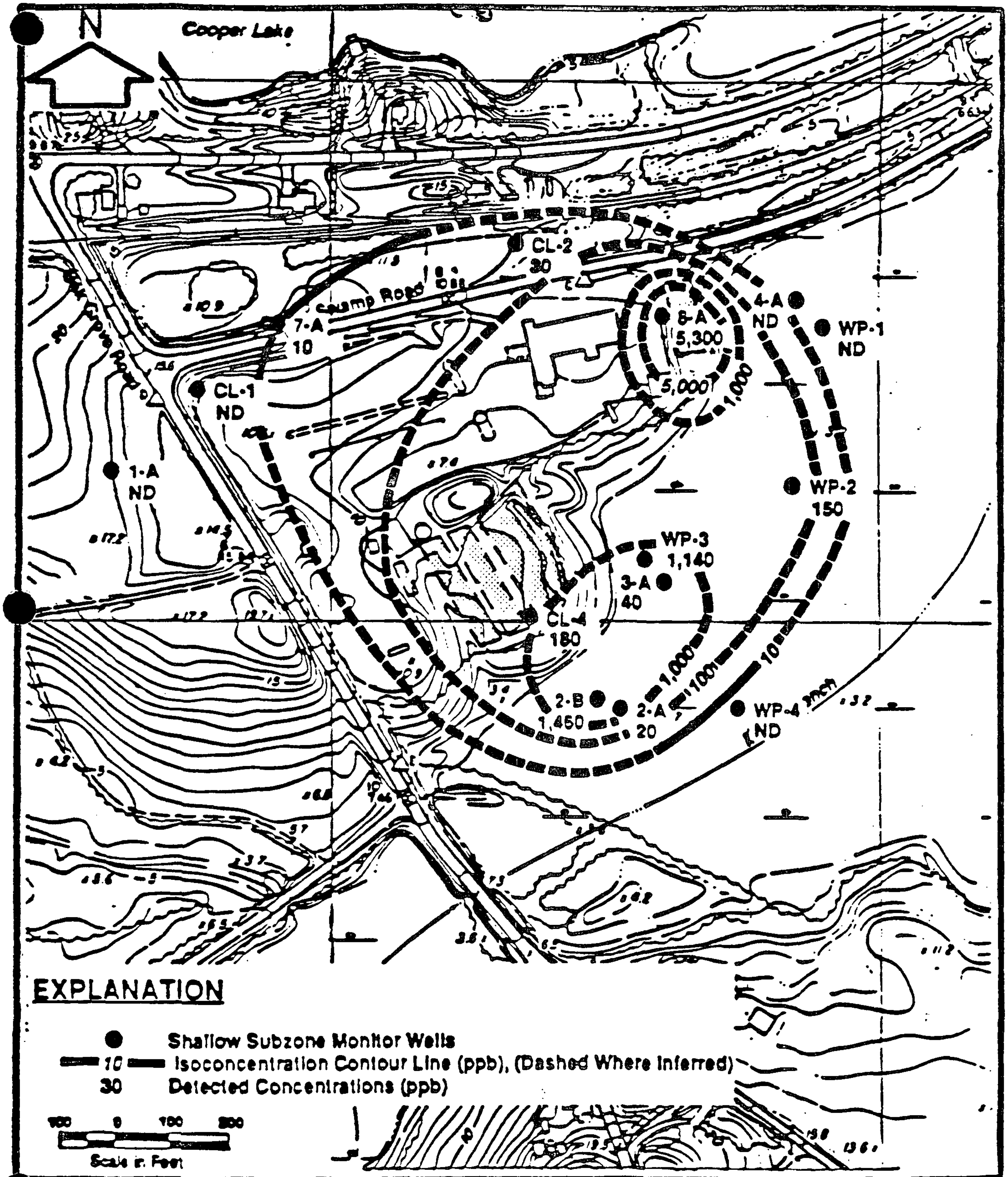

EPA **Figure 4-6**

Environmental Protection Agency

CDM

Camp Dresser & McKee

Total Priority Pollutant Semivolatiles Detected In CLTL Shallow Subzone Ground Water

Figure 4-7

Concentration (ug/L) of Selected Priority Pollutant Metals in Shallow Subzone Monitoring Wells Sampled in the Remedial Investigation at the CLTL Site

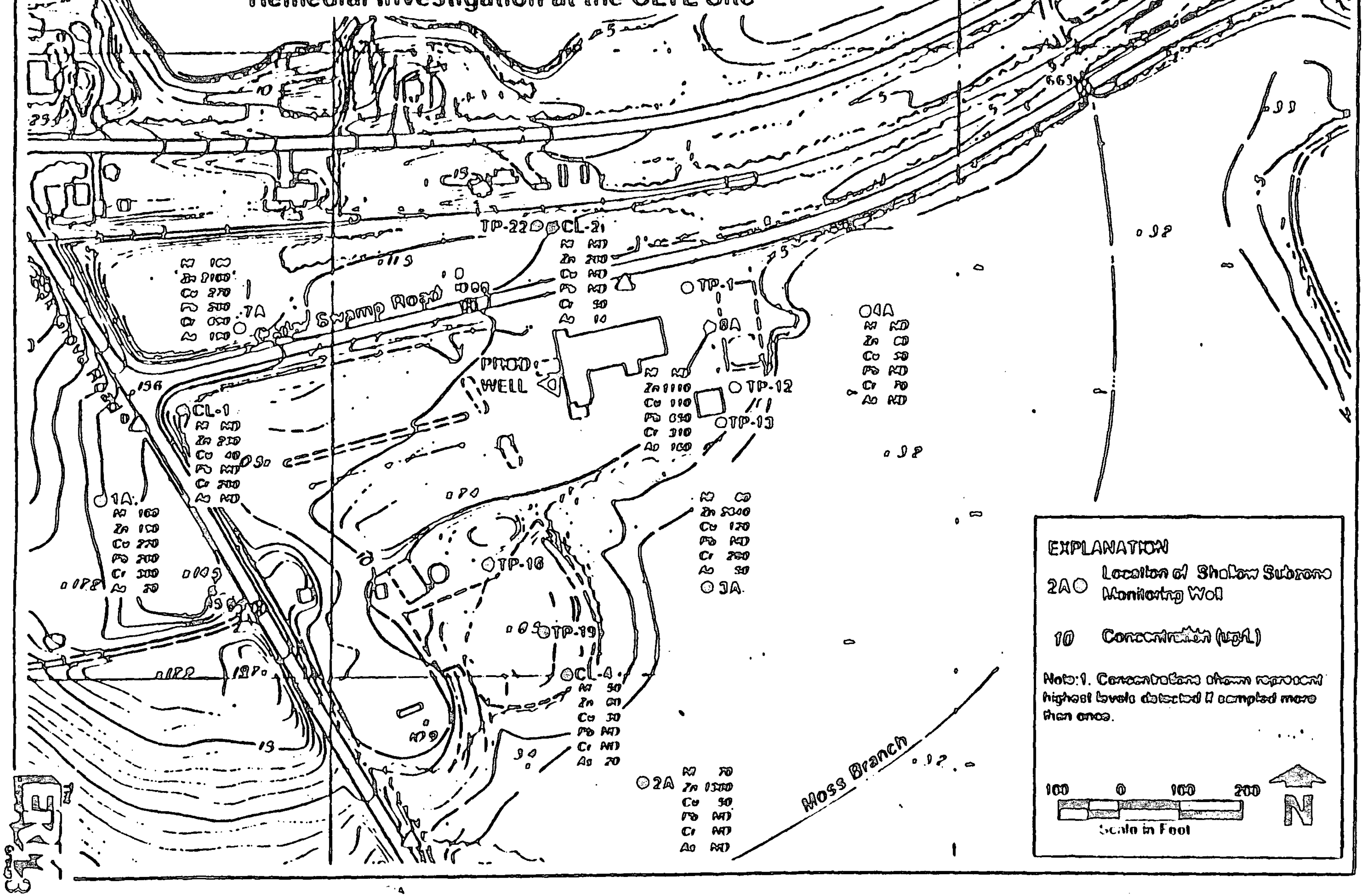

Table [illegible]-6

Tentatively Identified Organic Compounds in Ground Water Collected from Shallow Subzone Wells in the Remedial Investigation at the CLTL Site

COMPOUND	SHALLOW SUBZONE WELLS									
	1 A		2 A		3 A		6 A		7 A	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
UNKNOWN HYDROCARBON	20		27	100	1200		1372		146	
2-(2-METHOXYETHOXY)ETHANOL	20		13						34	
SATURATED ALIPHATIC HYDROCARBON										
ALIPHATIC HYDROCARBON				18		427				700
ETHYLESTER CARBAMIC ACID										
HYDROXY METHYL PENTANONE										
METHOXY ETHOXY ETHANOL										
BUTYL BENZENE SULFONAMIDE										
HEXANOIC ACID			15							
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL			30		66	120				
HEPTADECENE-8-CARBONIC ACID			16							
XYLENE										
BENZOFURAN										
1-PROPYNYL BENZENE										
2-CHLORO-6-METHYL PYRIDINE										
1-METHYLNAPHTHALENE										
4,4'-(1-METHYLETHYLIDENE)BISPHENOL					63					
1,1'-OXYBISETHANE					10					
N,N-DIMETHYLFORAMIDE					31	40				
METHYLBENZENAMINE										
CHLOROBENZENAMINE										
BENZO(B)THIOPHENE										
OCTYL PHENOL ISOMER					31					
2-CHLORO-PHOSPHATE ETHANOL										
HEXANE										
2-BUTOXY ETHANOL					13					
2-METHYLPENTENE					10					
2,3-TETRAHYDROTHIOPHENE DIOXIDE					13					
BENZOTHIAZOLE					13					
4-(1,1-DIMETHYLETHYL)PHENOL					27	41				
UNKNOWN				331	10	604		100		100
PROPANOL										
METHYL [illegible]PROPANE										
HYDROXYPROPOXYPROPANOL										
UNKNOWN PYRIDINE										
DIETHYL ESTER BENZENE CARBOXYLIC ACID										
TETRAMETHYL BUTYL PHENOL										
FATTY ACID				10			670			
METHOXYMETHYL AZIRIDINE										
HYDROXYMETHYL BENZENE ACETIC ACID										
AZULENE										
DIMETHYL PROPANOL										
METHYL FORMAMIDE										
ACETONE							30			
2,2'-(1-METHYL-2-HYDROXYETHYL)ETHER										
METHYL NAPHTHALENE										
UNKNOWN PHTHALATE ESTER										
CRESOL							109			
BENZOIC ACID							100			
BENZENEACETIC ACID							105			
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL							630			
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL MIX WITH UNK HYD										
ALPHA, ALPHA DIMETHYL BENZENEMETHANOL										
PHENOXY ETHANOL										
3-METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID										
O,O DIETHYL-S-ETHYL PHOSPHOROTHIOATE										

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Table 4-6 (cont.)

COMPOUND	SHALLOW [illegible] WELLS (CONT)									
	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
[illegible] ACID										
[illegible] METHYL PENTANONE										
DIMETHYL BENZENE										
CYCLOHEXANONE										
[illegible]										
TRIMETHYLCYCLOHEXANONE										
BENZENE METHANOL										
DIMETHYL BENZENE [illegible]										
BUTOXYBUTENE										
[illegible]										
[illegible]										
ETHYL [illegible] ESTER										
1,2-BIS(2-CHLOROETHOXY)ETHANE										
1,2-DICHLOROETHOXYETHANE										
BIS-(2-METHOXYETHYL)BENZENE DICARBOXYLIC ACID ESTER										
2-ETHYLHEXANOL										
N-PHENYLBENZENAMINE										
CHLOROETHANOL PHOSPHATE										
TOLUENE										
STYRENE										
BENZENAMINE										
CHLOROETHANOL [illegible]										
2-ETHYLHEXANOIC ACID										
ETHYL PHENOL ISOMER										
DIMETHYL PHENOL ISOMER										
CHLOROPHENOL ISOMER										
UNKNOWN PHTHALATE ESTER										
[illegible]						100				
[illegible]-NITRO-1,2-BENZENEDICARBOXYLIC ACID										
CHLORINATED HYDROCARBON										
2-METHYLBENZENAMINE										
ETHYL PHENOL ISOMER										
(1-METHYLETHYL)BENZENE						13				
1-[illegible]						10				
2-[illegible]						20				
HEXADECANOIC ACID										
3,3,5-TRIMETHYL-CYCLOHEXANONE										
3,3,5-TRIMETHYL-CYCLOHEXANE						220				
2,2-DIMETHYL-1-PROPANOL						100				
2-(1-METHYLETHYL)-PHENOL										
[illegible]										
4-METHYLPHENOL										
[illegible]-DIHYDRO-[illegible]-ONE										
ALPHA-HYDROXY-BENZENEACETIC ACID										
TERT-BUTOXYISOPROPOXY METHANE										
1,2-BENZENEDICARBOXYLIC ACID ESTER										
2,2-DIMETHYL-3(2H)-BENZOFURANONE						10				
N,N-DIMETHYL ACETAMIDE										
4-HYDROXY-3-METHYL-2-BUTANONE										
1-METHOXY-2-PROPANONE										
ETHYL ESTER [illegible] ACID										
BIS(2-METHOXYETHYL)PHTHALATE										
1,1'-((1-METHYL-1,2-ETHANEDIYL)BIS(OXY))BIS-2-PROPANOL								200		
1,1'-((1-METHYL-1,2-ETHANEDIYL)OXY(OXY))OXY-2-PROPANOL								130		
DIMETHYL PHENOL										
(2-METHOXYETHOXY)[illegible]										
2,2'-OXYBIS-BUTANE										
1-METHOXY-2-BUTANOL										
1,1'-OXYBIS-2-PROPANOL										
[illegible] PROPANOL										
ESTER 1,2-BENZENEDICARBOXYLIC ACID										
HEXAHYDRO-2H-AZEPIN-2-ONE										
9,12-OCTADECADIEN-1-OL										
BUTYL MYRISTATE(BUTYL TETRADECYLATE)										

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Table 4-6 (cont.)

COMPOUND	SHALLOW SUBZONE WELLS (CONT.)									
	1 A		2 A		3 A		4 A		5 A	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
FATTY ACID ESTER										
ALPHA-TERPINEOL										
2-METHYL-2-CYCLOHEXEN-1-ONE										
1,1,2-TRIMETHYL-CYCLOPENTANE										
NONADECANE										
TRICHLOROETHENE										
DICHLOROFLUOROMETHANE										
2-METHOXY-4-METHYLPHENOL										
2 CHLORO,PHOSPHATE (3:1) ETHANOL										
DIMETHYL BENZENE ISOMER										
MOL. SULFUR										
METHYL NAPHTHALENE ISOMER										
XYLENE ISOMER										
1,2,4-TRIMETHYLBENZENE										
2-METHYL-BENZENAMINE										
UNDECANE										
CHLORO DIMETHYLBENZENE ISOMER										
TETRADECANE										
2,6,10,14-TETRAMETHYL-HEPTADECANE										
PENTADECANE										
PHOSPHORIC ACID ESTER										
2-METHYL-2,4-PENTANEDIOL										
METHYL-BENZENEACETATE ISOMER										
DIETHYL ESTER 2-BUTENEDIOIC ACID										
4-METHYL-2 NITROPHENOL										
2-(2-HYDROXYPROPOXY)-1-PROPANOL										
4A,8A-DIHYDRO-4,8A-DIMETHYL-2(4H)NAPHTHALENONE										
DI(2-ETHYLHEXYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID										
2 CHLORO BENZENAMINE										
TRIETHYL ESTER PHOSPHORIC ACID										
ETHYL BENZENE ISOMER										
2, METHYL PHENOL										
1,4 DICHLORO 2 ETHENYL BENZENE										
BICYCLO(2.2.1)HEPTA, 1,7,7 TRIMETH										
ETHANOL, 2 PHENOXY										
UNKNOWN ALKANE										
UNKNOWN ALIPHATIC HYDROCARBON										
ISOMER OF CHLOROANILINE										
7-BENZOFURANOL, 2,3-DIHYDRO-2,2-DIMETHYL										
UNKNOWN THIOPHENE										
UNKNOWN PHENOL										
ETHANOL, 2-CHLORO-, PHOSPHATE										
BENZENE, 1-PROPYNYL-										
BENZENAMINE, 2-METHYL-										
UNKNOWN PHOSPHORIC ACID ESTER										
UNKNOWN AROMATIC HYDROCARBON										
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-										
1,2-BENZENEDICARBOXYLIC ACID, 3-NITRO-										
BENZENE, METHYL-										
BENZENE, CHLORO-										
PYRIDINE, 4-METHYL-										
PHENOL, 2-ETHYL-										
PHENOL, 2,3-DIMETHYL-										
PHENOL,TERT-BUTYL ISOMER										
UNKNOWN AROMATIC										

(D) COMPLETED BELOW DEEP SUBZONE
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION LISTED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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Table 4-6 (cont.)

COMPOUND	SHALLOW BEDROCK WELLS (ug/L)									
	OA		CL-1		CL-2		CL-3		TP-1	
	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00
UNKNOWN HYDROCARBON			27		104		234			
2-(2-METHOXYETHOXY)ETHANOL					12					
SATURATED ALIPHATIC HYDROCARBON										
ALIPHATIC HYDROCARBON		1010				21	100		170	190
ETHYLESTER CARBAMIC ACID										
HYDROXY METHYL PENTANONE							22			
METHOXY ETHOXY ETHANOL										
BUTYL BENZENE SULFONAMIDE										
HEXANOIC ACID										
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL										
HEPTADECENE-8-CARBOXYLIC ACID										
XYLENE										
BENZOFURAN										
1-PROPYNYL BENZENE										
2-CHLORO-6-METHYL PYRIDINE										
1-METHYLNAPHTHALENE										
4,4'-(1-METHYLETHYLIDENE)BISPHENOL		130								
1,1'-OXYBISETHANE							40			
N,N-DIMETHYLFORMAMIDE							[illegible]	[illegible]		
METHYLBENZENAMINE										
CHLOROBENZENAMINE							74			
BENZOTHIOPHENE										
OCTYL PHENOL [illegible]										
2-CHLORO-PHOSPHATE ETHANOL		200								
HEXANE										
2-BUTOXY ETHANOL										
2-METHYLPENTENE										
[illegible]										
BENZOTHIAZOLE										
4-(1,1-DIMETHYLETHYL)PHENOL		210								
UNKNOWN		190		04		290	100	724		42
PROPANOL										
METHYL [illegible]										
HYDROXYPROPOXYPROPANOL							27			
UNKNOWN PYRIDINE										
DIETHYL ESTER BENZENE DICARBOXYLIC ACID										
TETRAMETHYL BUTYL PHENOL							67			
FATTY ACID							117			
METHOXYBENZYL ALCOHOL										
HYDROXYMETHYL BENZENE ACETIC ACID										
ALKENE										
DIMETHYL PROPANOL										
METHYL PENTANONE										
ACETONE										
[illegible]										
METHYL NAPHTHALENE										
UNKNOWN PHTHALATE ESTER										
PHENOL										
BENZOIC ACID										
BENZENEACETIC ACID										
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL										
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL [illegible]										
ALPHA, ALPHA DIMETHYL BENZENEMETHANOL										
PHENOXY ETHANOL										
2-METHYL-3 HYDROXY-2,2,4-TRIMETHYLPENTYLESTER OF PROP ACID										
O,O-DIETHYL-O-ETHYL PHOSPHOROTHIOATE					14					

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Table 4-6 (cont.)

COMPOUND	SHALLOW SUBZONE WELLS (CONT)									
	OA		CL-1		CL-2		CL-4		TP-1	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
METHYL ESTER OF 9-OCTADECANOIC ACID					22		74			
AMINO METHYL PENTANONE							240			
DIMETHYL BENZENE							48			
CYCLOHEXANONE							42	97		
METHYLETHOXYPROPANE							371			
TRIMETHYLCYCLOHEXANONE							79			
BENZENE METHANOL							81			
DIMETHYL BENZENE METHANOL							10			
BUTOXYBUTENE							102			
2-DICHLOROETHENYL BENZENE ISOMER										
NITROCRESOL										
ETHYL CRESOL ISOMER										
1,2-BIS(2-CHLOROETHOXY)ETHANE								250		
1,2-BIS(CHLOROETHOXY)ETHANE										
BIS-(2-METHOXYETHYL)BENZENE DICARBOXYLIC ACID ESTER										
2-ETHYLHEXANOL										
N-PHENYLBENZENAMINE										
CHLOROETHANOL PHOSPHATE										
TOLUENE										
STYRENE										
BENZENAMINE		2500								
CHLOROETHENYL BENZENE										
2-ETHOXYLHEXANOIC ACID										
ETHYL PHENOL ISOMER										
DIMETHYL PHENOL ISOMER								31		
CHLOROPHENOL ISOMER										
UNKNOWN PHTHALATE ESTER										
N-(1,1-DIMETHYLETHYL)-3-METHYLBENZAMIDE										
3-NITRO-1,2-BENZENEDICARBOXYLIC ACID										
CHLORINATED HYDROCARBON										
2-METHYLBENZENAMINE								10		
METHYL PHENOL ISOMER		100								
(1-METHYLETHYL)BENZENE										
1-HEXANE										
2-HEXANE										
HEXADECANOIC ACID								10		
3,3,5-TRIMETHYL-CYCLOHEXANONE		300								
3,3,5-TRIMETHYL-CYCLOHEXANE										
2,2-DIMETHYL-1-PROPANOL										
3-(1-METHYLETHYL)-PHENOL										
(1)BENZOTHIENO(3,2 - B)(1)BENZOTHIOPHENE										
2-METHYLPHENOL										
1,7-DIHYDRO-6H-PURIN-6-ONE										
ALPHA-HYDROXY-BENZENEACETIC ACID										
TERT-BUTOXYISOPROPOXY METHANE										
1,2-BENZENEDICARBOXYLIC ACID ESTER		970						63		
3,3-DIMETHYL-2(3H)-BENZOFURANONE										
N,N-DIMETHYL ACETAMIDE										
4-HYDROXY-3-METHYL-2-BUTANONE										
1-METHOXY-2-PROPANONE										
ETHYL ESTER PHOSPHORIC ACID										
BIS(2-METHOXYETHYL)PHTHALATE										
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL						20				
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL										
DIMETHYL PHENOL										
(2-METHOXYETHOXY)ETHENE										
2,2'-OXYBIS-BUTANE										
1-METHOXY-2-BUTANOL										
1,1'-OXYBIS-2-PROPANOL										
MONOPROPANOATE PROPANOL										
ESTER 1,2 BENZENEDICARBOXYLIC ACID										
HEXAHYDRO 2H-AZEPIN-2-ONE				140						70
9,12-OCTADECADIEN-1-OL										
BUTYL MYRISTATE(BUTYL TETRADECYLATE)										

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Table 4-6 (Cont.)

COMPOUND	SHALLOW BEDROCK WELLS (CONT)									
	[illegible]		CL-1		CL-2		CL-4		TP-1	
	Aug-88	Sep-88	Aug-88	Sep-88	Jun-88	Sep-88	Aug-88	Sep-88	Aug-88	Sep-88
FATTY ACID ESTER										
ALPHA-TERPINEOL										
3-METHYL-2-CYCLOHEXEN-1-ONE										
1,1,3-TRIMETHYL-CYCLOPENTANE										
HEXADECANE		100								
TRICHLOROETHENE										
DICHLOROMETHANE								22		
2-METHOXY-4-METHYLPHENOL								12		
2-CHLORO PHOSPHATE (3:1) ETHANOL								110		
DIMETHYL BENZENE ISOMER										
[illegible], BUTYL										
METHYL NAPHTHALENE ISOMER		490								
XYLENE ISOMER		400								
1,2,4-TRIMETHYLBENZENE		190								
2-METHYL-BENZENAMINE		210								
UNDECANE		210								
CHLORO BENZENAMINE ISOMER		1010								
TETRADECANE		290								
2,6,10,14-TETRAMETHYL-HEPTADECANE		110								
PENTADECANE		290								
PHOSPHORIC ACID ESTER		300								
2-METHYL-2,4-PENTANEDIOL										
METHYL-BENZENAMINE ISOMER										
DIETHYL ESTER 2-BUTENEDIOIC ACID										
4-METHYL-2-NITROPHENOL										
1-(2-HYDROXYPROPOXY)-2-PROPANOL										
4A,9B-DIHYDRO-8,9B-DIMETHYL-3(4H)DIBENZOFURANONE										
BIS(2-METHOXYETHYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID										
2-CHLORO BENZENAMINE										
TRIETHYL ESTER PHOSPHORIC ACID										
METHYL PHENOL ISOMER										
2, METHYL PHENOL										
1,2 DICHLORO 4 ETHENYL BENZENE										
BICYCLO(4.2.0)OCTA 1,3,5 TRIENE										
ETHANOL, 2 PHENOXY										
UNKNOWN AMINE										
UNKNOWN ALIPHATIC HYDROCARBON										
ISOMER OF CHLOROANILINE										
7-BENZOFURANOL, 2,3-DIHYDRO-2,2-DIMETHYL										
UNKNOWN THIOPHENE										
UNKNOWN PHENOL										
ETHANOL, 2-CHLORO-, PHOSPHATE										
BENZENE, 1-PROPYNYL-										
BENZENAMINE, 2-METHYL-										
UNKNOWN PHOSPHORIC ACID ESTER										
UNKNOWN AROMATIC HYDROCARBON										
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-										
1,2-BENZENEDICARBOXYLIC ACID, 3-NITRO-										
BENZENE, METHYL-										
BENZENE, CHLORO-										
PYRIDINE, 4-METHYL-										
PHENOL, 4-ETHYL-										
PHENOL, 2,3-DIMETHYL-										
PHENOL,TERT BUTYL ISOMER										
UNKNOWN AROMATIC										

(B) COMPLETED BELOW BEDROCK SURFACE
(NA) NOT ENOUGH WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
ND CONCENTRATIONS ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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Table 4-6 (cont.)

COMPOUND	SHALLOW SUBZONE WELLS (CONT)									
	TP-12		TP-13		TP-10		TP-18		TP-8	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88 B	Jun-88	Sep-88	Jun-88	Sep-88
UNKNOWN HYDROCARBON	NA		NA	NA			NA	NA	NA	NA
2-(2-METHOXYETHOXY)ETHANOL										
SATURATED ALIPHATIC HYDROCARBON										
ALIPHATIC HYDROCARBON					111					
ETHYLESTER CARBAMIC ACID					18					
HYDROXY METHYL PENTANONE										
METHOXY ETHOXY ETHANOL										
BUTYL BENZENE SULFONAMIDE										
HEXANOIC ACID										
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL										
HEPTADECENE-8-CARBONIC ACID										
XYLENE										
BENZOFURAN										
1-PROPYNYL BENZENE										
2-CHLORO-6 METHYL PYRIDINE										
1-METHYLNAPHTHALENE										
4,4'-(1-METHYLETHYLIDENE)BISPHENOL										
1,1'-OXYBISETHANE										
N,N-DIMETHYLFORAMIDE					18					
METHYLBENZENAMINE										
CHLOROBENZENAMINE										
BENZO(B)THIOPHENE										
OCTYL PHENOL ISOMER										
2-CHLORO-PHOSPHATE ETHANOL										
HEXANE										
2-BUTOXY ETHANOL										
2-METHYLPENTENE										
1,1-TETRAHYDROTHIOPHENE DIOXIDE										
BENZOTHIAZOLE										
4-(1,1-DIMETHYLETHYL)PHENOL										
UNKNOWN					11					
PROPANOL										
METHYL DIMETHYL METHOXYPROPANE										
HYDROXYPROPOXYPROPANOL										
UNKNOWN PYRIDINE										
DIETHYL ESTER (BENZENE CARBOXYLIC ACID)										
TETRAMETHYL BUTYL PHENOL										
FATTY ACID					12					
METHOXYMETHYL BENZENE										
HYDROXYMETHYL BENZENE ACETIC ACID										
ANILINE										
DIMETHYL PROPANOL										
METHYL FORMAMIDE										
ACETONE										
BIS(1-METHYL-2-HYDROXYETHYL)ETHER										
METHYL NAPHTHALENE										
UNKNOWN PHTHALATE ESTER										
CRESOL										
BENZOIC ACID										
BENZENEACETIC ACID										
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL										
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL MIX WITH UNK HYD										
ALPHA, ALPHA DIMETHYL BENZENEMETHANOL										
PHENOXY ETHANOL										
2-METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID										
O,O-DIETHYL-S-ETHYL PHOSPHOROTHIOATE										

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Table 4-[illegible] (cont.)

COMPOUND	SHALLOW SUBZONE WELLS (CONT)									
	TP-12		TP-13		TP-18		TP-19		TP-22	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88 a	Jun-88	Sep-88	Jun-88	Sep-88
METHYL ESTER OF 9-OCTADECANOIC ACID										
AMINO METHYL PENTANONE					10					
DIMETHYL BENZENE										
CYCLOHEXANONE										
METHYLETHOXYPROPANE										
TRIMETHYLCYCLOHEXANONE										
BENZENE METHANOL										
DIMETHYL BENZENE METHANOL										
BUTOXYBUTENE										
2-DICHLOROETHENYL BENZENE ISOMER										
NITROCRESOL										
ETHYL CRESOL ISOMER										
1,2-BIS(2-CHLOROETHOXY)ETHANE										
1,2-BIS(CHLOROETHOXY)ETHANE										
BIS-(2-METHOXYETHYL)BENZENE DICARBOXYLIC ACID ESTER										
2-ETHYLHEXANOL										
N-PHENYLBENZENAMINE										
CHLOROETHANOL PHOSPHATE										
TOLUENE										
STYRENE										
BENZENAMINE										
CHLOROETHENYL BENZENE										
2-ETHOXYLHEXANOIC ACID										
ETHYL PHENOL ISOMER										
DIMETHYL PHENOL ISOMER										
CHLOROPHENOL ISOMER										
UNKNOWN PHTHALATE ESTER										
N-(1,1-DIMETHYLETHYL)-3-METHYLBENZAMIDE										
3-NITRO-1,2-BENZENEDICARBOXYLIC ACID										
CHLORINATED HYDROCARBON										
3-METHYLBENZENAMINE										
METHYL PHENOL ISOMER										
(1-METHYLETHYL)BENZENE										
1-HEXANE										
3-HEXANE										
HEXADECANOIC ACID										
2,2,6-TRIMETHYL-CYCLOHEXANONE										
2,2,6-TRIMETHYL-CYCLOHEXANE										
2,2-DIMETHYL-1-PROPANOL										
2-(1-METHYLETHYL)-PHENOL										
(1)BENZOTHIENO(4,5 - B)(1)BENZOTHIOPHENE										
4-METHYLPHENOL										
1,7-DIHYDRO-6H-PURIN-6-ONE										
ALPHA-HYDROXY-BENZENEACETIC ACID										
TERT-BUTOXYISOPROPOXY METHANE										
1,2-BENZENEDICARBOXYLIC ACID ESTER										
3,3-DIMETHYL-2(3H)-BENZOFURANONE										
N,N-DIMETHYL ACETAMIDE										
4-HYDROXY-3-METHYL-2-BUTANONE										
1-METHOXY-2-PROPANONE										
ETHYL ESTER PHOSPHORIC ACID										
BIS(2-METHOXYETHYL)PHTHALATE										
1,1'-((1-METHYL-1,2-ETHANEDIYL)BIS(OXY))BIS-2-PROPANOL										
1,1'-((1-METHYL-2,2-ETHANEDIYL)BIS(OXY))BIS-2-PROPANOL										
DIMETHYL PHENOL										
(2-METHOXYETHOXY)ETHENE										
2,2'-OXYBIS-BUTANE										
1-METHOXY-2-BUTANOL										
1,1'-OXYBIS-2-PROPANOL										
MONOPROPANOATE PROPANOL										
ESTER 1,2-BENZENEDICARBOXYLIC ACID										
HEXAHYDRO 2H-AZEPIN 2-ONE										
9,12-OCTADECADIEN-1-OL										
BUTYL MYRISTATE(BUTYL TETRADECYLATE)										

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Table 4-6 (Cont.)

COMPOUND	SHALLOW SUBZONE WELLS (CONT)									
	TP-12		TP-13		TP-16		TP-18		TP-22	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88 B	Jun-88	Sep-88	Jun-88	Sep-88
FATTY ACID ESTER										
ALPHA-TERPINEOL										
3-METHYL-2-CYCLOHEXEN-1-ONE										
1,1,3-TRIMETHYL-CYCLOPENTANE										
HEXADECANE										
TRICHLOROETHENE										
DICHLOROIODOMETHANE										
2-METHOXY-3-METHYLPHENOL										
2-CHLORO,PHOSPHATE (3:1) ETHANOL										
DIMETHYL BENZENE ISOMER										
MOL. SULFUR										
METHYL NAPTHALENE ISOMER										
XYLENE ISOMER										
1,2,4-TRIMETHYLBENZENE										
3-METHYL-BENZENAMINE										
UNDECANE										
CHLORO BENZENAMINE ISOMER										
TETRADECANE										
2,6,10,10-TETRAMETHYL-HEPTADECANE										
PENTADECANE										
PHOSPHORIC ACID ESTER										
2-METHYL-2,4-PENTANDIOL										
METHYL-BENZENAMINE ISOMER										
DIETHYL ESTER 2-BUTENEDIOIC ACID										
4-METHYL-2-NITROPHENOL										
2-(2-HYDROXYPROPOXY)-1-PROPANOL										
4A,9B-DIHYDRO-8,9B-DIMETHYL-3(4H)-DIBENZOFURANONE										
BIS(2-METHOXYETHYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID										
3-CHLORO BENZENAMINE										
TRIETHYL ESTER PHOSPHORIC ACID										
METHYL PYRIDINE ISOMER										
3, METHYL PHENOL										
1,4 DICHLORO 2 ETHENYL BENZENE										
BICYCLO(4.2.0)OCTA 1,3,5 TRIENE										
ETHANOL, 2-PHENOXY										
UNKNOWN ALKENE										
UNKNOWN ALIPHATIC HYDROCARBON										
ISOMER OF CHLOROANILINE										
7-BENZOFURANOL, 2,3,-DIHYDRO-2,2-DIMETHYL										
UNKNOWN THIOPHENE										
UNKNOWN PHENOL										
ETHANOL, 2-CHLORO-, PHOSPHATE										
BENZENE, 1-PROPYNYL-										
BENZENAMINE, 3-METHYL-										
UNKNOWN PHOSPHORIC ACID ESTER										
UNKNOWN AROMATIC HYDROCARBON										
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-										
1,2-BENZENEDICARBOXYLIC ACID, 3-NITRO-										
BENZENE, METHYL-										
BENZENE, CHLORO-										
PYRIDINE, 4-METHYL-										
PHENOL, 3-ETHYL-										
PHENOL, 2,3-DIMETHYL-										
PHENOL,TERT-BUTYL ISOMER										
UNKNOWN AROMATIC										

(B) COMPLETED BELOW DEEP SUBZONE
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATIONS ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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Table 4–6 (cont.)

Tentatively Identified Organic Compounds in Ground Water Collected from Well Points Located in Cedar Swamp, Adjacent to the CLTL Terminal

COMPOUND	WP-1	WP-2	WP-3	WP-4
COLLECTION DATE	4/6/88	4/6/88	4/6/88	4/6/88
UNKNOWN	233J	310J	470J	750J
UNKNOWN HYDROCARBON	203J	408J		60J
SUBSTITUTED CYCLOHEXANONE	57J	120J	710J	
SUBSTITUTED CYCLOHEXANOL	45J	280J	360J	62J
M-CHLOROANILINE	18J	20J		10J
2-PROPANOL, 1,1-[(1-METHYL-	110J			
1-DOTRIACONTANOL	20J			
DECANE, 1-IODO-	40J			
FORMAMIDE, N,N-DIMETHYL-		34J		
SUBSTITUTED BENZENE		83J		
SUBSTITUTED BENZAMINE		180J	2100J	
SUBSTITUTED PHENOL		100J	130J	
THIOPHENE, TETRAHYDRO-,1,1-		61J		
CYCLOHEXANAMINE			150J	
ANILINE			710J	
CHLOROANILINE ISOMER			420J	
PHENOL, DIMETHYL, ISOMER			660J	
AROMATIC HYDROCARBON			380J	
SUBSTITUTED BENZOFURANOL				81J
CARBON DISULFIDE°	8J	34J		13J
CYCLOHEXANONE 3,3,5-TRIMETHYL°	7J		87J	
C8H16 ISOMER°		20J		
2-HEPTANOL, 2-METHYL°			8J	
BENZENE-1,2-DIMETHYL°			10J	
UNKNOWN°		40J	5J	10J

J - REPORTED RESULT IS A QUANTITATIVE ESTIMATE.
CONCENTRATIONS REPORTED IN ug/L (PPB)
NO CONCENTRATION ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT.
°VOLATILE TIC. ALL OTHERS ARE SEMIVOLATILE TICS.

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total depth of this contaminated soil was not determined. Although the former primary settling lagoons were excavated to an approximate depth of 10 feet below the ground surface, monitoring well 8-A's log description indicates that a considerable amount of contaminated soil may still exist in the vicinity of the former primary settling lagoons that may serve as a continuing source of ground-water contamination.

The levels of ground-water contaminants found in RI well 8-A were used to represent approximate contaminant levels in the immediate vicinity of the former primary settling lagoons. The extent of shallow subzone contamination has not been well defined by the existing monitoring wells north, west and southeast of the former primary settling lagoons.

Levels of shallow subzone ground-water contamination have not been well defined in the immediate vicinity of the former aeration lagoons and final settling lagoon because there is only one well, CL-4), located along the southern edge of this area which detected 3240 ppb volatile organics and 180 ppb semivolatile organics.

Subsurface soil sample results from boring B-11, which was drilled in the vicinity of the former possible secondary settling lagoon, detected 220 ppm volatile organics and 1231 ppm semivolatile organics in soil samples obtained between two to three feet below the water table. This zone of contaminated soil may serve as a continuing source of shallow subzone ground-water contamination.

4.1.8 Intermediate Subzone Groundwater Sampling Results

Table 4-7 lists the analytical results for volatile organic and semivolatile organic compounds detected in the intermediate subzone ground water collected during the RI. It should be noted that monitoring wells 2D, 4C, 6B, DW-1 and the CLTL production well are designated as lower intermediate subzone wells due to the fact that these wells are screened below a clay layer that locally controls the flow of ground water between the upper and lower intermediate subzones in some areas of the site. The remaining wells are referred to as upper intermediate subzone wells. Lower intermediate subzone well DW-2 was not sampled during the RI; well 6B, immediately adjacent to well DW-2, provides water quality data for the lower intermediate subzone at this location (Plates I and V).

Figure 4-8 shows the distribution of total volatile organics in the intermediate subzone. The highest concentrations of volatile organics were detected in the immediate vicinity of the former primary settling lagoons. Over 75,000 ppb of volatile

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Table [illegible]-7

Priority Pollutant Organic Compounds in Ground Water Collected from Intermediate Subzone Wells in the Remedial Investigation at the CLTL Site

COMPOUND	[illegible] STANDARD*	INTERMEDIATE SUBZONE WELLS [illegible]														
		[illegible]		[illegible]		[illegible]			[illegible]		[illegible]		4C		[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible] **	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VOLATILES																
METHYLENE CHLORIDE	[illegible]					[illegible]							[illegible]			
TRANS-1,2-DICHLOROETHENE	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		
CHLOROFORM																
TRICHLOROETHENE	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]		[illegible]	[illegible]		
BENZENE	[illegible]			[illegible]		[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]		
TOLUENE				[illegible]												
VINYL CHLORIDE	[illegible]					[illegible]	[illegible]				[illegible]	[illegible]	[illegible]			
1,2-DICHLOROETHANE	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]				[illegible]		[illegible]	[illegible]		
TETRACHLOROETHENE	[illegible]					[illegible]	[illegible]									
CHLOROBENZENE	[illegible]					[illegible]	[illegible]				[illegible]		[illegible]	[illegible]		
ETHYLBENZENE						[illegible]							[illegible]			
1,1-DICHLOROETHENE	[illegible]												[illegible]			
1,2-DICHLOROPROPANE																
FLUOROTRICHLOROMETHANE				[illegible]		[illegible]										
1,1,2-TRICHLOROETHANE																
CHLOROETHANE																
SEMIVOLATILES																
1,2-DICHLOROBENZENE				[illegible]	[illegible]	[illegible]	[illegible]	[illegible] J			[illegible]	[illegible]				
1,3-DICHLOROBENZENE								[illegible] J								
1,4-DICHLOROBENZENE						[illegible]										
NAPHTHALENE				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						[illegible]		
DI-N-BUTYL PHTHALATE																
DIETHYL PHTHALATE																
N-NITROSODIPHENYLAMINE								[illegible]								
1,2,4-TRICHLOROBENZENE																
2-CHLORONAPHTHALENE																
BUTYL BENZYL PHTHALATE																
BIS(2-ETHYLHEXYL)PHTHALATE																
ISOPHORONE																
DIMETHYL PHTHALATE																
NITROBENZENE																
PHENOL					[illegible]											
2,4-DIMETHYLPHENOL																
2,4-DICHLOROPHENOL																
2-NITROPHENOL																
4-NITROPHENOL																
PESTICIDES																
HEPTACHLOR																
ALPHA BHC																
DELTA BHC																
DDT							[illegible]									
ENDOSULFAN I							[illegible]									
ENDOSULFAN SULFATE																
DDE																

O COMPOUND BELOW DETECTION LIMIT
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
ND CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATIONS REPORTED IN ug/L (PPB)
(V) ANALYZED FOR VOLATILES ONLY
(*) VOLATILE HOLDING TIME EXCEEDED
(**) EXTRACTION HOLDING TIME EXCEEDED ON ACID EXTRACTABLES AND BASE NEUTRALS; CONCENTRATIONS SUSPECT

*GROUND WATER STANDARDS/CRITERIA (ppb) - NJ DRINKING WATER QUALITY INSTITUTE
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"Monitoring Wells 3D, 4C, 5D, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

Table 4-7 (Cont.)

COMPOUND	ARAR, & KNOWN*	INTERMEDIATE SUBZONE WELLS (CONT) 2 D		7 D		9C	10C	CL-1		CL-6		DW-1			MW 9-A		MW 9-B	
		Apr-88	Sep-88	Apr-88	Sep-88	Mar-88	Mar-88	Apr-88	Sep-88 **	Apr-88	Sep-88 **	Apr-88 ***	Sep-88 **	Mar-88	Apr-88	Sep-88	Apr-88	Sep-88
VOLATILES																		
METHYLENE CHLORIDE	2							00	100							NS		NS
TRANS-1,2-DICHLOROETHENE	10		30		70	020	0	14000	14000	43000	0000	30000	00000	23000				
CHLOROFORM								20										
TRICHLOROETHENE	1	40	120	100	100	1300		2000	3000	900	90	2200	200	200				
BENZENE	1						6	130	100				300	140				
TOLUENE								50	00				200	110				
VINYL CHLORIDE	2							370	700	000		3400	3200	1300				
1,2-DICHLOROETHANE	1								300	1200	170		400	200				
TETRACHLOROETHENE	1					6 5		30										
CHLOROBENZENE	4						0	00	00		100		300	140				
ETHYLBENZENE								30					100					
1,1-DICHLOROETHENE	1							20										
1,2-DICHLOROPROPANE								30										
FLUOROTRICHLOROMETHANE																		
1,1,2-TRICHLOROETHANE																		
CHLOROETHANE																		
SEMIVOLATILES																		
1,2-DICHLOROBENZENE								30		00	00			10				
1,3-DICHLOROBENZENE																		
1,4-DICHLOROBENZENE																		
NAPHTHALENE								110	10	310	100	110	100	110				
DI-N-BUTYL PHTHALATE																		
DIETHYL PHTHALATE								30	20	30	30	10		20				
N-NITROSODIPHENYLAMINE								120	10	400	100	10	110	12				
1,2,4-TRICHLOROBENZENE																		
2-CHLORONAPHTHALENE																		
BUTYL BENZYL PHTHALATE																		
BIS(2-ETHYLHEXYL)PHTHALATE																		
ISOPHORONE												10						
DIMETHYL PHTHALATE								30	10									
NITROBENZENE									70									
PHENOL									470	1000	10							
2,4-DIMETHYLPHENOL								30		00		30		30				
2,4-DICHLOROPHENOL										70		10		07				
2-NITROPHENOL								00	70									
4-NITROPHENOL									40									
PESTICIDES																		
HEPTACHLOR																		
ALPHA BHC												0 03						
DELTA BHC										0 11								
DDT			0 1															
ENDOSULFAN I			0 33															
ENDOSULFAN SULFATE																		
DDD									0 07		0 03							

O COMPOUND BELOW [illegible]
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATIONS REPORTED IN ug/l (PPB)
(o) ANALYZED FOR VOLATILES ONLY
(*) VOLATILE HOLDING TIME EXCEEDED
(**) EXTRACTION HOLDING TIME EXCEEDED ON ACID EXTRACTABLES AND BASE NEUTRALS; CONCENTRATIONS SUSPECT

*GROUND WATER STANDARDS/CRITERIA (ug/l) - NJ DRINKING WATER QUALITY INSTITUTE
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Table 4-7 (cont.)

COMPOUND	ARAR # KNOWN*	INTERMEDIATE SUBZONE WELLS (CONT.)						PRODUCTION WELL	
		Rec-2		Rec-1		Rec-3			
		Jun-89	Sep-89	Jun-89	Sep-89	Jun-89	Sep-89	Jun-89	Sep-89
VOLATILES									
METHYLENE CHLORIDE	2		ND		ND		ND	ND	30
TRANS-1,2-DICHLOROETHENE	10	100							2000
CHLOROFORM									
TRICHLOROETHENE	1			20		80			1900
BENZENE	1								40
TOLUENE									
VINYL CHLORIDE	2	30							20
1,2-DICHLOROETHANE	2								20
TETRACHLOROETHENE	1	100							10
CHLOROBENZENE	4								10
ETHYLBENZENE									
1,1-DICHLOROETHENE	2								
1,2-DICHLOROPROPANE									
FLUOROTRICHLOROMETHANE									
1,1,2-TRICHLOROETHANE									
CHLOROETHANE									
SEMIVOLATILES									
1,2-DICHLOROBENZENE									
1,3-DICHLOROBENZENE									
1,4-DICHLOROBENZENE									
NAPHTHALENE									
DI-N-BUTYL PHTHALATE									
DIETHYL PHTHALATE									
N-NITROSODIPHENYLAMINE									
1,2,4-TRICHLOROBENZENE									
2-CHLORONAPHTHALENE									
BUTYL BENZYL PHTHALATE									
BIS(2-ETHYLHEXYL)PHTHALATE									
ISOPHORONE									
DIMETHYL PHTHALATE									
NITROBENZENE									
PHENOL									
2,4-DIMETHYLPHENOL									
2,4-DICHLOROPHENOL									
4-NITROPHENOL									
2-NITROPHENOL									
PESTICIDES									
HEPTACHLOR									
ALPHA BHC									
DELTA BHC									
DDT									
ENDOSULFAN I									
ENDOSULFAN SULFATE									
DDE									

@ COMPLETED BELOW DEEP SUBZONE
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
ND CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATIONS REPORTED IN ug/L (PPB)
(V) ANALYZED FOR VOLATILES ONLY
(*) VOLATILE HOLDING TIME EXCEEDED
(**) EXTRACTION HOLDING TIME EXCEEDED ON ACID EXTRACTABLES AND BASE NEUTRALS; CONCENTRATIONS SUSPECT

*GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJ DRINKING WATER QUALITY INSTITUTE
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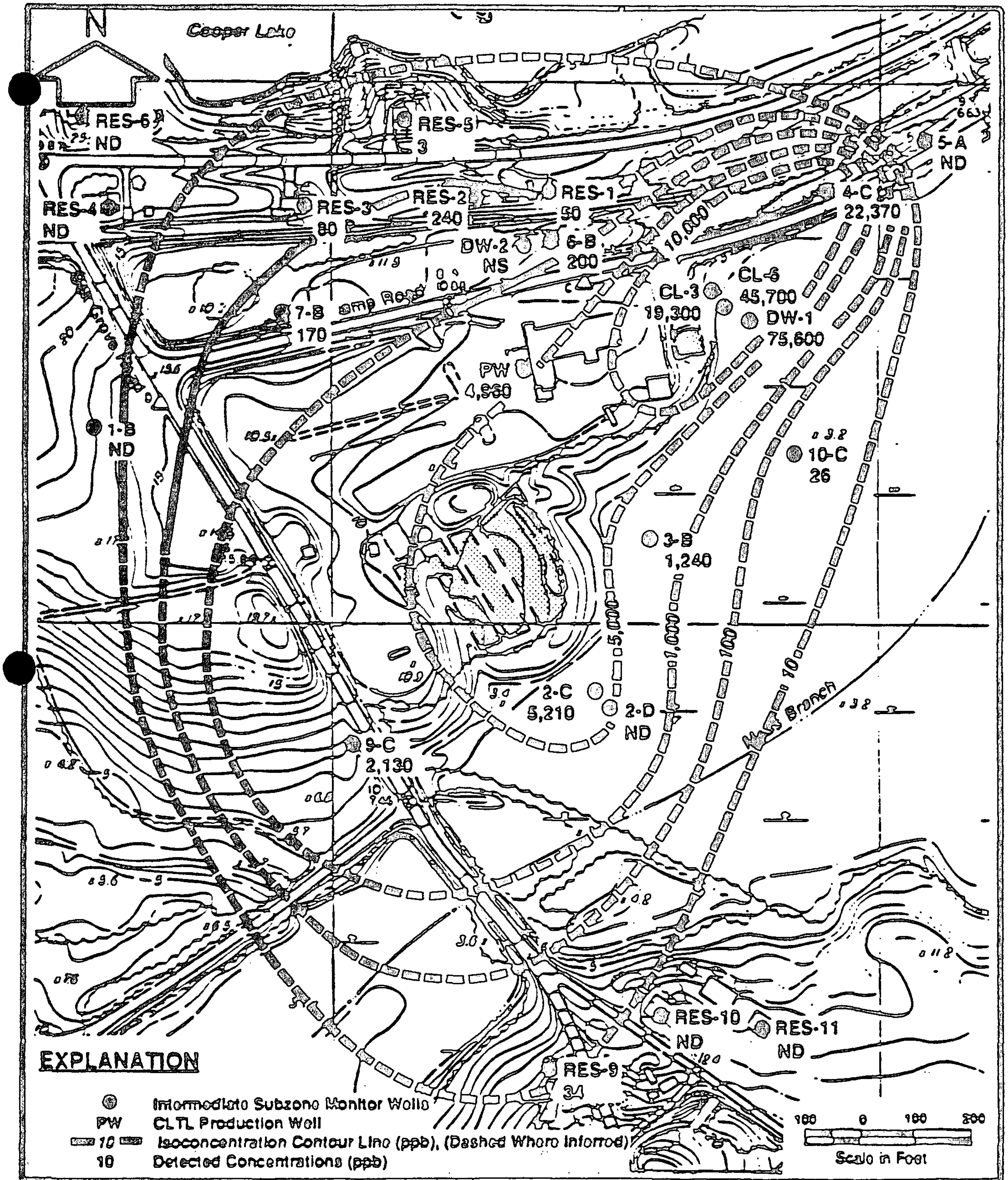
"Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"



EPA **Figure 4-8**

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CDM

Camp Dresser & McKee

Total Priority Pollutant Volatile Organics Detected In CLTL Intermediate Subzone Monitor Wells organics were detected in ground-water samples from monitoring well DW-1, approximately 75 feet east of the former primary settling lagoons.

Volatile organic contamination in intermediate subzone wells include; trans-1,2-dichloroethene (69000 ppb), trichloroethene (4800 ppb), vinyl chloride (5200 ppb), tetrachloroethene (160 ppb), methylene chloride (100 ppb), benzene (300 ppb), 1,2-dichloroethane (1200 ppb), chlorobenzene (200 ppb) and 1,1-dichloroethene (20 ppb).

The primary sources of volatile organic contamination in the intermediate subzone are the former CLTL wastewater disposal lagoons. Figure 4-8 shows that the highest concentrations of volatile organics occur in the vicinity of these contaminant source areas. The volatile organic plume in the intermediate subzone is not well defined in the areas east, south, and southwest of the former aeration lagoons and the areas east and north of the former primary settling lagoons.

The lower intermediate subzone monitoring well in the vicinity of the former settling lagoons (DW-1) shows much higher concentrations of total volatile organics than wells screened in the upper intermediate subzone adjacent to the former settling lagoons (CL-3 and CL-6). The lower intermediate subzone well DW-1, screened through the subsurface interval of -89.5 to -91.5 feet (MSL), recorded 75,600 ppb total volatile organics. Upper intermediate subzone wells CL-6, screened through the subsurface interval of -22 to -37 feet (MSL), and CL-3, screened through the subsurface interval of -23.5 to -33.5 feet (MSL), detected 45,700 ppb and 19300 ppb, respectively. This evidence suggests that the discontinuous clays that separate the upper and lower intermediate subzones do not significantly retard the downward migration of ground-water contaminants.

There are no intermediate subzone wells in the immediate vicinity of the former aeration and final settling lagoons. Upper intermediate subzone monitoring well 2C, which is approximately 150 feet southeast of the former aeration and final settling lagoons, recorded levels of volatile organics in excess of 5,000 ppb. Intermediate subzone monitoring well 9-C, which is approximately 250 feet southwest of the former aeration lagoons, detected over 2000 ppb of volatile organics.

Trichloroethene (TCE) was detected in residential well RES-9, approximately 800 feet southwest of the former aeration lagoons and final settling lagoon area, at levels of 33 ppb. This TCE contamination may be related to the CLTL site considering the fact that TCE is one of the most commonly detected ground-water contaminants found on site.

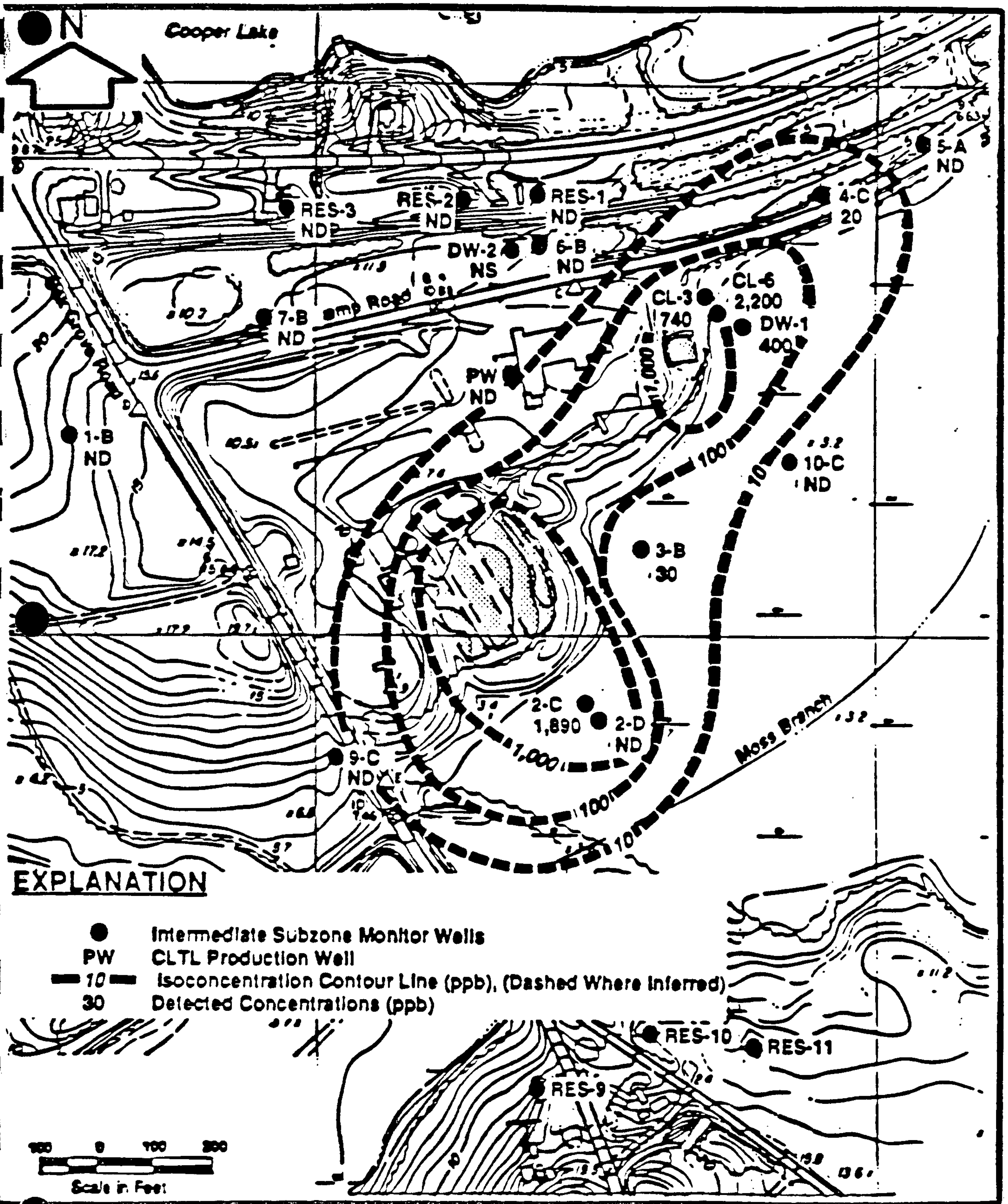

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Figure 4-9

Total Priority Pollutant Semivolatile Organics Detected In CLTL Intermediate Subzone Ground Water

Table [illegible]

Priority Pollutant Inorganic Constituents, Classical Parameters, and Water Quality Parameters In Ground Water Collected from Intermediate Subzone Wells in the Remedial Investigation at the CLTL Site

PARAMETER	NJAC 7/ NJGWQS*	INTERMEDIATE SUBZONE WELLS														
		[illegible]		[illegible]		[illegible]C			[illegible]		[illegible]		4C		[illegible]	
		Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Nov-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
ARSENIC	50				20						4	0				
ANTIMONY																
BERYLLIUM																
CADMIUM	10															
CHROMIUM	50				100											
COPPER	1000			00	200		70	100				30		110		00
LEAD	50															
MERCURY	2							0.2								
NICKEL					120			70								
SELENIUM	10															
SILVER	50															
THALLIUM																
ZINC	5000	00	400	200	2200	200	1000	2410 J		300	300	700	00	210	00	120
PHENOLS				10	24	20	20	20			20	20	20	10		0
CYANIDE **	200															
TOC		2200	1100	14000	12000	14000	14000	11[illegible] J	1300	1380	20000	30000	20000	25000	4000	4000
TOX		22		0200	1300	4000	1000	2000	7	00	700	210	12000	50	47000	17
COD **		12000	40000	40000	124000	40000	20000	121000			120000	120000	100000	00000	47000	27000
TDS **		147000	100000	217000	204000	422000	214000	240000	131000	130000	400000	400000	400000	403000	200000	174000

○ [illegible]
ALL RESULTS REPORTED IN ug/l (PPB)
NO CONCENTRATIONS ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT
(*) ANALYSIS HOLDING TIME EXCEEDED; CONCENTRATIONS SUSPECT
(**) ALL CYANIDE ANALYSIS HOLDING TIMES WERE EXCEEDED FOR JUNE 1988 AND SEPTEMBER 1988 AND ALL COD AND TDS ANALYSIS HOLDING TIMES WERE EXCEEDED FOR SEPTEMBER 1988. CONCENTRATIONS ARE ESTIMATED FOR THESE PARAMETERS ON THESE DATES
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
(V) ANALYZED FOR VOLATILES ONLY
(J) REPORTED RESULT IS A QUANTITATIVE ESTIMATE
(B) REPORTED RESULT IS QUALITATIVELY INVALID SINCE THE COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

* NJ GROUND WATER STANDARDS/CRITERIA (ug/l) - NJAC 7:9-6.6 GROUND WATER QUALITY CRITERIA
OBTAINED FROM NJDEP [illegible]

"Monitoring Wells 3D, 4C, 6D, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table [illegible] (cont.)

PARAMETER	NJ GW STANDARD*	INTERMEDIATE AQUIFER WELLS (CONT)														
		[illegible]		[illegible]		0C	10C	CL-[illegible]		CL-[illegible]		OW-1			CLTL-A	
		Apr-88	Sep-88	Apr-88	Sep-88	Mar-88	Mar-88	Apr-88	Sep-88	Apr-88	Sep-88	Apr-88	Sep-88	Mar-88	Apr-88	[illegible]
ARSENIC	00					10		103	00	1230	300	21		20		[illegible]
ANTIMONY								0								
BERYLLIUM								1	[illegible]							
CADMIUM	10															
CHROMIUM	00			00												
COPPER	1000					00	10	100	70	70						
LEAD	[illegible]						[illegible]	[illegible]	[illegible]					[illegible]		
MERCURY	2						0.3									
NICKEL								120	100							
SELENIUM	10															
SILVER	[illegible]											[illegible]				
THALLIUM																
ZINC	0000	00	00		300	[illegible] J	[illegible] J	040	320	3040	3030				7030	
PHENOLS		4				0	0	3000	010	1400	104	30	107	310 J		
CYANIDE **	[illegible]															
TOC		1000	3000	1000	4100	17[illegible] J	[illegible] J	30000	13000	30000	10000	40000	40000	[illegible] J	3000	
TOX		37	130	00	130	1060	140	11000	0000		2000	23600	23000	12000	13	
COD **						14000	107000	110000	70000	477000	70000	170000	301000	311000		
TDS **		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400000	440000	[illegible] °	310000	[illegible] °	341000	400000	[illegible]	

○ CONCENTRATION ABOVE [illegible]
ALL RESULTS REPORTED IN ug/l (PPB)
NO CONCENTRATIONS ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT
(*) ANALYSIS HOLDING TIME EXCEEDED; CONCENTRATIONS SUSPECT
(**) ALL CYANIDE ANALYSIS HOLDING TIMES WERE EXCEEDED FOR JUNE 1988 AND SEPTEMBER 1988 AND ALL COD AND TDS ANALYSIS HOLDING TIMES WERE EXCEEDED FOR SEPTEMBER 1988. CONCENTRATIONS ARE ESTIMATED FOR THESE PARAMETERS ON THESE DATES
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
(V) ANALYZED FOR VOLATILES ONLY
(J) REPORTED RESULT IS A QUANTITATIVE ESTIMATE
(B) REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

* NJ GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJAC 7:9-6.6 GROUND WATER QUALITY CRITERIA
OBTAINED FROM NJDEP [illegible]

"Monitoring Wells 2D, 6C, 6B, OW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table 4-8 (cont.)

PARAMETER	ARAR, IF KNOWN*	INTERMEDIATE SUBZONE WELLS (CONT)								PRODUCTION WELL	
		W-3 D-D		R00-2		R00-1		R00-3			
		Jun 00	Sep 00	Jun 00	Sep 00	Jun 00	Sep 00	Jun 00	Sep 00	Jun 00	Sep 00
ARSENIC	00	[illegible]	NS		NS		NS		NS	NS	
ANTIMONY											
BERYLLIUM											
CADMIUM	10										
CHROMIUM	00										
COPPER	1000			100				100			00
LEAD	00	0000									
MERCURY	0										
NICKEL											
SELENIUM	10										
SILVER	00										
THALLIUM											
ZINC	0000	100				100					00
PHENOLS											00
CYANIDE **	000										
TOC		1000		0400		700		1000			0700
TOX				200		40		00			0900
COD **				14000							
TDS **		00000		000000		00000		000000			000000

( ) [illegible]
ALL RESULTS REPORTED IN ug/l (PPB)
NO CONCENTRATIONS ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT
(*) ANALYSIS HOLDING TIME EXCEEDED; CONCENTRATIONS SUSPECT
(**) ALL CYANIDE ANALYSIS HOLDING TIMES WERE EXCEEDED FOR JUNE [illegible] AND SEPTEMBER [illegible] AND ALL COD AND TDS ANALYSIS HOLDING TIMES WERE EXCEEDED FOR SEPTEMBER [illegible]. CONCENTRATIONS ARE ESTIMATED FOR THESE PARAMETERS ON THESE DATES
(IN) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
(V) ANALYZED FOR VOLATILES ONLY
(J) REPORTED RESULT IS A QUANTITATIVE ESTIMATE
(B) REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

* NJ GROUND WATER STANDARDS/OBJECTIVES (ug/l) - NJAC 7:9-6 GROUND WATER QUALITY CRITERIA
OBTAINED FROM NJDEP [illegible]

"Monitoring Wells 2D, 4C, 6D, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Semivolatile organic compounds were detected in 7 of the 21 intermediate subzone monitoring wells (Table 4-7). Figure 4-9 illustrates that the concentration of total semivolatiles in the intermediate subzone is highest beneath the former wastewater disposal lagoons. 1,2-dichlorobenzene (350 ppb) was the most commonly detected semivolatile organic ground-water contaminant.

The fact that semivolatile organics are not as widespread, both laterally and vertically reflects their relatively lower mobility in ground-water as compared to that of volatile organics. Detected levels of semivolatile organics in the upper intermediate subzone (2200 ppb) are much higher than those detected in the lower intermediate subzone (400 ppb).

Table 4-8 lists the results of the analysis for metals, classical parameters and water quality indicator parameters in ground-water samples collected from intermediate subzone monitoring wells. The distribution of metals within the intermediate subzone shows distinct trends both vertically and laterally. As shown on Figure 4-10, the highest concentrations of metals occur in upper intermediate subzone monitoring wells that lie within the immediate vicinity of the former wastewater disposal lagoons. The occurrence of elevated metals levels in the upper intermediate subzone wells generally coincides with high concentrations of volatile organics (Figure 4-8) and to a lesser extent semivolatiles (Figure 4-9). In contrast, the concentrations of metals detected in each of the lower intermediate subzone wells approach background levels for these constituents. This is true even for lower intermediate subzone wells DW-1 and 4C, which recorded concentrations of volatile organics in excess of 20000 ppb.

Metals contamination found in the upper intermediate subzone wells include chromium (100 ppb), lead (3500 ppb), arsenic (1230 ppb) and zinc (5840 ppb).

Water quality indicator parameters for intermediate subzone wells are shown in Table 4-8. TDS is generally higher in the eastern portion of the site, near Cedar Swamp, than elsewhere on the site.

Pesticides were detected in 5 of the 21 intermediate subzone monitoring wells sampled (Table 4-7). In all cases, total pesticide levels detected in the intermediate subzone are below 1 ppb. One well in the vicinity of the former aeration lagoons (2C) and one well at the employee parking area (6B) detected DDT and Endosulfan 1, while the three intermediate subzone wells beneath the former settling lagoons detected trace amounts of DDE, Delta BHC and Alpha BHC.

3481

Table 4-9 lists the TICs detected in ground water collected from intermediate subzone wells at the CLTL site. Within the intermediate subzone, the TIC concentrations generally correlate with levels of volatile organics and semivolatiles. One notable exception, monitoring well CL-6, detected concentrations of TICs at approximately 600 ppb. Intermediate subzone wells DW-1 and CL-3, located adjacent to the former settling lagoons, showed estimated concentrations of TICs at 8,000 ppb and over 17,000 ppb, respectively.

4.1.9 Deep Subzone Ground-water Sampling Results

Table 4-10 presents the results of analysis for volatile and semivolatile organic compounds detected in samples of ground water collected from deep subzone monitoring wells at the CLTL site. It is noted that there are no deep subzone ground water wells in the areas of the former waste disposal lagoons. Therefore, the relatively low levels of contaminants detected in the existing deep subzone monitoring wells do not necessarily represent the maximum contaminant levels present in this subzone. Contaminant levels may be higher in the vicinity of the former wastewater lagoons.

Figure 4-11 plots the distribution of volatile organics in the deep subzone ground water. Volatile organics were detected in deep subzone wells 4D and 10D located along the boundary of the CLTL site. Ground water from monitoring well 4D, screened over the subsurface interval of -100 to -110 feet (MSL), showed 20 ppb of trans-1,2-dichloroethene during the June 1986 sampling effort. It was not detected during the September 1986 and March 1988 sampling events.

Ground water from monitoring well 10D, screened over the subsurface interval of -108.5 to -118.5 feet (MSL), recorded 40 ppb of toluene during the March 1988 sampling effort.

No semivolatile organics were detected in the deep subzone wells (Table 4-10).

Table 4-11 lists the results of analysis for inorganics, classical parameters and water quality indicator parameters in ground-water samples collected from deep subzone monitoring wells.

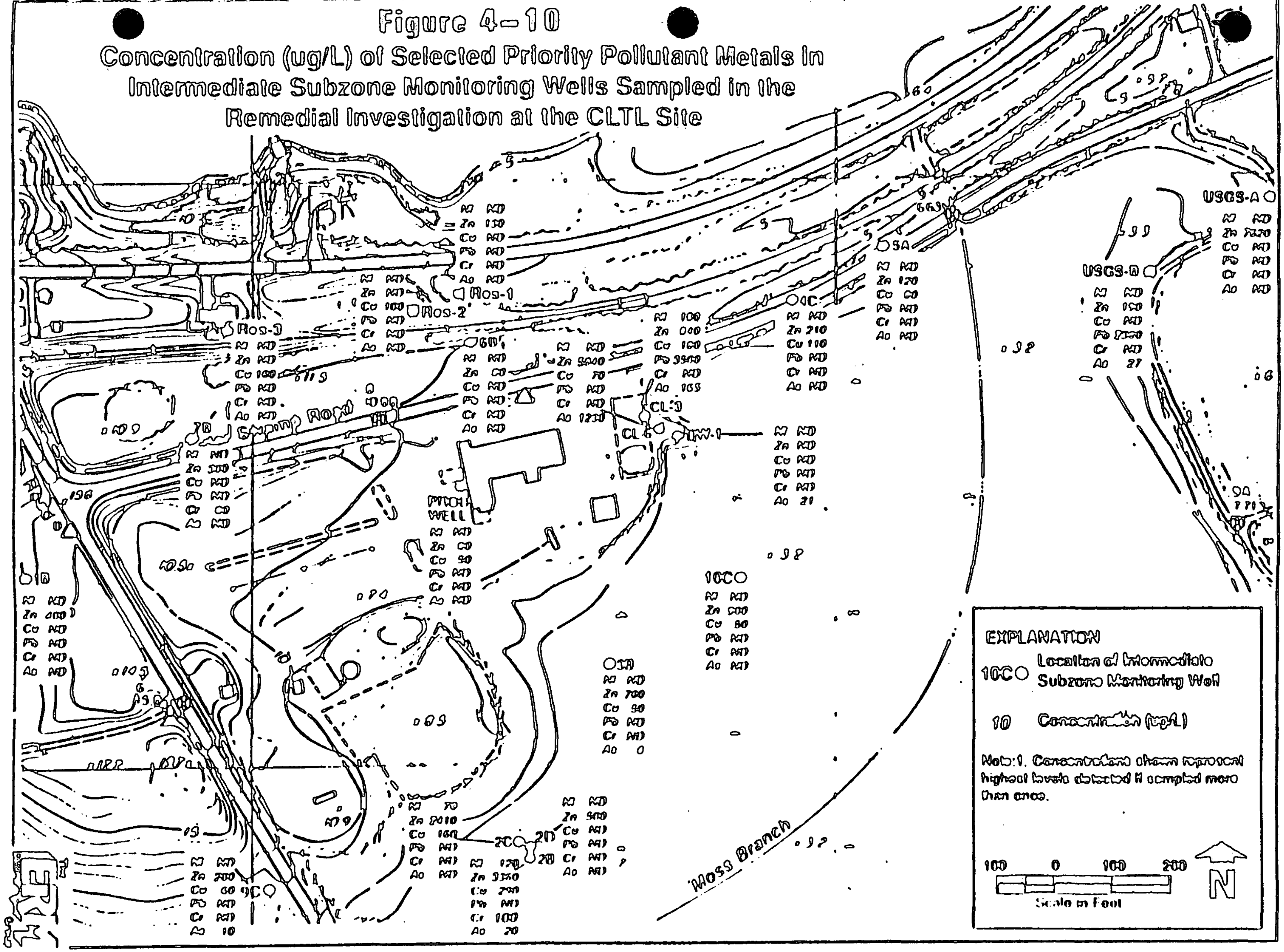
As shown on Figure 4-12, the two downgradient deep subzone wells (4D and 10D) located closest to the former settling and aeration lagoons recorded higher concentrations of selected metals than other deep subzone wells. Chromium was detected in well 10D at levels of 60 ppb.

3482

1013

Figure 4-10

Concentration (ug/L) of Selected Priority Pollutant Metals in Intermediate Subzone Monitoring Wells Sampled in the Remedial Investigation at the CLTL Site



Note: 1. Concentrations shown represent highest levels detected if sampled more than once.

3163

Table 4

Tentatively Identified Organic Compounds in Ground Water Collected from Intermediate Subzone Wells in the Remedial Investigation at the CLTL Site

COMPOUND	INTERMEDIATE SUBZONE WELLS										
	1B		2B		2C			[illegible]		[illegible]	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Nov-88	Jun-88	Sep-88	Jun-88	Sep-88
UNKNOWN HYDROCARBON			80		100			12		302	
2-(2-METHOXYETHOXY)ETHANOL	33										
SATURATED ALIPHATIC HYDROCARBON	10										
ALIPHATIC HYDROCARBON										331	280
ETHYLESTER CARBAMIC ACID											
HYDROXY METHYL PENTANONE											
METHOXY ETHOXY ETHANOL											
BUTYL BENZENE SULFONAMIDE										22	
HEXANOIC ACID											
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL			20	20							
HEPTADECENE-8-CARBONIC ACID											
XYLENE			22								
BENZOFURAN			12		12	20					
1-PROPYNYL BENZENE			70		103						
2-CHLORO-6-METHYL PYRIDINE			11								
1-METHYLNAPHTHALENE			18			17					
4,4'-(1-METHYLETHYLIDENE)BISPHENOL			31								
2,2'-OXYBISETHANOL					10					27	
N,N-DIMETHYLFORMAMIDE					02	08					04
METHYLBENZENAMINE					12						
CHLOROBENZENAMINE					30						
BENZO(B)THIOPHENE					72	30					
OCTYL PHENOL ISOMER					10	24					22
2-CHLORO-PHENYLMALEIC [illegible]					22	23					120
HEXANE								10			
2-BUTOXY ETHANOL											
2-METHYLPENTENE											
1,1-TETRAHYDRO[illegible]											
BENZOTHIAZOLE											
4-(1,1-DIMETHYLETHYL)PHENOL											
UNKNOWN				310		2701	1400		107	1131	
PROPANOL										40	
METHYL [illegible]										213	
HYDROXYPROPOXYPROPANOL										003	
UNKNOWN PYRIDINE										03	
DIETHYL ESTER BENZENE CARBOXYLIC ACID										230	
TETRAMETHYL BUTYL PHENOL										31	
FATTY ACID				20						700	
METHOXYMETHYL ALCOHOL										03	
HYDROXYMETHYL [illegible] ACETIC ACID										37	
ANILINE										214	
DIMETHYL PROPANOL										130	
METHYL FORMAMIDE										107	
ACETONE											
BIS(1-METHYL-1-HYDROXYETHYL)[illegible]											37
METHYL NAPHTHALENE											
UNKNOWN PHTHALATE ESTER											
CRESOL											
BENZOIC ACID											
BENZENEACETIC ACID											
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL											
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL MIX WITH UNK HYD											
ALPHA, ALPHA-DIMETHYL BENZENEMETHANOL											
PHENOXY ETHANOL											
2-METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID											
O,O-DIETHYL-O-ETHYL PHOSPHORODITHIOATE											

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Table 4-9 (Cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)										
	[illegible]		[illegible]		[illegible]			[illegible]		[illegible]	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Mar-89	Jun-88	Sep-88	Jun-88	Sep-88
METHYL ESTER OF 9-OCTADECENOIC ACID											
AMINO METHYL PENTANONE											
DIMETHYL BENZENE											
CYCLOHEXANONE											
METHYLETHOXY[illegible]											
TRIMETHYLCYCLOHEXANONE											
BENZENE METHANOL											
DIMETHYL BENZENE METHANOL											
BUTOXYBUTENE											
2-DICHLOROETHENYL BENZENE ISOMER											
NITROCRESOL											
ETHYL CRESOL ISOMER											
1,2-BIS(2-CHLOROETHOXY)ETHANE						100					
1,2-BIS(CHLOROETHOXY)ETHANE											
BIS-(2-METHOXYETHYL)BENZENE DICARBOXYLIC ACID ESTER											
2-ETHYLHEXANOL											
N-PHENYLBENZENAMINE											
CHLOROETHANOL PHOSPHATE											
TOLUENE											
STYRENE											
BENZENAMINE											
CHLOROETHENYL BENZENE											
2-ETHYLHEXANOIC ACID											
ETHYL PHENOL ISOMER											
DIMETHYL PHENOL ISOMER											
CHLOROPHENOL ISOMER											
UNKNOWN PHTHALATE ESTER											
N-(1,1-DIMETHYLETHYL)-2-METHYLPROPANAMIDE											
3-NITRO-1,2-BENZENEDICARBOXYLIC ACID											
CHLORINATED HYDROCARBON				20							
2-METHYL BENZENAMINE						10					
METHYL PHENOL ISOMER						14					
(1-METHYLETHYL)BENZENE											
1-HEXANE											
2-HEXANE											
HEXADECANOIC ACID				11							
2,2,6-TRIMETHYL-CYCLOHEXANONE											
2,2,6-TRIMETHYL-CYCLOHEXANE											
2,2-DIMETHYL-1-PROPANOL											
2-(1-METHYLETHYL)-PHENOL				11							
(1)BENZOTHIENO(3,2 - B)[illegible]		01									
2-METHYLPHENOL				10							
1,7-DIHYDRO-6H-PURIN-6-ONE				00							
ALPHA HYDROXY-BENZENEACETIC ACID						17					
TERT-BUTOXYISOPROPOXY METHANE						20					
1,2-BENZENEDICARBOXYLIC ACID ESTER						17					
2,5-DIMETHYL-3(2H)-BENZOFURANONE											
N,N-DIMETHYL ACETAMIDE											24
4-HYDROXY-3-METHYL-2-BUTANONE											200
1-METHOXY-2-PROPANONE											47
ETHYL ESTER PHOSPHORIC ACID											100
BIS(2-METHOXYETHYL)PHTHALATE											22
1,1'-((1-METHYL-1,2-ETHANEDIYL)BIS(OXY))BIS-2-PROPANOL											
1,1'-((1-METHYL-1,2-ETHANEDIYL)BIS(OXY))BIS-2-PROPANOL											
DIMETHYL PHENOL											
(2-METHOXYETHOXY) ETHENE											
2,2'-OXYBIS-BUTANE											
1-METHOXY-2-BUTANOL											
1,1'-OXYBIS-2-PROPANOL											
MONOPROPANOATE PROPANOL											
ESTER 1,2-BENZENEDICARBOXYLIC ACID											
HEXAHYDRO 2H-AZEPIN-2-ONE											
9,12-OCTADECADIEN-1-OL											
BUTYL [illegible]											

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Table 4-9 (cont.)

[illegible]	INTERMEDIATE [illegible] WELLS (CONT)										
	1D		2D		3C			4D		5D	
	Apr-88	Sep-88	Apr-88	Sep-88	Apr-88	Sep-88	Nov-88	Apr-88	Sep-88	Apr-88	Sep-88
[illegible] ACID ESTER											
ALPHA-TERPINEOL											
2-METHYL-2-CYCLOHEXEN-1-ONE											
1,1,3-TRIMETHYL-CYCLOPENTANE											
HEXADECANE											
TRICHLOROETHENE											
DICHLORO[illegible]METHANE											
2-METHOXY-4-METHYLPHENOL											
2-CHLORO,PHOSPHATE (3:1) ETHANOL											
DIMETHYL BENZENE ISOMER											
[illegible]											
METHYL NAPHTHALENE ISOMER											
XYLENE ISOMER											
1,2,4-TRIMETHYLBENZENE											
2-METHYL-BENZENAMINE											
[illegible]DECANE											
CHLORO BENZENE [illegible]											
TETRADECANE											
2,6,10,10-TETRAMETHYL-HEPTADECANE											
PENTADECANE											
PHOSPHORIC ACID ESTER											
2-METHYL-2,4-PENTANEDIOL											
METHYL-BENZENE[illegible] ISOMER											
DIETHYL ESTER [illegible]											
4-METHYL-2-NITROPHENOL											
2-(2-HYDROXYPROPOXY)-1-PROPANOL											
4A,8B-DIHYDRO-[illegible]-DIMETHYL-[illegible]											
BIS(2-METHOXYETHYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID											
2-CHLORO BENZENAMINE											
TRIETHYL ESTER PHOSPHORIC ACID											
ETHYL [illegible] BENZENE											
2, METHYL PHENOL											
1,4 DICHLORO 2 [illegible] BENZENE											
DICYCLO[illegible]											
ETHANOL, 2-PHENOXY											
UNKNOWN ALKANE											
UNKNOWN ALIPHATIC HYDROCARBON											
ISOMER OF CHLOROANILINE							10				
[illegible]							10				
UNKNOWN THIOPHENE											
UNKNOWN PHENOL											
ETHANOL, 2-CHLORO-, PHOSPHATE							20				
BENZENE, 1-PROPYNYL-							10				
BENZENAMINE, 2-METHYL-							10				
UNKNOWN PHOSPHORIC ACID ESTER							10				
UNKNOWN AROMATIC HYDROCARBON							10				
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-							30				
1,2-BENZENEDICARBOXYLIC ACID, [illegible]-							10				
BENZENE, METHYL-											
BENZENE, CHLORO-											
PYRIDINE, 4-METHYL-											
PHENOL, 2-ETHYL-											
PHENOL, 2,3-DIMETHYL-											
PHENOL,TERT-BUTYL ISOMER											
UNKNOWN AROMATIC											

(C) COMPLETED BELOW [illegible]
(IW) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
ND CONCENTRATION [illegible] FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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Table 4-9 (cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)									
	6C		8A		9D		7D		9C	10C
	Aug-00	Sep-00	Aug-00	Sep-00	Aug-00	Sep-00	Aug-00	Sep-00	Mar-00	Mar-00
UNKNOWN HYDROCARBON	010				21					070
2-(2-METHOXYETHOXY)ETHANOL		0090			00					
SATURATED ALIPHATIC HYDROCARBON										
ALIPHATIC HYDROCARBON			000							
ETHYLBUTYL CARBAMIC ACID			07							
HYDROXY METHYL PENTANONE			07							
METHOXY ETHOXY ETHANOL			00							
BUTYL BENZENE SULFONAMIDE			00							
HEXANOIC ACID										
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL										
HEPTADECENE-8-CARBONIC ACID										
XYLENE										
BENZOFURAN										
1-PROPYNYL BENZENE										
2-CHLORO-6-METHYL PYRIDINE										
1-METHYLNAPHTHALENE										
4,4'-(1-METHYLETHYLIDENE)BISPHENOL										
1,1'-OXYBISETHANE										
N,N-DIMETHYLFORMAMIDE	000	040								
METHYLBENZENAMINE										
CHLOROBENZENAMINE	00									
BENZO(B)THIOPHENE										
OCTYL PHENOL ISOMER	00	00								
2-CHLORO-[illegible]		00		11						
HEXANE										
2-BUTOXY ETHANOL		00	00							
2-METHYLPENTANE										
1,1-TETRAHYDRO[illegible]										
BENZOTHIAZOLE										
4-(1,1-DIMETHYLETHYL)PHENOL										
UNKNOWN				07		400		100		070
PROPANOL										
METHYL [illegible]										
HYDROXYPROPOXYPROPANOL										
UNKNOWN PYRIDINE										
DIETHYL ESTER [illegible] CARBOXYLIC ACID										
TETRAMETHYL BUTYL PHENOL										
FATTY ACID										
METHOXYMETHYL ALKANE										
HYDROXY[illegible]										
ALKANE										
DIMETHYL PROPANOL										
METHYL FORMAMIDE										
ACETONE										
BIS(1-METHYL-1-HYDROXYETHYL)[illegible]	00									
METHYL NAPHTHALENE	00									
UNKNOWN PHTHALATE ESTER										
CRESOL										
BENZOIC ACID										
BENZENEACETIC ACID										
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL										
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL MIX WITH [illegible]	00									
ALPHA, ALPHA-DIMETHYL BENZENEMETHANOL	003									40
PHENOXY ETHANOL			40							
2-METHYL-3-HYDROXY-2,2,4-TRIMETHYLPENTYLESTER OF PROP ACID					00					
O,O-DIETHYL-O-ETHYL PHOSPHORODITHIOATE										

Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone

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Table 4-9 (cont.)

[illegible]	[illegible]									
	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
	Apr-00	Sep-00	Apr-00	Sep-00	Apr-00	Sep-00	Apr-00	Sep-00	May-00	May-00
[illegible]										
[illegible]										
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[illegible]		[illegible]								
[illegible]				[illegible]		[illegible]		[illegible]		
[illegible]										
[illegible]										

"Monitoring Wells 2D, [illegible], [illegible], OW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

Table [illegible]-9 (cont.)

[illegible]	[illegible]C Jun-88	[illegible]C Sep-88	[illegible]A Jun-88	[illegible]A Sep-88	[illegible]D Jun-88	[illegible]D Sep-88	7D Jun-88	7D Sep-88	[illegible]C Nov-88	10C Nov-88
FATTY ACID ESTER										
ALPHA-TERPINEOL				00						
3-METHYL-2-CYCLOHEXEN-1-ONE				00						
1,1,3-TRIMETHYL-CYCLOPENTANE				11						
HEXADECANE				10						
TRICHLOROETHENE						00				
DICHLORO[illegible]METHANE										
2-METHOXY-4-METHYLPHENOL										
2-CHLORO,PHOSPHATE (3:1) [illegible]										
DIETHYL [illegible] [illegible]										
[illegible], [illegible]										
METHYL [illegible]										
[illegible] [illegible]										
1,2,4-TRIMETHYLBENZENE										
2-METHYL-[illegible]										
[illegible]										
CHLORO [illegible]		40								
TETRADECANE										
2,6,10,14-TETRAMETHYL-HEPTADECANE										
PENTADECANE										
[illegible] ACID ESTER										
2-METHYL-2,4-PENTANEDIOL										
METHYL-[illegible] [illegible]										
DIETHYL ESTER [illegible] ACID										
4-METHYL-2-NITROPHENOL										
1-(2-HYDROXYPROPOXY)-2-PROPANOL										
[illegible]										
[illegible] 1,2-[illegible]CARBOXYLIC ACID										
2-CHLORO [illegible]										
TRIETHYL ESTER PHOSPHORIC ACID										
[illegible]										
[illegible] PHENOL										
1,4 [illegible]										
[illegible]										
ETHANOL, 2-PHENOXY										
UNKNOWN ALKANE										00
UNKNOWN ALIPHATIC HYDROCARBON										00
ISOMER OF CHLORDANE										00
[illegible]PYRANOL, [illegible]										[illegible]
UNKNOWN [illegible]										
UNKNOWN PHENOL										00
ETHANOL, 2-CHLORO, PHOSPHATE										00
BENZENE, 1-PROPYNYL-										
BENZENAMINE, 2-METHYL-										
UNKNOWN PHOSPHORIC ACID ESTER										
UNKNOWN AROMATIC HYDROCARBON										
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-										
1,2-[illegible] ACID, [illegible]										
BENZENE, [illegible]-										
BENZENE, CHLORO-										
PYRIDINE, 4-METHYL-										
PHENOL, 2-ETHYL-										
PHENOL, 2,3-DIMETHYL-										
PHENOL,TERT-BUTYL [illegible]										00
UNKNOWN AROMATIC										

(B) COMPLETED BELOW [illegible] SYSTEM
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION LISTED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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Table 4-9 (cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)										
	CL-3		CL-9		DW-1			USGS 9-A		USGS 9-B	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Mar-89	Jun-88	Sep-88	Jun-88	Sep-88
UNKNOWN HYDROCARBON							40J	25	NS	53	NS
2-(2-METHOXYETHOXY)ETHANOL											
SATURATED ALIPHATIC HYDROCARBON											
ALIPHATIC HYDROCARBON				20							
ETHYLESTER CARBAMIC ACID											
HYDROXY METHYL PENTANONE											
METHOXY ETHOXY ETHANOL											
BUTYL BENZENE SULFONAMIDE											
HEXANOIC ACID											
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL						100					
HEPTADECENE-8-CARBONIC ACID											
XYLENE											
BENZOFURAN											
1-PROPYNYL BENZENE											
2-CHLORO-6-METHYL PYRIDINE											
1-METHYLNAPHTHALENE											
4,4'-(1-METHYLETHYLIDENE)BISPHENOL				23		100					
1,1'-OXYBISETHANE											
N,N-DIMETHYLFORAMIDE						390					
METHYLBENZENAMINE	9000										
CHLOROBENZENAMINE	4008										
BENZO(B)THIOPHENE											
OCTYL PHENOL ISOMER						180					
2-CHLORO-PHOSPHATE ETHANOL											
HEXANE											
2-BUTOXY ETHANOL											
2-METHYLPENTENE											
1,1-TETRAHYDROTHIOPHENE DIOXIDE											
BENZOTHIAZOLE											
4-(1,1-DIMETHYLETHYL)PHENOL											
UNKNOWN		380		170		800	870				
PROPANOL											
METHYL DIMETHYLETHOXYPROPANE											
HYDROXYPROPOXYPROPANOL											
UNKNOWN PYRIDINE											
DIETHYL ESTER (BENZENE CARBOXYLIC ACID											
TETRAMETHYL BUTYL PHENOL											
FATTY ACID											
METHOXYMETHYL AZIRIDINE											
HYDROXYMETHYL BENZENE ACETIC ACID											
AZULENE											
DIMETHYL PROPANOL											
METHYL FORMAMIDE											
ACETONE											
BIS(1-METHYL-2-HYDROXYETHYL)ETHER		13									
METHYL NAPHTHALENE											
UNKNOWN PHTHALATE ESTER								19			
CRESOL											
BENZOIC ACID											
BENZENEACETIC ACID											
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL											
4,4'-(1-METHYLETHYLIDENE)BIS PHENOL DIS WITH UNK HYD											
ALPHA, ALPHA-DIMETHYL BENZENEMETHANOL						100					
PHENOXY ETHANOL											
2-METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID											
O,O-DIETHYL-S-ETHYL PHOSPHORODITHIOATE											

"Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table 4-9 (cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT.)										
	CL-3		CL-8		DW-1			USG 9-A		USG 9-B	
	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Mar-00	Jun-00	Sep-00	Jun-00	Sep-00
METHYL ESTER OF HEXADECANOIC ACID											
AMINO METHYL PENTANONE											
DIMETHYL BENZENE											
CYCLOHEXANONE											
METHYLETHOXYPROPANE											
TRIMETHYL CYCLOHEXANONE											
BENZENE METHANOL											
DIMETHYL BENZENE METHANOL											
BUTOXYBUTENE											
2 DICHLOROETHENYL BENZENE ISOMER	[illegible]										
NITROCRESOL	[illegible]										
ETHYL CRESOL ISOMER	[illegible]										
1,2-BIS(2-CHLOROETHOXY)ETHANE		[illegible]									
1,2-BIS(CHLOROETHOXY)ETHANE	[illegible]										
BIS-(2-METHOXYETHYL)BENZENE DICARBOXYLIC ACID ESTER	[illegible]										
2-ETHYLHEXANOL	[illegible]										
N-PHENYL BENZENAMINE	[illegible]										
CHLOROETHANOL PHOSPHATE	[illegible]										
TOLUENE	[illegible]										
STYRENE	[illegible]										
BENZENAMINE	[illegible]										
CHLOROMETHYL BENZENE	[illegible]										
2-ETHYLHEXANOIC ACID	[illegible]										
ETHYL PHENOL ISOMER	[illegible]			[illegible]		[illegible]					
DIMETHYL PHENOL ISOMER	[illegible]										
CHLOROPHENOL ISOMER	[illegible]										
UNKNOWN PHTHALATE ESTER											
N-(1,1-DIMETHYLETHYL)-2-[illegible]											
3-NITRO-1,2-BENZENEDICARBOXYLIC ACID											
CHLORINATED HYDROCARBON											
2-METHYL BENZENAMINE											
METHYL PHENOL ISOMER		[illegible]					[illegible]				
(1-METHYLETHYL)BENZENE											
1-HEXANAL											
2-HEXANAL											
HEXADECANOIC ACID		[illegible]									
2,2,6-TRIMETHYL-CYCLOHEXANONE						[illegible]					
2,2,6-TRIMETHYL-CYCLOHEXANOL											
2,2-DIMETHYL-1-PROPANOL											
2-(1-METHYLETHYL)-PHENOL											
(1)BENZOTHIENO(2,3 - B)[illegible]											
4-METHYLPHENOL											
1,2-DIHYDRO-3H-PURIN-6-ONE											
ALPHA-HYDROXY-BENZENEACETIC ACID											
TERT-BUTOXYISOPROPOXY METHANE											
1,2-BENZENEDICARBOXYLIC ACID ESTER											
2,2-DIMETHYL-3(2H)-BENZOFURANONE											
N,N-DIETHYL ACETAMIDE											
4-HYDROXY-4-METHYL-2-PENTANONE											
1-METHOXY-2-PROPANONE											
ETHYL ESTER PHOSPHONIC ACID											
DI(2-ETHYLHEXYL)PHTHALATE											
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL		[illegible]				[illegible]					
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL											
DIMETHYL PHENOL											
(2-METHOXYETHOXY)ETHENE											
2,2'-OXYBIS-BUTANE											
3-METHOXY-2-BUTANOL											
1,1'-OXYBIS-2-PROPANOL											
[illegible]PROPANOATE PROPANE											
ESTER 1,2-BENZENEDICARBOXYLIC ACID											
HEXAHYDRO 2H-AZEPIN-2-ONE											
9,12-OCTADECADIEN-1-OL											
BUTYL MYRISTATE(BUTYL TETRADECYLATE)											

Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone

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Table 4–9 ([illegible]nt.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)										
	CL-[illegible]		CL-[illegible]		DW-1			UPD [illegible]-A		UPD [illegible]-B	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Mar-89	Jun-88	Sep-88	Jun-88	Sep-88
FATTY ACID ESTER											
ALPHA-TERPINEOL											
2-METHYL-2-CYCLOHEXEN-1-ONE											
1,1,2-TRIMETHYL-CYCLOPENTANE											
HEXADECANE											
TRICHLOROETHENE											
DICHLOROMETHANE											
2-METHOXY-4-METHYLPHENOL											
2-CHLORO PHOSPHATE (3:1) ETHANOL		14		16							
DIMETHYL BENZENE ISOMER				24		170					
[illegible], SULFUR		20				210					
METHYL NAPTHALENE ISOMER				19							
ALKENE ISOMER											
1,2,4-TRIMETHYLBENZENE											
2-METHYL-BENZENAMINE											
UNDECANE											
CHLORO [illegible] ISOMER		110				116					
TETRADECANE											
2,6,10,14-TETRAMETHYL-HEPTADECANE											
PENTADECANE											
PHOSPHORIC ACID ESTER											
2-METHYL-2,4-PENTANEDIOL		20									
METHYL-BENZENAMINE ISOMER		70		140		700					
DIETHYL ESTER BUTANEDIOIC ACID		220									
4-METHYL-2-NITROPHENOL		20									
1-(2-HYDROXYPROPOXY)-2-PROPANOL		20									
4A,8A-DIHYDRO-[illegible]-DIMETHYL-[illegible]NAPHTHALENONE		40									
BIS(2-METHOXYETHYL) ESTER 1,2-BENZENEDICARBOXYLIC ACID				21							
2-CHLORO BENZENAMINE				20		720					
TRIETHYL ESTER PHOSPHORIC ACID											
METHYL PHENOL ISOMER						2700					
2, METHYL PHENOL				20		700					
1,4 DICHLORO 2 ETHENYL BENZENE				10							
[illegible]				11							
ETHANOL, 2-PHENOXY											
UNKNOWN ALKENE							40				
UNKNOWN ALIPHATIC HYDROCARBON											
ISOMER OF CHLOROANILINE							100				
2-BENZOPYRANOL, [illegible]							17				
UNKNOWN THIOPHENE											
UNKNOWN PHENOL											
ETHANOL, 2-CHLORO-, PHOSPHATE											
BENZENE, 1-PROPYNYL-											
BENZENAMINE, 2-METHYL-											
UNKNOWN PHOSPHORIC ACID ESTER											
UNKNOWN AROMATIC HYDROCARBON							22				
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-											
1,2-BENZENEDICARBOXYLIC ACID, 3-NITRO-											
BENZENE, METHYL-							33				
BENZENE, CHLORO-							20				
PYRIDINE, 4-METHYL-							190				
PHENOL, 2-ETHYL-							20				
PHENOL, 2,3-DIMETHYL-							23				
PHENOL, TERT-BUTYL ISOMER											
UNKNOWN AROMATIC							11				

(B) COMPLETED BELOW DEEP BEDROCK
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

"Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table 4-9 (cont.)

COMPOUND	INTERMEDIATE SYSTEM WELL ZONE*							
	Rco-2		Rco-1		Rco-3		PRODUCTION WELL	
	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00	Jun-00	Sep-00
UNKNOWN HYDROCARBON 2-(2-METHOXYETHOXY)ETHANOL SATURATED ALIPHATIC HYDROCARBON ALIPHATIC HYDROCARBON	201	ND	97	ND	00	ND	ND	
ETHYLESTER CARBAMIC ACID HYDROXY METHYL PENTANONE METHOXY ETHOXY ETHANOL BUTYL BENZENE SULFONAMIDE								
HEXANOIC ACID 2,3-DIHYDRO-1,1-DIMETHYL-1-[illegible] HEPTADECENE-2-CARBOXYLIC ACID XYLENE								
BENZOFURAN 1-PROPYNYL BENZENE 2-CHLORO-6-METHYL PYRIDINE 1-METHYLNAPHTHALENE								
4,4'-(1-METHYLETHYLIDENE)[illegible] 1,1'-OXYBISETHANE N,N-DIMETHYLFORMAMIDE METHYLBENZENAMINE								47
CHLOROBENZENAMINE BENZO(B)THIOPHENE OCTYL PHENOL ISOMER 2-CHLORO-PHOSPHATE [illegible]								
HEXANE 2-BUTOXY ETHANOL 2-METHYLPENTENE 1,1-TETRAHYDROTHIOPHENE [illegible]								
BENZOTHIAZOLE 4-(1,1-DIMETHYLETHYL)PHENOL UNKNOWN PROPANOL								310
METHYL [illegible] HYDROXY PROPOXY PROPANOL UNKNOWN PYRIDINE DIETHYL ESTER BENZENE CARBOXYLIC ACID								
TETRAMETHYL BUTYL PHENOL FATTY ACID METHOXYMETHYL BENZENE HYDROXYMETHYL [illegible]								
ANILINE METHYL PROPANOL ETHYL PENTANONE ACETONE								
[illegible] METHYL NAPHTHALENE UNKNOWN PHTHALATE ESTER CRESOL	80							
BENZOIC ACID BENZENEACETIC ACID 1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL 4,4'-(1-METHYLETHYLIDENE)BIS PHENOL [illegible]								
ALPHA, ALPHA DIMETHYL BENZENEMETHANOL PHENOXY ETHANOL 2-METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID O,O-DIETHYL-O-ETHYL PHOSPHOROTHIOATE								

Monitoring Wells 2D, 4C, 6D, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone

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Table 4-9 (cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)						PRODUCTION WELL	
	R00-2		R00-1		R00-3			
	Aug-00	Sep-00	Aug-00	Sep-00	Aug-00	Sep-00	Aug-00	Sep-00
[illegible] ESTER OF [illegible] ACID								
[illegible] METHYL PENTANONE								
DIMETHYL BENZENE								
CYCLOHEXANONE								
[illegible]THYLETHOXYPROPANE								
TRIMETHYLCYCLOHEXANONE								
BENZENE METHANOL								
DIMETHYL BENZENE METHANOL								
BUTOXYBUTENE								
[illegible] ISOMER								
[illegible]								
ETHYL CRESOL ISOMER								
1,2-BIS(2-CHLOROETHOXY)ETHANE								
1,2-BIS(CHLOROETHOXY)ETHANE								
[illegible] ACID ESTER								
2-ETHYLHEXANOL								
N-PHENYLBENZENAMINE								
[illegible] PHOSPHATE								
TOLUENE								
STYRENE								
BENZENAMINE								
[illegible]								
2-ETHYLHEXANOIC ACID								
ETHYL PHENOL ISOMER								
DIMETHYL PHENOL ISOMER								
[illegible] ISOMER								
UNKNOWN PHTHALATE ESTER								
N-(1,1-DIMETHYLETHYL)-2-METHYLPROPANAMIDE								
3-NITRO-1,2-BENZENEDICARBOXYLIC ACID								
CHLORINATED HYDROCARBON								
2-METHYLBENZENAMINE								
METHYL PHENOL ISOMER								
(1-METHYLETHYL)BENZENE								
[illegible]-NONANE								
[illegible]-NONANE								
HEXADECANOIC ACID								
2,2,6-TRIMETHYL-CYCLOHEXANONE								
2,2,6-TRIMETHYL-CYCLOHEXANE								
2,2-DIMETHYL-1-PROPANOL								
2-(1-METHYLETHYL)-PHENOL								
[illegible]								
4-METHYLPHENOL								
1,7-DIHYDRO-6H-PURIN-6-ONE								
ALPHA-HYDROXY-BENZENEACETIC ACID								
TERT-BUTOXYISOPROPOXY ETHANE								
1,2-BENZENEDICARBOXYLIC ACID ESTER								
2,2-DIMETHYL-3(2H)-BENZOFURANONE								
N,N-DIMETHYL ACETAMIDE								
4-HYDROXY-3-METHYL-2-BUTANONE								
1-METHOXY-2-PROPANONE								
ETHYL ESTER PROPANOIC ACID								
BIS(2-METHOXYETHYL)PHTHALATE								
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL								
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BIS-2-PROPANOL								
DIMETHYL PHENOL								
(2-METHOXYETHOXY)ETHENE								
2,2'-OXYBIS-BUTANE								
1-METHOXY-2-BUTANOL								
1,1'-OXYBIS-2-PROPANOL								
[illegible] PROPANOL								
ESTER 1,2 BENZENEDICARBOXYLIC ACID								
HEXAHYDRO 2H-AZEPIN-2-ONE								
9,12-OCTADECADIEN-1-OL								
[illegible]								

"Monitoring Wells 2D, 4C, 8D, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table 4–9 (cont.)

COMPOUND	INTERMEDIATE SUBZONE WELLS (CONT)							
	Res-2		Res-1		Res-3		PRODUCTION WELL	
	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88	Jun-88	Sep-88
FATTY ACID ESTER								
ALPHA-TERPINEOL								
3-METHYL-2-CYCLOHEXEN-1-ONE								
1,1,3-TRIMETHYL CYCLOPENTANE								
HEXADECANE								
TRICHLOROETHENE								
DICHLOROBROMOMETHANE								
3 METHOXY-2-METHYLPHENOL								
2-CHLORO,PHOSPHATE (3:1) ETHANOL								10
DIMETHYL BENZENE ISOMER								
MOL. SULFUR								
METHYL NAPTHALENE ISOMER								
XYLENE ISOMER								
1,2,4-TRIMETHYLBENZENE								
3-METHYL-BENZENAMINE								
UNDECANE								
CHLORO BENZENAMINE ISOMER								
TETRADECANE								
2,6,10,14-TETRAMETHYL-HEPTADECANE								
PENTADECANE								
PHOSPHORIC ACID ESTER								
2-METHYL-2,4-PENTANEDIOL								
METHYL-BENZENAMINE ISOMER								
DIETHYL ESTER 2-BUTENEDIOIC ACID								
4-METHYL-2-NITROPHENOL								
2-(2-HYDROXYPROPOXY)-1-PROPANOL								
4A,9B-DIHYDRO-8,9B-DIMETHYL-3(4H)-DIBENZOFURANONE								
BIS(2-METHOXYETHYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID								21
2-CHLORO BENZENAMINE								27
TRIETHYL ESTER PHOSPHORIC ACID								10
METHYL PHENOL ISOMER								
2, METHYL PHENOL								
1,4 DICHLORO 2 ETHENYL BENZENE								
BICYCLO[4.2.0]OCTA 1,3,5 TRIENE								
ETHANOL, 2-PHENOXY								
UNKNOWN ALKENE								
UNKNOWN ALIPHATIC HYDROCARBON								
ISOMER OF CHLOROANILINE								
7-BENZOFURANOL, 2,3,-DIHYDRO-2,2-DIMETHYL								
UNKNOWN THIOPHENE								
UNKNOWN PHENOL								
ETHANOL, 2-CHORO-, PHOSPHATE								
BENZENE, 1-PROPYNYL-								
BENZENAMINE, 3-METHYL-								
UNKNOWN PHOSPHORIC ACID ESTER								
UNKNOWN AROMATIC HYDROCARBON								
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-								
1,2-BENZENEDICARBOXYLIC ACID, 3-NITRO-								
BENZENE, METHYL-								
BENZENE, CHLORO-								
PYRIDINE, 4-METHYL-								
PHENOL, 2-ETHYL-								
PHENOL, 2,3-DIMETHYL-								
PHENOL,TERT-BUTYL ISOMER								
UNKNOWN AROMATIC								

(@) COMPLETED BELOW DEEP SUBZONE
(NA) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
ALL RESULTS ARE QUANTITATIVE ESTIMATES

"Monitoring Wells 2D, 4C, 6B, DW-1, and CLTL Production Well are screened in the Lower Intermediate Zone"

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Table 4-1

Priority Pollutant Organic Compounds in Ground Water Collected from Deep Subzone Wells in the Remedial Investigation at the CLTL Site

[illegible]	[illegible]	[illegible]		[illegible]			[illegible]		[illegible]	[illegible]		[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]													
METHYLENE CHLORIDE	0										[illegible]		[illegible]
TRANS-1,2-DICHLOROETHYLENE	00			00									
CHLOROFORM													
TRICHLOROETHYLENE	[illegible]												
BENZENE	0												
TOLUENE									00				
VINYL CHLORIDE	0												
1,2-DICHLOROETHANE	[illegible]												
TETRACHLOROETHYLENE	0												
CHLOROBENZENE	0												
ETHYLBENZENE													
1,1-DICHLOROETHANE	[illegible]												
1,2-DICHLOROPROPANE													
FLUOROTRICHLOROMETHANE													
1,1,1-TRICHLOROETHANE													
CHLOROETHANE													
[illegible]													
1,2-DICHLOROBENZENE													
1,3-DICHLOROBENZENE													
1,4-DICHLOROBENZENE													
NAPHTHALENE													
DI-N-BUTYL PHTHALATE													
DIETHYL PHTHALATE													
N-NITROSODIPHENYLAMINE													
1,2,4-TRICHLOROBENZENE													
2-CHLORONAPHTHALENE													
BUTYL BENZYL PHTHALATE													
BIS(2-ETHYLHEXYL)PHTHALATE													
[illegible]													
DIMETHYL PHTHALATE													
NITROBENZENE													
PHENOL													
2,4-DIMETHYLPHENOL													
2,4-DICHLOROPHENOL													
2-NITROPHENOL													
4-NITROPHENOL													
PESTICIDES													
HEPTACHLOR													
ALPHA BHC			0.11										
DELTA BHC													
DDT			0.10										
ENDOSULFAN I													
ENDOSULFAN SULFATE													
DDE													

[illegible]
[illegible]
(NS) WELL NOT SAMPLED
[illegible]
CONCENTRATIONS REPORTED IN [illegible]
[illegible]
[illegible]
[illegible]

[illegible]
[illegible]

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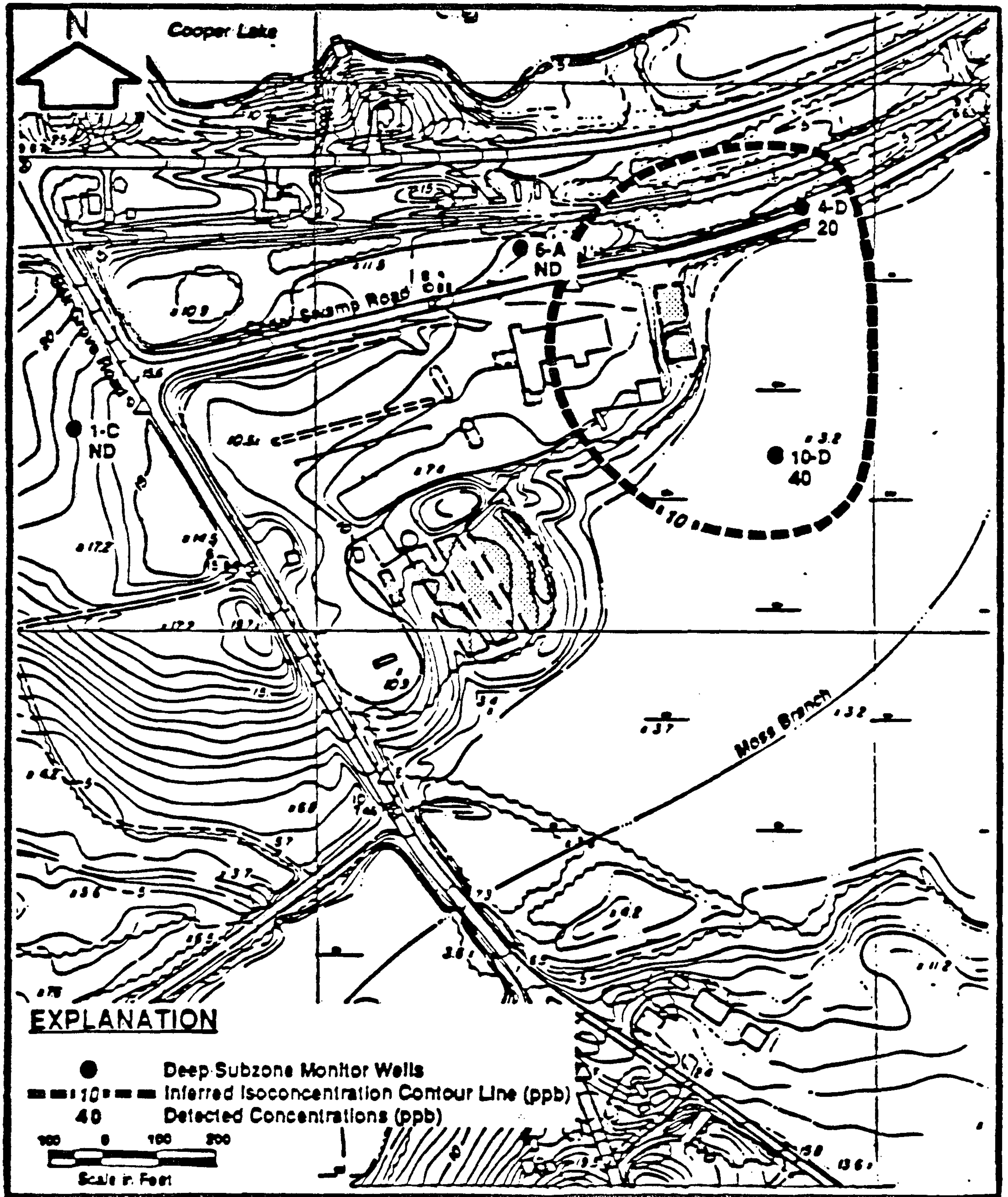

EPA **Figure 4-11**

Environmental Protection Agency

CDM

Camp Dresser & McKee

Total Priority Pollutant Volatile Organics Detected In CLTL Deep Subzone Ground Water

Table 4-11

Priority Pollutant Inorganic Constituents, Classical Parameters, and Water Quality Parameters In Ground Water Collected from Deep Subzone Wells in the Remedial Investigation at the CLTL Site

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ARSENIC	[illegible]						[illegible]				[illegible]		[illegible]
ANTIMONY													
BERYLLIUM													
CADMIUM	[illegible]												
CHROMIUM	[illegible]								[illegible]				
COPPER	[illegible]					[illegible]			[illegible]				
LEAD	[illegible]								[illegible]				
MERCURY	[illegible]								[illegible]				
NICKEL	[illegible]					[illegible]							
SELENIUM	[illegible]												
SILVER	[illegible]												
THALLIUM													
ZINC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
PHENOLS			[illegible]										
CYANIDE	[illegible]												
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]				[illegible]				[illegible]	[illegible]				
[illegible]			[illegible]				[illegible]		[illegible]				
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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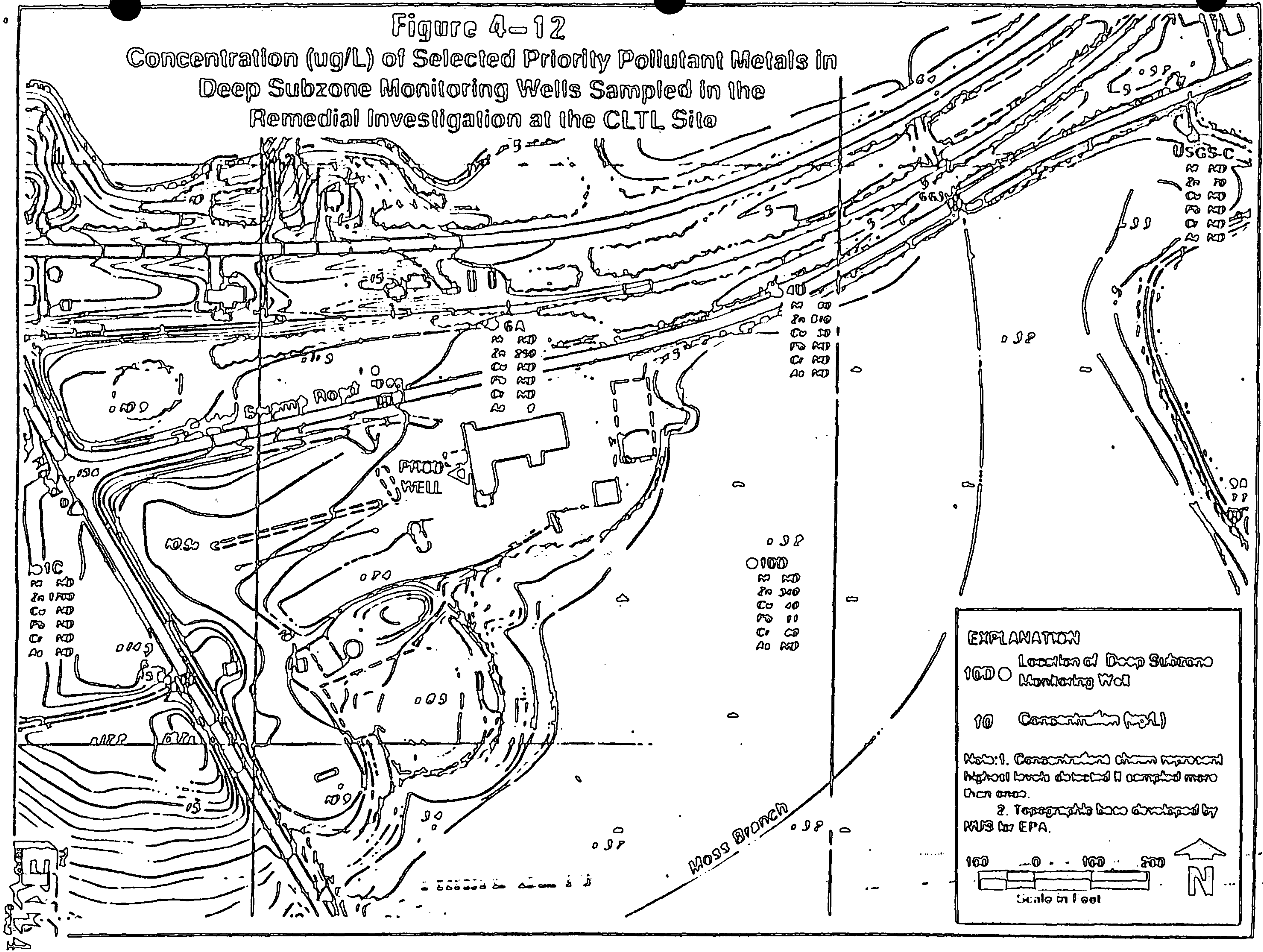
Figure 4-12

Concentration (ug/L) of Selected Priority Pollutant Metals in Deep Subzone Monitoring Wells Sampled in the Remedial Investigation at the CLTL Site



Note: 1. Concentrations shown represent highest levels detected if sampled more than once.
2. Topographic base developed by NUS for EPA.

Table 4-12

Tentatively Identified Organic Compounds in Ground Water Collected from Deep Subzone Wells in the Remedial Investigation at the CLTL Site

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Table 4–12 (cont.)

COMPOUND	DEEP SUBZONE WELLS											
	1C		4D			9A		10D	[illegible]		[illegible]	
	Jun-88	Sep-88	Jun-88	Sep-88	Mar-89	Jun-88	Sep-88	Mar-89	Jun-88	Sep-88	Jun-88	Sep-88
UNKNOWN HYDROCARBON						73			14	ND	10	ND
2-(2-METHOXYETHOXY)ETHANOL												
SATURATED ALIPHATIC HYDROCARBON												
ALIPHATIC HYDROCARBON	120			21		11						
ETHYLESTER CARBAMIC ACID	23											
HYDROXY METHYL PENTANONE	41											
METHOXY ETHOXY ETHANOL	12											
BUTYL BENZENE SULFONAMIDE	27											
HEXANOIC ACID												
2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANOL												
HEPTADECENE-8-CARBONIC ACID												
XYLENE												
BENZOFURAN												
1-PROPYNYL BENZENE												
2-CHLORO-6-METHYL PYRIDINE												
1-METHYLNAPHTHALENE												
4,4'-(1-METHYLETHYLIDENE)BISPHENOL												
1,1'-OXYBISETHANE												
N,N-DIMETHYLFORMAMIDE												
METHYLBENZENAMINE												
CHLOROBENZENAMINE												
BENZO(B)THIOPHENE												
OCTYL PHENOL (ISOMER)												
2-CHLORO-[illegible] ETHANOL												
HEXANE												
2-BUTOXY ETHANOL												
2-METHYLPENTENE												
1,1-TETRAHYDRO[illegible]												
BENZOTHIAZOLE												
4-(1,1-DIMETHYLETHYL)PHENOL												
UNKNOWN								.00				
PROPANOL												
METHYL [illegible] METHOXYPROPANE												
HYDROXYPROPOXYPROPANOL												
UNKNOWN PYRIDINE												
DIETHYL ESTER BENZENE CARBOXYLIC ACID												
TETRAMETHYL BUTYL PHENOL												
FATTY ACID												
METHOXYMETHYL AZIRIDINE												
HYDROXYMETHYL BENZENE ACETIC ACID												
AZULENE												
DIMETHYL PROPANOL												
METHYL FORMAMIDE												
ACETONE												
BIS(1-METHYL-2-HYDROXYETHYL)ETHER												
METHYL NAPHTHALENE												
UNKNOWN PHTHALATE ESTER			00									
CRESOL												
BENZOIC ACID												
BENZENEACETIC ACID												
1,1'-[(1-METHYL-1,2-ETHANEDIYL)BIS(OXY)]BISPROPANOL												
4,4'(1-METHYLETHYLIDENE)BIS PHENOL MIX WITH UNK HYD												
ALPHA, ALPHA DIMETHYL BENZENEMETHANOL												
PHENOXY ETHANOL												
3 METHYL-3-HYDROXY-2,4,4-TRIMETHYLPENTYLESTER OF PROP ACID												
O,O-DIETHYL-O-ETHYL PHOSPHOROTHIOATE												

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Table 4-1 (cont.)

COMPOUND	DEEP SUBZONE WELLS											
	1C		4D			9A		10D	[illegible]-2C		[illegible]	
	AUG-86	DEC-86	AUG-86	SEP-86	NOV-86	AUG-86	SEP-86	NOV-86	AUG-86	DEC-86	AUG-86	[illegible]
FATTY ACID ESTER				10								
ALPHA-TERPINEOL												
2-METHYL-2-CYCLOHEXEN-1-ONE												
1,1,3-TRIMETHYL-CYCLOPENTANE												
HEXADECANE												
TRICHLOROETHENE												
DICHLORODIFLUOROMETHANE												
2-METHOXY-4-METHYLPHENOL												
2-CHLORO,PHOSPHATE (3:1) ETHANOL												
DIMETHYL DISULFIDE [illegible]												
OIL, DIESEL												
METHYL NAPHTHALENE ISOMER												
XYLENE ISOMER												
1,2,4-TRIMETHYLBENZENE												
2 METHYL-DECAHYDRONAPHTHALENE												
UNDECANE												
CHLORO DIMETHYL [illegible]												
TETRADECANE												
2,6,10,14-TETRAMETHYL-HEPTADECANE												
PENTADECANE												
PHOSPHORIC ACID ESTER												
2-METHYL-2,4-PENTANEDIOL												
METHYL-[illegible] ISOMER												
DIETHYL ESTER 2-BUTENEDIOIC ACID												
4-METHYL-2-NITROPHENOL												
1-(2-HYDROXYPROPOXY)-2-PROPANOL												
4A,8B-DIHYDRO-8,8B-DIMETHYL-[illegible]												
DI(2-ETHYLHEXYL)ESTER 1,2-BENZENEDICARBOXYLIC ACID												
2-CHLORO BENZENAMINE												
TRIETHYL ESTER PHOSPHORIC ACID												
METHYL PHENOL ISOMER												
2, METHYL PHENOL												
1,2 DICHLORO 2 ETHOXY ETHANE												
DICYCLOHEXYL [illegible]												
ETHANOL, 2-PHENOXY								10				
UNKNOWN ALKENE	10											
UNKNOWN ALIPHATIC HYDROCARBON												
ISOMER OF CHLOROANILINE												
2-PROPANOL, 1,1-[illegible]												
UNKNOWN THIOPHENE												
UNKNOWN PHENOL												
ETHANOL, 2-CHLORO-, PHOSPHATE												
BENZENE, 1-PROPYNYL-												
BENZENAMINE, 2-METHYL-												
UNKNOWN PHOSPHORIC ACID ESTER												
UNKNOWN AROMATIC HYDROCARBON												
PHENOL, 4-(1,1,3,3-TETRAMETHYLBUTYL)-												
1,2-BENZENEDICARBOXYLIC ACID, [illegible]												
BENZENE, METHYL-												
BENZENE, CHLORO-												
PYRIDINE, 4-METHYL-												
PHENOL, 2-ETHYL-												
PHENOL, 2,3-DIMETHYL-												
PHENOL,TERT-BUTYL ISOMER												
UNKNOWN AROMATIC												

(C) COMPLETED BELOW DEEP SUBZONE
(IW) INSUFFICIENT WATER FOR SAMPLE
(NS) WELL NOT SAMPLED
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED
ALL RESULTS ARE QUANTITATIVE ESTIMATES

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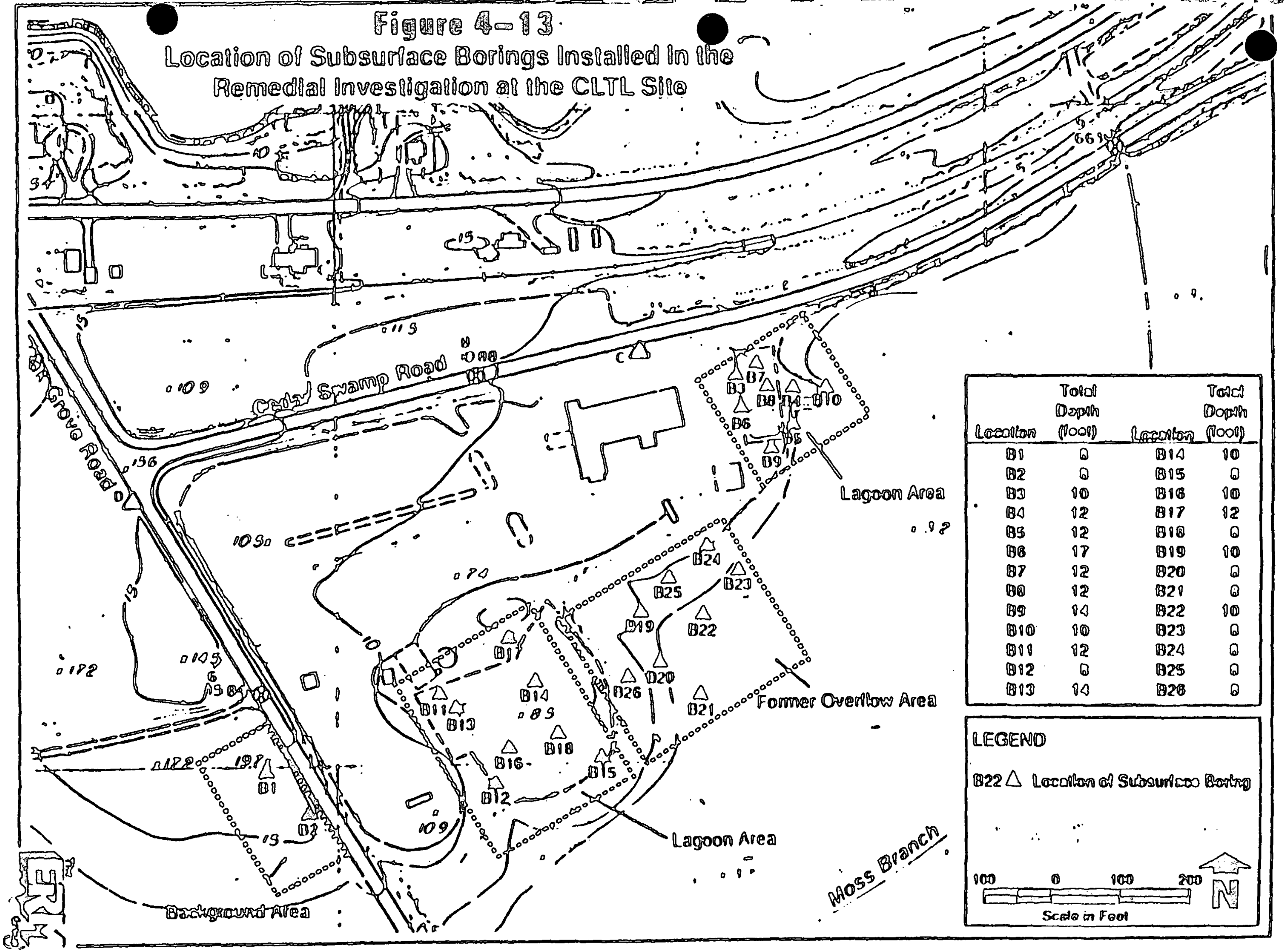
Figure 4-13
Location of Subsurface Borings Installed in the Remedial Investigation at the CLTL Site



Location	Total Depth (feet)	Location	Total Depth (feet)
B1	8	B14	10
B2	8	B15	8
B3	10	B16	10
B4	12	B17	12
B5	12	B18	8
B6	17	B19	10
B7	12	B20	8
B8	12	B21	8
B9	14	B22	10
B10	10	B23	8
B11	12	B24	8
B12	8	B25	8
B13	14	B26	8

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Table 4-13

Field pH Levels of Ground Water Samples Collected as Part of the Remedial Investigation at the CLTL Site

Well	June 1986	September 1986	March 1988
1 A	7.5	7.1	*
1 B	10.95	7.1	*
1 C	6.4	6.8	*
2 A	6.4	6.2	*
2 B	8.3	6.2	*
2 C	8.2	6.3	6.6
2 D	9.1	7.3	*
3 A	6.2	6.55	*
3 B	6.3	6.5	*
4 A	5	6.05	*
4 C	6.1	5.7	*
4 D	11	7.5	11.60 L
5 A	6.1	6.1	*
6 A	10.8	7.5	*
6 B	9.2	6.5	*
[illegible] A	5.8	5.7	*
[illegible] B	9	6.5	*
8 A	6.5	6.1	*
9 C	*	*	11.35 L
10 C	*	*	6.8
10 D	*	*	7.4
TP-1	6.1	5.85	*
TP-12	**	6.7	*
TP-13	**	**	*
TP-16	6.3	6.35	*
TP-19	**	**	*
TP-22	**	**	*
CL-1	6	6.6	*
CL-2	5.5	5.0	*
CL-3	5.6	6.2	*
CL-4	5.2	6	*
CL-6	6.2	6.4	*
DW-1	6.1	5.7	6.91
Res-3	5.4	*	*
Res-2	5.2	*	*
Res-1	4.9	*	*
USGS-A	6.6	*	*
USGS-B	4.2	*	*
USGS-C	5.3	*	*
USGS-D	5.6	*	*
[illegible]TL PROD WELL	*	6	*

* = Well Not Sampled

** = Well Not Sampled Due to Insufficient Water

L = Litmus Paper Reading Considerably Lower

Table 4-14

Field Specific Conductance and Temperature of Ground Water Samples Collected as Part of the Remedial Investigation at the CLTL Site

	SPECIFIC CONDUCTANCE (umhos/cm @ 25 C)			TEMPERATURE (degrees Centigrade)		
Well	June 1986	September 1986	March 1988	June 1986	September 1986	March 1988
1 A	185	700	*	13.4	17	*
1 B	273	315	*	13.1	16	*
1 C	125	214	*	13	16	*
2 A	734	564	*	14.3	20	*
2 B	753	507	*	11.5	13.5	*
2 C	719	646	4400	13.7	17	12
2 D	352	244	*	12.5	19	*
3 A	1326	1540	*	13	18	*
3 B	610	868	*	11.7	13	*
4 A	873	880	*	12.2	22	*
4 C	996	885	*	15.5	13	*
4 D	2175	380	2020	14	16	11.5
5 A	474	470	*	13	13.5	*
6 A	726	97	*	16	18	*
6 B	230	112	*	12.0	17.5	*
7 A	282	96	*	13	17.5	*
7 B	388	229	*	13.0	17.5	*
8 A	1052	664	*	17.5	18	*
9 C	*	*	3210	*	*	10
10 C	*	*	8100	*	*	12.5
10 D	*	*	1100	*	*	11.5
CL-1	**	703	*	**	16	*
CL-2	622	441	*	15.4	18	*
CL-3	915	776	*	16	16	*
CL-4	679	1008	*	14	17	*
CL-6	1063	520	*	15	13.5	*
TP-1	329	373	*	16	18	*
TP-12	**	1390	*	**	17	*
TP-13	**	**	*	**	**	*
TP-16	542	2100	*	13	16.5	*
TP-19	**	**	*	**	**	*
TP-22	**	**	*	**	**	*
DW-1	1174	1456	8600	14.5	15	12
Res-3		*	*		*	*
Res-2		*	*		*	*
Res-1		*	*		*	*
USGS-A	463	*	*	13.5	*	*
USGS-B	127	*	*	14	*	*
USGS-C	134	*	*	13	*	*
USGS-D	1509	*	*	13	*	*
CLTL PROD WELL	*	600	*	*	15.5	*

* = Not Sampled

** = Not Sampled Due to Insufficient Water

Conductivity Measurements are Corrected to 25C Using the Calculated Cell Constant (from instrument standardization) and the Field Conductivity Value

@ = Meter Not Standardized

Zinc concentrations were considerably higher at deep subzone monitoring well 1-C than in other deep subzone monitoring wells. However, 1-C did not show detectable concentrations of other site-related inorganics found in other deep subzone wells (4-D and 10-D).

Pesticides were detected in only one deep subzone monitoring well sample. Alpha BHC (0.11 ppb) and DDT (0.10 ppb) were detected in deep subzone ground water from well 1-C.

Levels of TDS and TOC detected in deep subzone ground water are generally lower than levels found in the shallow and intermediate subzone ground water (Table 4-11). TDS levels ranged from 76,000 ppb to 458,000 ppb, TOC levels ranged from 1000 ppb to 8700 ppb. Deep subzone TDS and TOC levels appear to be highest in monitoring wells located along the eastern boundary of the site near the former wastewater disposal lagoons.

Few TICs were detected in deep subzone monitoring wells (Table 4-12).

4.1.10 Field pH, Specific Conductivity, and Temperature

The range in pH in ground water from the Potomac-Raritan-Magothy aquifer system is 4.4 to 8.3 as reported by Fusillo and Voronin (1981). Table 4-13 presents the pH levels in ground-water samples collected during the various sampling efforts at the CLTL site. During the June 1986 sampling effort, the pH in six wells installed during the period from March to May 1986 (1B, 2D, 4D, 6A, 6B and 7B) was above 8.3; and one well, USGS-B, registered a pH of 4.2, just below the observed pH range.

As discussed in Section 3.2.3, these high pH levels were believed to result from incomplete well development. The wells were redeveloped several weeks after their installation. During the September 1986 sampling effort, the pH levels in the wells which were sampled ranged between 5.70 and 7.50. During the March 1988 sampling effort, ground water from monitoring well 4D and 9C exceeded the pH range documented by Fusillo and Voronin (1981), Although a field check of the ground water with litmus paper indicated a pH much closer to the upper pH range for the aquifer system.

The specific conductance and temperature ranges for the Potomac-Raritan-Magothy aquifer system are 39 to 4,200 umhos/cm and 12. 7 to 26.0 degrees Centigrade according to Fusillo and Voronin (1981). Table 4-14 lists the specific conductance and temperature values collected during the various ground-water sampling efforts at the CLTL site. Although the specific conductance values for the various monitoring well sampling events fall within the range for the aquifer system, several samples collected during March 1988 were cooler than the reported temperature range for the aquifer system.

4.2 Soil Sampling Results

This section presents analytical results of soil samples collected at the CLTL site. The soil samples are discussed in three separate sections corresponding to the three types of soil samples, namely: samples from subsurface soil borings, samples from bucket augers, and shallow soil samples. The analytical results for each type of soil sample are divided into three categories: organic compounds; inorganic constituents (metals), classical parameters (cyanide and phenols), the indicator parameters TOC, TOX, COD and TICs. In the tables listing organic compounds and TICS, the left column includes all compounds detected in soil from the CLTL site; whether the compound was detected in all soil samples or in just one soil sample.

In the following discussions relating to organic compounds and inorganic constituents, classical parameters and indicator parameters, levels of these constituents and/or parameters detected in soil samples are compared with relevant on-site and off-site background levels as well as NJDEP soil cleanup objectives. Table 4-15 lists the background levels and cleanup objectives for selected inorganic constituents and indicator parameters for New Jersey soils. These levels were developed from the following three sources: 1) site-specific background levels established using the highest concentration in samples collected from subsurface borings located in a designated background area; 2) background levels for New Jersey soil published in the 1987 Draft New Jersey Risk Assessment Guidelines; and 3) site-specific soil cleanup objectives provided by NJDEP.

Appendix S presents the Quality Assurance/Quality Control (QA/QC) review of the analytical results. This appendix includes a thorough review of the data package deliverables from the laboratory including holding times, duplicate analyses, matrix spike recoveries, method blank analyses, and a number of other analyses. The tables listing analytical results in this section contain qualifiers generated in the QA/QC review. Although the tables provide a brief explanation of the qualifiers, the technical basis for the qualifiers is provided in Appendix S.

4.2.1 Subsurface Boring Sampling Results

Sixty-six soil samples were collected from a total of 26 subsurface soil borings (Plate 1) located in the general vicinity

Table 4-15

BACKGROUND LEVELS AND CLEAN-UP OBJECTIVES FOR SELECTED PRIORITY POLLUTANT INORGANIC CONSTITUENTS AND INDICATOR PARAMETERS DETECTED IN SOIL AT THE CLTL SITE

CONSTITUENT/ PARAMETER	SITE-SPECIFIC BACKGROUND LEVEL[a] (mg/kg)	BACKGROUND LEVEL FOR NEW JERSEY SOIL[b] (mg/kg)	NJDEP CLEAN-UP OBJECTIVE[c] (mg/kg)
Arsenic	8.6	NA	20
Beryllium	0.2	NA	1
Cadmium	0.2*	1.0-1.4	3
Chromium	15	5-48	100
Copper	6	0.5-53.6	170
Lead	7	1-180	250-1,000
Mercury	0.2*	NA	1
Nickel	5	11.1-86.5	100
Silver	0.9	NA	5
Thallium	2	NA	NA
Zinc	23.2	4.5-168	350
TOC	1,400	NA	NA
COD	10,600	NA	NA

a - Highest concentration in samples from background soil borings in Area 4, CLTL site.

b - 1987 Draft New Jersey Risk Assessment Guidelines.

c - Soil cleanup objectives provided by NJDEP.

NA - Level not established.

* - Not detected above laboratory reporting limit in Area 4. Value represents laboratory reporting limit.

Table 4-16

Priority Pollutant Organic Compounds in Subsurface Soil Boring Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	B1 *			B2 *			B3 *	B4 *	B5 *		B6		B7 *	B8 *	B9 *	
	0-2	2-4	4-6	0-2	2-4	4-6	9.5-10	5-6	1-2	11-12	7-8	16-17	11-12	11-12	9-10	13-14
VOLATILES																
METHYLENE CHLORIDE																
TRANS-1,2-DICHLOROETHYLENE							1.0					10				
TRICHLOROETHENE												200				
BENZENE												1.10				
TOLUENE							6.6					0.57				
TETRACHLOROETHENE							6.0					10				
CHLOROBENZENE							8.0				0.47	83				
ETHYLBENZENE							3.0				0.24	17.4				
1,1,1-TRICHLOROETHANE																
SEMIVOLATILES																
1,2-DICHLOROBENZENE											2.37	81.0				
1,4-DICHLOROBENZENE																
NAPHTHALENE							3.7				5.60	301				
DI-N-BUTYL PHTHALATE							1.4				0.71	13.1				
DI-N-OCTYL PHTHALATE									0.36		0.05	3				
N-NITROSODIPHENYLAMINE							12.7	1.88	2.01		1.66	10.7				
1,2,4-TRICHLOROBENZENE							6.6				4.74					
BUTYL BENZYL PHTHALATE							30.1				2.70	330				
BIS(2-ETHYLHEXYL)PHTHALATE							44.3	1.00	18.7		20.3	271				
PHENOL											0.71					
2,4-DIMETHYLPHENOL																
2,4-DICHLOROPHENOL																
4-NITROPHENOL																
ANTHRACENE																
FLUORANTHENE							6.0		0.36		1.66	6.6				
PHENANTHRENE							6.0				1.0	22				
PYRENE							6.6				1.07					
BENZO (A) ANTHRACENE							6.6									
BENZO (K) FLUORANTHENE							9.7				0.71					
FLUORENE											0.81	11.6				
BENZO (A) PYRENE							6.7									
ACENAPHTHENE												11.6				
PENTACHLOROPHENOL																
PESTICIDES																
HEPTACHLOR		0.01														
DDT	0.02															
DDE							0.06		0.120		2.40	0.174				
DDD																

CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
* - PESTICIDES/PCB EXTRACTION HOLDING TIME EXCEEDED; CONCENTRATIONS ESTIMATED

NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP 990.
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS.

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Table 4-1[illegible](cont.)

PARAMETER	B10 *			B11		B12 *		B13 *					B14		
	2-4	6-8	8-10	2-4 **	8-10	2-4	6-8	2-4	6-8	8-10	10-12	12-14	2-4	6-8	8-10
VOLATILES															
METHYLENE CHLORIDE															
TRANS-1,2-DICHLOROETHYLENE															
TRICHLOROETHENE				810											
BENZENE															
TOLUENE				4 03											
TETRACHLOROETHENE				1 1											
CHLOROBENZENE				0 40											
ETHYLBENZENE				3											
1,1,1-TRICHLOROETHANE				0 01											
SEMIVOLATILES															
1,2-DICHLOROBENZENE				020											
1,4-DICHLOROBENZENE				0 06											
NAPHTHALENE				40 1											
DI-N-BUTYL PHTHALATE				11 0											
DI-N-OCTYL PHTHALATE				3 04											
N-NITROSODIPHENYLAMINE		00	0.00	00.7											
1,2,4-TRICHLOROBENZENE															
BUTYL BENZYL PHTHALATE				007	0 3										
BIS(2-ETHYLHEXYL)PHTHALATE		100	2.01	002	1.30	1.00							1.00		
PHENOL															
2,4-DIMETHYLPHENOL															
2,4-DICHLOROPHENOL															
4-NITROPHENOL															
ANTHRACENE				2 27											
FLUORANTHENE				4 07											
PHENANTHRENE				4 01											
PYRENE				0.00											
BENZO (A) ANTHRACENE															
BENZO (B) FLUORANTHENE															
FLUORENE				0.3											
BENZO (A) PYRENE															
ACENAPHTHENE				0.00											
PENTACHLOROPHENOL															
PESTICIDES															
HEPTACHLOR															
DDT															
DDE		0.70											0 007		
DDD													0 200		

CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
* - SEMIVOLATILE EXTRACTION HOLDING TIME EXCEEDED; CONCENTRATIONS ESTIMATED
** - VOLATILE HOLDING TIME EXCEEDED; CONCENTRATIONS ESTIMATED

[illegible] SOIL CLEANUP OBJECTIVES PROVIDED BY [illegible].
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS.

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Table 4-15 (cont.)

PARAMETER	[illegible]		[illegible]			[illegible]		[illegible]			[illegible]			[illegible]		[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VOLATILES																		
METHYLENE CHLORIDE	[illegible]						[illegible]											
TRANS-1,2-DICHLOROETHYLENE									[illegible]									
TRICHLOROETHENE																		
BENZENE																		
TOLUENE									[illegible]									
TETRACHLOROETHENE																		
CHLOROBENZENE									[illegible]									
ETHYLBENZENE									[illegible]									
1,1,1-TRICHLOROETHANE																		
SEMIVOLATILES																		
1,3-DICHLOROBENZENE																		
1,4-DICHLOROBENZENE																		
NAPHTHALENE	[illegible]	[illegible]	[illegible]						[illegible]									
DI-N-BUTYL PHTHALATE	[illegible]		[illegible]						[illegible]									
DI-N-OCTYL PHTHALATE																		
N-NITROSODIPHENYLAMINE	[illegible]	[illegible]	[illegible]						[illegible]			[illegible]						
1,2,4-TRICHLOROBENZENE																		
BUTYL BENZYL PHTHALATE	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]									
BIS(2-ETHYLHEXYL)PHTHALATE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]			[illegible]		[illegible]			[illegible]	
PHENOL			[illegible]						[illegible]									
2,4-DIMETHYLPHENOL			[illegible]						[illegible]			[illegible]						
2,4-DICHLOROPHENOL			[illegible]						[illegible]									
4-NITROPHENOL			[illegible]															
ANTHRACENE																		
FLUORANTHENE																		
PHENANTHRENE	[illegible]																	
PYRENE																		
BENZO (A) ANTHRACENE																		
BENZO (B) FLUORANTHENE																		
FLUORENE																		
BENZO (A) PYRENE																		
ACENAPHTHENE																		
PENTACHLOROPHENOL			[illegible]															
PESTICIDES																		
HEPTACHLOR																		
DDT						[illegible]												
DDE		[illegible]	[illegible]			[illegible]		[illegible]			[illegible]	[illegible]						
DDD		[illegible]	[illegible]			[illegible]		[illegible]			[illegible]	[illegible]						

CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
* - RECOMMENDED EXTRACTION HOLDING TIME EXCEEDED; CONCENTRATIONS ESTIMATED

[illegible] SOIL CLEANUP OBJECTIVES PROVIDED BY [illegible].
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS

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Table 4-16 (cont)

PARAMETER	B12				B13				B14			B16			B20 *		
	3-4	5-6	7-8	9-10	1-2	3-4	5-6	7-8	3-4	5-6	7-8	3-4	5-6	7-8	3-4	5-6	7-8
VOLATILES																	
METHYLENE CHLORIDE																	
TRANS-1,2-DICHLOROETHYLENE																	
TRICHLOROETHENE																	
BENZENE																	
TOLUENE																	
TETRACHLOROETHENE																	
CHLOROBENZENE																	
ETHYLBENZENE																	
1,1,1-TRICHLOROETHANE																	
SEMIVOLATILES																	
1,3-DICHLOROBENZENE																	
1,4-DICHLOROBENZENE																	
NAPHTHALENE																	
DI-N-BUTYL PHTHALATE																	
DI-N-OCTYL PHTHALATE																	
N-NITROSODIPHENYLAMINE																	
1,2,4-TRICHLOROBENZENE																	
BUTYL BENZYL PHTHALATE																	
BIS(2-ETHYLHEXYL)PHTHALATE					1.80												
PHENOL																	
2,4-DIMETHYLPHENOL																	
2,4-DICHLOROPHENOL																	
4-NITROPHENOL																	
ANTHRACENE																	
FLUORANTHENE																	
PHENANTHRENE																	
PYRENE																	
BENZO (A) ANTHRACENE																	
BENZO (B) FLUORANTHENE																	
FLUORENE																	
BENZO (A) PYRENE																	
ACENAPHTHENE																	
PENTACHLOROPHENOL																	
PESTICIDES																	
HEPTACHLOR																	
DDT																	
DDE					0.03												
DDD					0.07												

CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
* - PESTICIDES/PCB EXTRACTION HOLDING TIME EXCEEDED; CONCENTRATIONS ESTIMATED

NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP [illegible].
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS

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Table 4-17

Priority Pollutant Inorganic Constituents, Classical Parameters, and Indicator Parameters in Subsurface Soil Boring Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	REFERENCE LEVEL°	B1			B2			B3	B4	B5		B6		B7	B8	B9	
		0-1	2-3	4-5	0-1	2-3	4-5	8.5-10	2-4	1-2	11-12	7-9	16-17	11-12	11-12	9-10	13-14
ANTIMONY																	
ARSENIC	20	6.0	4.0	7.3	6.5	7.4	2.1	4.4	17.3	6.6	2.09	4.74	3.13	0.56	1.06	3.37	4.22
BERYLLIUM	1	0.2	0.1														
CADMIUM	3							2.6	3.03	1.05		1.70					
CHROMIUM	100	15	10	12	11	10	3	6	32.6	10.3	6	20.6	11.6	6.9	6.9	6.6	7.6
COPPER	170	4	3	6	6	4	2	5	26.4	6.3	1.1	10.7	3.5	2.3	1.1	1.2	1.1
LEAD	250-1000	6		7	4			100	39.0	33.3		630	193			1.2	
MERCURY	1																
NICKEL	100	8		3	3	1		3	6.1	3.6	1.1	3.6	8.3	1.2	2.3	2.3	1.1
SELENIUM	4																
SILVER				0.9													
THALLIUM		2	2	1													
ZINC	350	33.3	6.0	81	12.3	12.3	4	16.6	116	34	4.71	67.3	11	4.72	3.66	6.46	3
PHENOLS								0.5	0.41	0.21			3.9	0.33			
CYANIDE																	
TOC		1400	640	370	1300	310	200	370	3000	4700	250	640	3000	160	100	170	130
TOX																120	
COD **		10000	1200	3000	3000	<600	100	11100	30000*	10700*	<300*	10000*	23100*	<300*	300*	300*	<300*

NO CONCENTRATION ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT
* REPORTED ON WET WEIGHT BASIS
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
** - COD ANALYSIS HOLDING TIME EXCEEDED, CONCENTRATION ESTIMATED

°NJDEP SOIL CLEANUP OBJECTIVES (PPM) PROVIDED BY NJDEP LCA

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of the former wastewater disposal lagoons and a background area. Figure 4-13 shows the approximate locations of the subsurface soil borings at the site. Plate 1 shows how the locations of the subsurface borings relate to the individual lagoons. The borings range in depth from 8 to 17 feet below the ground surface. Table 4-16 presents the results of the analyses for organic compounds from the 66 subsurface boring samples collected. Trichloroethene (290 ppm) is the volatile organic contaminant present at highest concentrations in subsurface soil samples, followed by chlorobenzene (53 ppm), ethylbenzene (17 ppm), tetrachloroethene (16 ppm), trans-1,2-dichloroethene (10 ppm) and toluene (8.5 ppm).

The soil samples submitted for analysis were collected from intervals that exhibited visible evidence of contamination and/or registered OVA readings above background. In borings that showed evidence of contamination, at least the uppermost sample within the apparently contaminated zone and the deepest sample from the boring were submitted for analysis. In borings that did not encounter apparently contaminated soil, one representative soil sample was collected.

The exact depth of contamination cannot be precisely determined based on this type of sampling procedure because three to eight foot intervals exist over which no samples were collected. Volatile organic (396 ppm) and semivolatile organic (1133 ppm) soil contamination were detected in excess of NJDEP recommended soil cleanup guidelines in subsurface borings along the western edge of the former primary settling lagoons from seven feet to a minimum of 17 feet below the ground surface with the highest levels of contamination occurring in the deeper soil samples (Table 4-16). Subsurface boring samples obtained between 9 to 14 feet below the ground surface along the eastern edge of the primary settling lagoons detected no volatile or semivolatile contamination.

It must be noted that during the installation of well 8-A, located along the western edge of the former primary settling lagoons, it was observed that the subsurface soil was saturated with a black oily substance having a strong odor from 6 feet below the ground surface to the wells total depth of 15 feet below the ground surface. This indicates that there may be subsurface soil contamination in the vicinity of the former settling lagoons.

Volatile organics were detected in samples from subsurface boring B11 (7 to 8 feet), with 220 ppm, and B17 (11 to 12 feet), with 3.1 ppm, both collected from the northwestern margin of the former aeration lagoons; and B18 (3 to 4 feet), with 1 ppm, collected near the middle of the former aeration lagoons. Volatile organics were not detected in subsurface soil samples taken in the overflow area of the former final settling lagoon or from the background area.

Four subsurface soil samples have levels of volatile organics that exceed NJDEP soil cleanup objectives. Seven subsurface soil boring samples have concentrations of semivolatiles which exceed the NJDEP soil cleanup objective of <10 ppm total semivolatiles. Of these eleven soil samples, five were from locations in the former primary settling lagoon area as follows: B3 (9.5 to 10 feet); B5 (1 to 2 feet); B6 (7 to 8 feet); B6 (16 to 17 feet) and B10 (6 to 7 feet).

Soil borings B3, B5, and B6 are located along the perimeter of the former primary settling lagoons. B10 was collected approximately 70 feet east of the former primary settling lagoons (Plate 1). Bis(2-ethyl hexylphthalate, butyl benzyl phthalate, N-nitrosodiphenylamine, and naphthalene dominate the list of semivolatile soil contaminants detected in the former primary settling lagoon area.

Within the former aeration and final settling lagoon area, a total of five subsurface soil samples exceed the NJDEP soil cleanup objectives for semivolatiles. These samples include the following: B11 (7 to 8 feet) (1232 ppm) located in the possible secondary settling lagoon: B16 (3 to 4 feet)(1923 ppm) located in the western aeration lagoon; B-18 (2 to 3 feet)(11 ppm) located in the eastern aeration lagoon; and B15 (3 to 4 feet) (40 ppm) located along the southern edge of the final settling lagoons. With the exception of subsurface boring sample B-14 which is on the border of the eastern aeration lagoon, no other subsurface borings are located in the former wastewater disposal lagoons.

Similar to the former settling lagoon area, Bis(2-ethyl hexyl)phthalate, Butyl benzyl phthalate, N-nitrosodiphenylamine and naphthalene dominate the list of semivolatiles in the former aeration lagoon area.

In the former aeration lagoon area, samples from boring B11 indicated that high concentrations of volatile organics and semivolatiles were present below 7 feet in the former possible secondary settling lagoon. Sample B17, north of the eastern former aeration lagoon exhibited concentrations of volatile organics in excess of NJDEP soil cleanup objectives as deep as 12 feet below the ground surface. Semivolatiles were not detected in the soil samples from the background area.

Fifteen of the soil samples collected in the subsurface soil boring effort recorded concentrations of pesticides (Table 4-16). DDE is the pesticide that was detected in the highest concentrations. DDE was only detected in subsurface soil and ground water samples collected in the immediate vicinities of the former wastewater lagoons. DDD, DDT, and Heptachlor were also detected throughout the site but at much lower concentrations than DDE. In general, pesticides occurred in samples that also contained semivolatiles. The soil samples with concentrations of total pesticides above 1 ppm included the following: B-6 (7 to 8 feet), (2 ppm), collected at the western margin of the former primary settling lagoons; B-16 (3 to 4 feet)(2 ppm), located in the western former aeration lagoon area; and B-19 (0 to 1 foot)(1 ppm), collected from the middle of the drainage swale in the former overflow area. A maximum concentration of 0.02 ppm total pesticides was detected in the subsurface soil samples collected from the background area.

One of the twenty-five subsurface soil samples collected from soil borings in the former overflow area detected semivolatiles in excess of NJDEP soil cleanup objectives. Bis(2-ethyl hexyl)phthalate, N-nitrosodiphenalamine and 2,4-Dimethylphenol combined to total 15 ppm in sample B19 (7 to 8 feet). Subsurface soil boring B19 was collected from the edge of Cedar Swamp in the vicinity of a drainage swale that received the final wastewater that was discharged from the final settling lagoon.

Table 4-17 presents the analytical results for inorganic constituents, classical parameters and indicator parameters in soil samples collected from subsurface borings at the CLTL site.

Of the sixty samples collected from subsurface soil borings in the former primary settling lagoons area, the former aeration and final settling lagoons area, and the former overflow area, seven samples exceed the NJDEP soil cleanup objectives for at least one of the following metals: arsenic, cadmium, chromium, lead, and zinc. These samples include:

Sample	Depth Below Surface (feet)	Contaminant Level (ppm)
B6	7 to 8	838 lead
B10	6 to 7	453 arsenic
		8 cadmium
		1,320 zinc
B15	7 to 8	4 cadmium
B16	3 to 4	36 cadmium
B17	7 to 8	20 arsenic
B19	0 to 1	95 arsenic
		8 cadmium
		101 chromium
		374 lead
B26	3 to 4	6 cadmium.

Table 4-17 (cont)

PARAMETER	REFERENCE LEVEL*	D10			D11		D12		D13					D14			D10	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ANTIMONY																		
ARSENIC	20	0.0	433	3.10	3		3.40	2.30	4.33	0.71	2.33	1.01	0.02	12.3	0.73	2.03	0.12	0.27
BERYLLIUM	1		0.70				0.22							0.33	0.12		0.23	0.12
CADMIUM	3		0.00											0 0			1.30	4.4
CHROMIUM	100	0.3	33.4	0.1	3.0	0.0	0.3	7.0	3.3		3.3	4.0	3.3	10.1	20.3	0.0	23.7	22.00
COPPER	170	3.3	30.4	1.0	1.0		4.7	2.3			0.1		2.4	12.4	0.00	1.1	7.0	12.7
LEAD	220-1000	4.0	20.0				4.7	1.1	1.1		2.3			23.0	0.4	2.3	20.3	27.1
MERCURY	1																	
NICKEL	100	0.0	10.7	1.0			7	2.3						7.0	4.0	2.3	0.0	7.00
SELENIUM	1																	
SILVER																		
THALLIUM																		
ZINC	300	10.4	1320	0.03	3.11	2.13	10.3	7.33	4.03	1.42	1.04	4.04	3.03	34.0	22.2	0.13	30.3	00.7
PHENOLS			13.7		3.4						0.23							0.30
CYANIDE		2.3		0 00														
TOC		1200	07000	370	1400	100	170	110	210	130	100	170	100	1100	1400	00	2100	2000
TOX					340								120					
COD **		3000*	221400*	2200*	20000*	4000*	000*	4400*	000*	4300*	4700*	000*	700*	22100*	3100*	300*	23000*	22100*

NO CONCENTRATION ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT
* REPORTED ON WET WEIGHT BASIS
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
** - COD ANALYSIS HOLDING TIME EXCEEDED, CONCENTRATION ESTIMATED

*NJDEP SOIL CLEANUP OBJECTIVES (ppm) PROVIDED BY NJDEP [illegible]

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Table 4-17 (cont)

PARAMETER	REFERENCE LEVEL*	[illegible]			[illegible]		[illegible]			[illegible]			[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ANTIMONY														
ARSENIC	30	11.7	3.07	1.03	30.4	4.00	0.14	0.37	0.3	04.0	17	4.04	1.00	1.01
BERYLLIUM	1	[illegible]						[illegible]	[illegible]			[illegible]	[illegible]	
CADMIUM	3	30.3	3.01				1.11	0.45		0.3	1.23		0.22	
CHROMIUM	100	70.00	0.3	0.1	10 00	13.3	13.4	17.0	13.0	101	30.0	17.3	0	10.3
COPPER	170	30.0	3.4	1.0	10.3	4.0	0.0	7.0	4.3	02.0	10.0	4.0	3.3	
LEAD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
MERCURY	1									0.00				
NICKEL	100	13.1	3.3	3.3	0.0	4.0	3.0	0.7	4.3	31.0	0.0		4.3	
SELENIUM	1													
SILVER														
THALLIUM														
ZINC	300	110	30.2	0.13	30	10.0	20.0	41.3	13.0	340	37.0	0.00	10.3	3.20
PHENOLS		17.0					0.20	10		4.33	11.0	0.23		
CYANIDE														
TOC		1100	140	140	3000	1400	3000	2700	340	10600	12000	340	070	130
TOX														
COD ~		[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°	[illegible]°

NO CONCENTRATION ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT
° REPORTED ON WET WEIGHT BASIS
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
~ - COD ANALYSIS HOLDING TIME EXCEEDED, CONCENTRATION ESTIMATED

*NJDEP SOIL CLEANUP OBJECTIVES (ppm) PROVIDED BY NJDEP [illegible]

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Table 4-17 (cont.)

PARAMETER	REFERENCE LEVEL*	[illegible]			[illegible]				[illegible]				[illegible]		
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ANTIMONY															
ARSENIC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BERYLLIUM	[illegible]								[illegible]	[illegible]			[illegible]		
CADMIUM	[illegible]							[illegible]	[illegible]				[illegible]		
CHROMIUM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COPPER	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
LEAD	[illegible]	[illegible]			[illegible]				[illegible]	[illegible]	[illegible]		[illegible]		
MERCURY	[illegible]														
NICKEL	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
SELENIUM	[illegible]														
SILVER															
THALLIUM															
ZINC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHENOLS						[illegible]			[illegible]						
CYANIDE															
TOC		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOX															
COD **		[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*	[illegible]*

NO CONCENTRATION ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT
* REPORTED ON WET WEIGHT BASIS
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
** - COD ANALYSIS HOLDING TIME EXCEEDED, CONCENTRATION ESTIMATED

*NJDEP SOIL CLEANUP OBJECTIVES (PPM) PROVIDED BY NJDEP [illegible]

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Table 4-17 (cont.)

PARAMETER	REFERENCE LEVEL°	B18 2-4	 4-6	 7-9	B20 2-4	 4-6	 7-9
ANTIMONY							
ARSENIC	20	0.88	2.30	2.00	0.17	1.07	1.30
BERYLLIUM	1				0.24		0.12
CADMIUM	3				3.05	0.02	
CHROMIUM	100	20.1	7.2	8.4	17.6	7.00	7.00
COPPER	170	5.0	2.4	1.2	8.0	1.2	
LEAD	250-1000	3.0	1.2		2.9		
MERCURY	1						
NICKEL	100	4.7	2.4	1.2	4.7	1.2	
SELENIUM	4						
SILVER							
THALLIUM							
ZINC	350	20.7	7.30	3.17	75.0	5.90	2.04
PHENOLS					0.22		
CYANIDE							
TOC		860	90	52	2000	150	50
TOX							
COD **		2200*	1900*	<300*	5100*	1300*	400*

NO CONCENTRATION ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT
* REPORTED ON WET WEIGHT BASIS
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
** - COD ANALYSIS HOLDING TIME EXCEEDED, CONCENTRATION ESTIMATED

°NJDEP SOIL CLEANUP OBJECTIVES (PPM) PROVIDED BY NJDEP [illegible]

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Borings B6 and B10 are located in the former settling lagoon area; B15, B16, and B 17 are located in the former aeration lagoon area; and B19 and B26 are located in the former overflow area (Plate 1).

With the exception of B26, each of the samples with concentrations of metals in excess of NJDEP cleanup objectives comes from a boring that showed concentrations of volatile organics and/or semivolatiles in excess of NJDEP soil cleanup objectives. Many of these samples, and other samples with concentrations of metals approaching the NJDEP soil cleanup objectives, also generally show the highest concentrations of phenols, TOC and COD (Table 4-17). The results indicate that the former wastewater disposal lagoons are the source of the inorganic contaminants detected in subsurface soil borings.

Table 4-18 presents the results of analysis for TICs in soil samples collected from the subsurface soil borings at the CLTL site (Plate 1). Generally, the highest estimated levels of TICs occurred in soil samples in which moderate to high levels of organic contamination were detected.

4.2.2 Bucket Auger Sampling Results

Hand-held bucket auger samples were collected from two locations within the unlined, earthen containment area for the wastewater holding tank and from two locations of the former aeration lagoons. Figure 4-14 shows the approximate locations of the bucket auger samples. Plate 1 shows the surveyed locations of the bucket auger samples. As described in Section 3.4.4, two soil samples were collected from each bucket auger location as follows: one soil sample collected from 0.5 to 1.0 foot below the ground surface; and one sample collected at the water table. The total depth of the bucket auger boreholes ranged from 2.5 to 3.5 feet below the ground surface.

Table 4-19 presents the results of analysis for organic compounds in soil samples collected in the bucket auger sampling effort. Concentrations of semivolatiles and/or pesticides were detected in soil samples AG-1 and AG-2, which were located in the containment area for the wastewater holding tank. None of the soil samples collected in the bucket auger sampling effort exceeded the NJDEP soil cleanup objectives for organic compounds. The chemicals found included 0.48 ppm N-nitrosodi-n-propylamine in AG-2 (0.5 to 1.0 foot) as well as traces of pesticides in AG-1 (0.5 to 1.0 foot), AG-2 (0.5 to 1.0 foot and (2.2 to 2.8 feet). No volatile organics were detected above laboratory reporting limits in the bucket auger samples.

Table 4-20 presents the analytical results of inorganic

Table 4-[illegible]8

Tentatively Identified Organic Compounds Detected in Subsurface Soil Boring Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	B1			B2			B3	B4	B5		B6		B7	B8	B9	
	0-1	2-3	4-5	0-1	2-3	4-5	8.5-10	5-6	1-2	11-12	7-8	16-17	11-12	11-12	8-10	13-14
ALIPHATIC HYDROCARBON	10						70	150	368		60.8	304.3				
UNKNOWN HYDROCARBON	33.6						33	4.5								
1-ETHYL-3-METHYLCYCLOPENTANE		0.6														
2,3,4-TRIMETHYL-1-PENTENE							0.70									
1-METHYLETHYLBENZENE							0.6									
UNKNOWN							0.16	10.00			0.600					
XYLENE							3.5									
SUBSTITUTED NAPHTHALENE							2									
ISOMERIC DODECYLBENZENES							1									
2-ETHYLHEXYL DIPHENYL ESTER PHOSPHORIC ACID							3									
ACETONE								0.070			0.300					
2,7,7-TRIMETHYLBICYCLO(3.1.1)HEPT-2-ENE								0.200								
FATTY ACID								1.6				66				
SULFUR								0.0	0							
D-FRIEDOOLEAN-14-EN-3-ONE								3.3								
METHYL ESTER ACETIC ACID											0.300					
METHYLCYCLOHEXANE												1.7				
CUMENE												10.2				
STYRENE												10.4				
1,1,3-TRIMETHYLCYCLOHEXANE												1.2				
2-METHYLNAPHTHALENE												10				
DIMETHYLNAPHTHALENES											2.2	12				
TETRAMETHYLBUTYLPHENOL																
TRIMETHYLNAPHTHALENE																
NONYLPHENOL																
UNKNOWN SILOXANES																
ETHYL NAPHTHALENE																
1,2,4,5-TETRACHLOROBENZENE																
1,6-PENTAMETHYLENE-[illegible]																
OCTYL PHENOL ISOMER																
MIX OF NONYL PHENOL ISOMER AND [illegible]																
SUBSTITUTED CYCLOHEXANE ISOMER																
HEXADECANOIC ACID																
UNKNOWN PHTHALATES																
2,6-DIMETHYLPHENOL																
1,3,3-TRIMETHYL-2-OXABICYCLO(2.2.2)OCTANE																
[illegible]-2,5-DIENE-1-ONE																

CONCENTRATION REPORTED IN mg/kg (ppm)
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
ALL CONCENTRATIONS ARE ESTIMATED

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Table 4-1[illegible] (cont.)

PARAMETER	U10			U11		[illegible]		[illegible]					[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALIPHATIC HYDROCARBON		[illegible]	1.0	[illegible]	0.020										
UNKNOWN HYDROCARBON		0		47									4.0		
1-ETHYL-2-METHYLCYCLOPENTANE															
2,2,3-TRIMETHYL-1-PENTENE															
1-METHYLETHYLBENZENE															
UNKNOWN			0	00											
XYLENE															
SUBSTITUTED NAPHTHALENE															
ISOMERIC DODECYLBENZENE															
2-ETHYLHEXYL [illegible] ESTER PHOSPHORIC ACID															
ACETONE		0.003													
2,7,7-TRIMETHYLBICYCLO[3.1.1]HEPT-2-ENE															
FATTY ACID				[illegible]											
SULFUR		00							0.0		0.7	1.0			
[illegible]-10-EN-9-ONE		0													
METHYL ESTER ACETIC ACID															
METHYLCYCLOHEXANE															
CUMENE															
STYRENE															
1,1,3-TRIMETHYLCYCLOHEXANE															
2-METHYLNAPHTHALENE		20	0.0	27											
DIMETHYLNAPHTHALENE		00		10											
TETRAMETHYLBUTYLPHENOL		40													
TRIMETHYLNAPHTHALENE		0													
NONYLPHENOL		10													
UNKNOWN ALKANES				70											
ETHYL NAPHTHALENE				10											
[illegible]-TETRACHLOROBENZENE				17											
1,4-PENTAMETHYLENE-[illegible]													00		
OCTYL PHENOL ISOMER													07	0.0	
MIX OF NONYL PHENOL ISOMER AND [illegible]													00		
SUBSTITUTED CYCLOHEXANE [illegible]															
HEXADECANOIC ACID															
UNKNOWN PHTHALATES															
2,6-DIMETHYLPHENOL															
1,3,3-TRIMETHYL-2-OXABICYCLO[2.2.2]OCTANE															
[illegible]															

CONCENTRATION REPORTED IN mg/kg (ppm)
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
ALL CONCENTRATIONS ARE ESTIMATED

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Table 4-18 ([illegible]nt.)

PARAMETER	[illegible]		[illegible]			[illegible]		[illegible]			[illegible]			[illegible]		[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALIPHATIC HYDROCARBON	40	20.0	0040	0.4	0.0		0.0	20 0	00 0			0 0		0 0	00.0			
UNKNOWN HYDROCARBON								0 0				0 0		0.0				
[illegible]-ETHYL-[illegible]-METHYLCYCLOPENTANE																		
[illegible]-TRIMETHYL-[illegible]-PENTENE																		
[illegible]																		
UNKNOWN								0.4							0.4			
XYLENE																		
SUBSTITUTED NAPHTHALENE																		
[illegible]																		
[illegible] ESTER PHOSPHORIC ACID														0.4				
ACETONE																		
[illegible]																		
FATTY ACID								0 0		0.0								
SULFUR								0 0								0.0	0.0	0.4
[illegible]												0.0						
METHYL ESTER ACETIC ACID																		
METHYLCYCLOHEXANE																		
CUMENE																		
STYRENE																		
[illegible]-TRIMETHYLCYCLOHEXANE																		
[illegible]-METHYLNAPHTHALENE		0.0							0	0								
DIMETHYLNAPHTHALENES	0		000						0									
TETRAMETHYLBUTYLPHENOL								0.0	0.0			0		0.0				
TRIMETHYLNAPHTHALENE																		
NONYLPHENOL																		
UNKNOWN [illegible]																		
ETHYL NAPHTHALENE									0.0									
[illegible]-TETRACHLORO[illegible]																		
[illegible]																		
OCTYL PHENOL ISOMER	0	0		0.0														
MIX OF NONYL PHENOL ISOMER AND [illegible]																		
SUBSTITUTED CYCLOHEXANE [illegible]			00															
HEXADECANOIC ACID						0.0												
UNKNOWN PHTHALATES								0.4	0									
[illegible]-DIMETHYLPHENOL																		
[illegible]-TRIMETHYL-[illegible]-OXABICYCLO[illegible]OCTANE																		
[illegible]																		

CONCENTRATION REPORTED IN mg/kg (ppm)
NO CONCENTRATION INDICATED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
ALL CONCENTRATIONS ARE ESTIMATED

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Table 4-18 (cont.)

PARAMETER	B11				B13				B14			B15			B16		
	2-4	5-6	7-8	8-10	1-2	3-4	5-6	7-8	3-4	5-6	7-8	3-4	5-6	7-8	3-4	5-6	7-8
ALIPHATIC HYDROCARBON					13.3										3.8		
UNKNOWN HYDROCARBON					0.2												
1-ETHYL-2-METHYLCYCLOPENTANE																	
2,4,4-TRIMETHYL-1-PENTENE																	
1-METHYLETHYLBENZENE																	
UNKNOWN					1.0										7.0		
XYLENE																	
SUBSTITUTED NAPHTHALENE																	
ISOMERIC DODECYLBENZENE																	
2-ETHYLHEXYL DIPHENYL ESTER PHOSPHORIC ACID																	
ACETONE																	
2,6,6-TRIMETHYLBICYCLO[3.1.1]HEPT-2-ENE																	
FATTY ACID																	
SULFUR	0.8	0.8	0.8	0.7	0.6												
D-FRIEDOOLEAN-14-EN-3-ONE					2.0										1.0		
METHYL ESTER ACETIC ACID																	
METHYLCYCLOHEXANE																	
CUMENE																	
STYRENE																	
1,1,3-TRIMETHYLCYCLOHEXANE																	
2-METHYLNAPHTHALENE																	
DIMETHYLNAPHTHALENES																	
TETRAMETHYLBUTYLPHENOLS																	
TRIMETHYLNAPHTHALENE																	
NONYLPHENOL																	
UNKNOWN SILOXANES																	
ETHYL NAPHTHALENE																	
1,2,4,5-TETRACHLOROBENZENE																	
1,4-PENTAMETHYLENE-DEWAR-BENZENE																	
OCTYL PHENOL ISOMER																	
MIX OF NONYL PHENOL ISOMER AND 1-BUTOXYETHOXYETHYL [illegible]																	
SUBSTITUTED CYCLOHEXANE ISOMER																	
HEXADECANOIC ACID																	
UNKNOWN PHTHALATES																	
2,6-DIMETHYLPHENOL																	
1,3,3-TRIMETHYL-2-OXABICYCLO[2.2.2]OCTANE					0.100												
STIGMASTA-3,5-DIEN-7-ONE					1.1												

CONCENTRATION REPORTED IN mg/kg (ppm)
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
SAMPLE DEPTHS GIVEN IN FEET BELOW SURFACE
ALL CONCENTRATIONS ARE ESTIMATED

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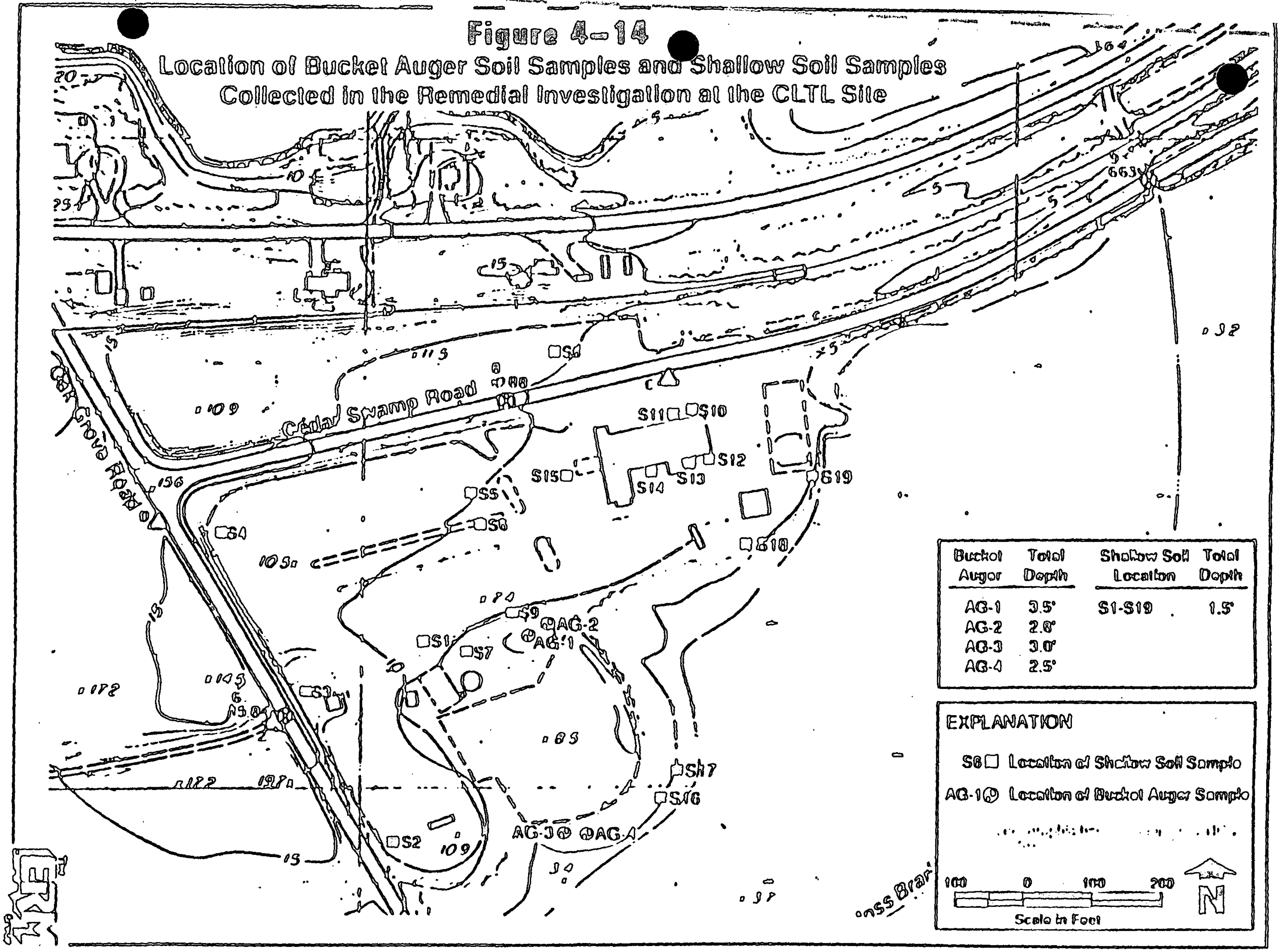
Figure 4-14

Location of Bucket Auger Soil Samples and Shallow Soil Samples Collected in the Remedial Investigation at the CLTL Site



Bucket Auger	Total Depth	Shallow Soil Location	Total Depth
AG-1	3.5'	S1-S19	1.5'
AG-2	2.6'		
AG-3	3.0'		
AG-4	2.5'		

EXPLANATION

S6 ☐ Location of Shallow Soil Sample

AG-1 ⊕ Location of Bucket Auger Sample

Table 4-19

Priority Pollutant Organic Compounds in Bucket Auger Soil Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	AB-1		AB-2		AB-3		AB-4	
	0.0-1.0'	2.0-2.5'	0.0-1.0'	2.2-3.0'	0.0-1.0'	2.5-3.0'	0.5-1.0'	2.0-3.0'
VOLATILES								
METHYLENE CHLORIDE		0.010 B	0.014 B			0.010 B	0.011 B	
TRANS-1,2-DICHLOROETHYLENE								
TRICHLOROETHENE								
BENZENE								
TOLUENE							0.003 J	
TETRACHLOROETHENE								
CHLOROBENZENE								
ETHYLBENZENE								
1,1,1-TRICHLOROETHANE								
SEMIVOLATILES								
1,2-DICHLOROBENZENE								
1,4-DICHLOROBENZENE								
NAPHTHALENE								
N-NITROSODI-N-PROPYLAMINE			0.40					
NITROBENZENE								
DI-N-BUTYL PHTHALATE								
DI-N-OCTYL PHTHALATE								
N-NITROSODIPHENYLAMINE								
1,2,4-TRICHLOROBENZENE								
BUTYL BENZYL PHTHALATE								
BIS(2-ETHYLHEXYL)PHTHALATE	1.04 B							0.4 B
PHENOL								
2,4-DIMETHYLPHENOL								
2,4-DICHLOROPHENOL								
4-NITROPHENOL								
ANTHRACENE								
FLUORANTHENE								
PHENANTHRENE								
PYRENE								
BENZO (A) ANTHRACENE								
CHRYSENE								
BENZO (B) FLUORANTHENE								
BENZO (K)FLOURANTHENE								
FLUORENE								
BENZO (A) PYRENE								
INDENO(1,2,3-CD)PYRENE								
BENZO(GHI)PERYLENE								
ACENAPHTHENE								
PENTACHLOROPHENOL								
PESTICIDES								
HEPTACHLOR								
DDT			0.040	0.012				
DDE			0.024					
DDD	0.022		0.202					

J = REPORTED RESULT IS A QUANTITATIVE ESTIMATE

B = REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

CONCENTRATION REPORTED IN mg/kg (ppm) dry weight

NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT

NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP [illegible].

SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS.

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constituents, classical and indicator parameters in soil samples collected in the bucket auger sampling effort. Arsenic was detected in AG-2 (0.5 to 1.0 foot) (26.3 ppm) at a concentration in excess of the NJDEP soil cleanup objectives. Generally, the concentration of inorganic constituents and indicator parameters is higher in the bucket auger samples collected at 0.5 to 1.0 foot than in the samples collected at the water table.

Table 4-21 lists the TICs detected in bucket auger soil samples. Samples collected from AG-1 include the highest estimated concentrations of TICs detected in the bucket auger samples. As for the inorganic analysis, the sample collected at 0.5 to 1.0 foot consistently detected a higher total estimated concentration of TICs than the sample collected at the water table.

Inadequate housekeeping in the vicinity of the wastewater holding tank and adjacent wastewater loading pad; the former leaks in the wastewater holding tank (Section 1.2); and/or surface runoff from the former wastewater disposal lagoons are possible sources of the contamination detected by the bucket auger sampling effort. Previous agricultural practices on portions of the CLTL site, prior to purchase by CLTL in 1960, may represent a secondary source of pesticide contamination in soils collected during the bucket auger sampling effort.

4.2.3 Shallow Soil Sampling Results

Shallow soil samples were collected from the upper 1.5 feet of the site at a total of 19 locations. The shallow soil samples were collected from the following general areas shown on Figure 4-14: nine samples (S-1 through S-9) from various locations within the truck parking lot/driveway area; six samples (S-10 through S-15) from locations around the terminal building and cleaning bays; two samples (S-16 and S-17) from the wooded area southeast of the former final settling lagoons; one sample (S-18) from a location south of the enclosed settling tank and drum storage area; and one sample (S-19) from a location at the southern margin of the former primary settling lagoons.

Table 4-22 presents the results of analysis for organic compounds in soil samples collected in the shallow soil sampling effort. In shallow soil sample S-1, located adjacent to the wastewater loading pad, trans-1,2-dichloroethene, toluene, tetrachloroethene and ethylbenzene were detected. The total volatile organic concentration at S-1 is 3 ppm which exceeds the NJDEP soil clean-up objective of <1 ppm. None of the other shallow soil samples recorded concentrations of volatile organics above laboratory reporting limits.

Semivolatiles were detected in 4 of the 19 soil samples collected

Table 4-20

Priority Pollutant Inorganic Constituents, Classical Parameters, and Indicator Parameters in Bucket Auger Soil Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	REFERENCE LEVEL°	AB - 1 0.5-1.0'	AB - 1 3.0-3.5'	AB - 2 0.5-1.0'	AB - 2 2.2-2.8'	AB - 3 0.5-1.0'	AB - 3 2.5-3.0'	AB - 4 0.5-1.0'	AB - 4 2.0-2.0'
ANTIMONY									
ARSENIC	20	13.5 J	6.0 J	28.3 J	7.1 J	6.8 J	3.8 J	4.5 J	5.8 J
BERYLLIUM	1	0.67		0.72					
CADMIUM	3								
CHROMIUM	100	14.6	13.8	15.6	15.3	10.2	8.3	12.4	16.1
COPPER	170	10.1	6.0	14.4	5.9	6.8	3.0	4.5	4.6
LEAD	250-1000	20.2		38.3	8.2	6.6		8.8	
MERCURY	1								
NICKEL	100	6.7	6.0	8.4	6.9	5.6		5.6	
SELENIUM	1								
SILVER									
THALLIUM									
ZINC	350	30.0 J	23.0 J	55.0 J	24.7 J	27.1 J	11.3 J	24.0 J	20.7 J
PHENOLS									
CYANIDE									
TOC		3000	3900	6500	1500	3200	350	1900	930
TOX					470 B	110 B		230 B	
COD		11000	11100	29100	6350	5060	1500	12400	4400

J - REPORTED RESULT IS A QUANTITATIVE ESTIMATE

B - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION

NO CONCENTRATION ENTERED FOR PARAMETERS NOT DETECTED ABOVE QUANTITATION LIMIT

CONCENTRATION REPORTED IN mg/kg (ppm) DRY WEIGHT

°-NJDEP SOIL CLEANUP OBJECTIVES (PPM) PROVIDED BY NJDEP 8/88.

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Table 4-21

Tentatively Identified Organic Compounds in Bucket Auger Soil Samples Collected in the Remedial Investigation at the CLTL Site

COMPOUND	AB - 1		AB - 2		AB - 3		AB - 4	
	0.5-1.0'	3.0-3.5'	0.5-1.0'	2.2-2.8'	0.5-1.0'	2.8-3.0'	0.8-1.0'	2.0-2.8'
UNKNOWN	2.403	2.213	1.607	0.506	3.026	0.300	0.303	0.471
UNKNOWN HYDROCARBON					0.506			
PHENOL, 2-FLUORO-	0.404	0.375			5.666			
7H-PYRAZOLO(4,3-D)PYRIMIDIN-	0.449				0.506		0.508	
1,1'-BIPHENYL, FLUORO-	0.403	0.662			0.303		0.403	
HEXANEDIOIC ACID, SUBSTITUTED	4.007	0.475						
ACETIC ACID		0.250			0.665			
2-PROPANONE, 1-HYDROXY-		0.212						
METHANAMINE, N,N-DIMETHYL-		2.000						
1H-IMIDAZOLE, 4-METHYL-		1.100					0.236	
2H-1-BENZOPYRAN-2-ONE, 4,5,7		0.400						
HEXANEDIOIC ACID, DIOCTYL ESTER			0.262				0.280	
ETHANONE, 2-(FORMYLOXY)-1PH				0.170				
BENZAMIDE, N-PROPYL-				0.165				
OCTANE, 3-METHYL-					0.607		0.250	
ISOTHIAZOLE, METHYL-, ISOMER					0.427		0.202	
1H-PYRAZOLE, 1-METHYL-					0.642			

ALL RESULTS ARE ESTIMATED CONCENTRATIONS

CONCENTRATIONS REPORTED IN mg/kg (ppm) DRY WEIGHT

NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT

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Table 4-22

Priority Pollutant Organic Compounds Detected in Shallow Soil Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	S1	S2	S3	S4	S5	S6	S7	S8	S9
VOLATILES									
METHYLENE CHLORIDE									
TRANS-1,2-DICHLOROETHYLENE	0.42								
TRICHLOROETHENE									
BENZENE									
TOLUENE	0.53								
TETRACHLOROETHENE	1.0								
CHLOROBENZENE									
ETHYLBENZENE	0.74								
1,1,1-TRICHLOROETHANE									
SEMIVOLATILES									
1,2-DICHLOROBENZENE									
1,4-DICHLOROBENZENE									
NAPHTHALENE	0.9								
NITROBENZENE	0.9								
DI-N-BUTYL PHTHALATE									
DI-N-OCTYL PHTHALATE									
N-NITROSODIPHENYLAMINE									
1,2,4-TRICHLOROBENZENE									
BUTYL BENZYL PHTHALATE									
BIS(2-ETHYLHEXYL)PHTHALATE						1.07			
PHENOL									
2,4-DIMETHYLPHENOL			B						
2,4-DICHLOROPHENOL									
4-NITROPHENOL									
ANTHRACENE									
FLUORANTHRENE			2.61						
PHENANTHRENE	7.0		2.00						
PYRENE			2.02						
BENZO(A)ANTHRACENE			2.71						
CHRYSENE			2.02						
BENZO(K)FLUORANTHRENE			3.07						
BENZO(B)FLUORANTHRENE									
FLUORENE									
BENZO(A)PYRENE			2.61						
INDENO(1,2,3-CD)PYRENE			1.25						
BENZO(GHI)PERYLENE			3.44						
ACENAPHTHENE									
PENTACHLOROPHENOL									
PESTICIDES/PCBs *									
HEPTACHLOR									
DDT				0.033			0.033		0.044
DDE				0.022		0.073	0.011		0.033
DDD				0.022			0.011		0.011

B - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
CONCENTRATION REPORTED IN mg/Kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
S1-S9 COLLECTED FEBRUARY 1988
S10-S15 COLLECTED APRIL 1988
S16-S19 COLLECTED MARCH 1988
ALL SAMPLES COLLECTED 0.5-1.5 FEET BELOW SURFACE
* - PESTICIDE/PCB EXTRACTION HOLDING TIME EXCEEDED FOR S1 THROUGH S19; CONCENTRATION ESTIMATED

NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP 9/88.
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS.

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Table 4–22 (cont.)

PARAMETER	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19
VOLATILES										
METHYLENE CHLORIDE										0.01 B
TRANS-1,2-DICHLOROETHYLENE										
TRICHLOROETHENE										
BENZENE										
TOLUENE										
TETRACHLOROETHENE										
CHLOROBENZENE										
ETHYLBENZENE										
1,1,1-TRICHLOROETHANE										
SEMIVOLATILES										
1,2-DICHLOROBENZENE										
1,4-DICHLOROBENZENE										
NAPHTHALENE										0.0
NITROBENZENE										
DI-N-BUTYL PHTHALATE										
DI-N-OCTYL PHTHALATE										
N-NITROSODIPHENYLAMINE										1.33
1,2,4-TRICHLOROBENZENE										0.73
BUTYL BENZYL PHTHALATE										0.00
BIS(2-ETHYLHEXYL)PHTHALATE							0.07 B	1.35 B		2.0
PHENOL										
2,4-DIMETHYLPHENOL										
2,4-DICHLOROPHENOL										
4-NITROPHENOL										
ANTHRACENE										
FLUORANTHENE										0.07
PHENANTHRENE										0.0
PYRENE										1.10
BENZO(A)ANTHRACENE										0.00
CHRYSENE										
BENZO(B)FLUORANTHENE										1.03
BENZO(K)FLUORANTHENE										1.02
FLUORENE										
BENZO(A)PYRENE										1.30
INDENO(1,2,3-CD)PYRENE										1.02
BENZO(GHI)PERYLENE										1.10
ACENAPHTHENE										
PENTACHLOROPHENOL										
PESTICIDES/PCBs *										
HEPTACHLOR										
DDT										
DDE	0.011	0.043							0.040	
DDD								0.012		

B - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
NO CONCENTRATION ENTERED FOR COMPOUND NOT DETECTED ABOVE QUANTITATION LIMIT
S1-S9 COLLECTED FEBRUARY 1988
S10-S13 COLLECTED APRIL 1988
S16-S19 COLLECTED MARCH 1988
ALL SAMPLES COLLECTED 0.5-1.5 FEET BELOW SURFACE
* - PESTICIDE/PCB EXTRACTION HOLDING TIME EXCEEDED FOR S1 THROUGH S11; CONCENTRATION ESTIMATED

NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP 5/88.
-SOIL CLEANUP OBJECTIVES ARE 1 PPM FOR TOTAL VOLATILE ORGANICS AND 10 PPM FOR TOTAL BASE NEUTRALS.

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in the shallow soil sampling (Table 4-22). These samples include S-1, S-3 and S-6, located in the truck parking lot/driveway area and S19, located adjacent to the former primary settling lagoons. The semivolatiles detected in shallow soil samples are base neutral extractable compounds. Total semivolatiles range from 15 to 25 ppm in S-1, S-3 and S-19, as compared to the NJDEP soil clean-up objective of <10 ppm total semivolatiles. The concentration of semivolatiles in S-6 is below 2 ppm.

Pesticides detected in shallow soil samples include DDT, DDE and DDD (Table 4-22). The total concentration of pesticides in shallow soil samples exceeds the on-site background (0.02 ppm, from subsurface soil boring B1) in 6 of the 19 shallow soil samples as follows: four locations (S-4, S-6, S-7 and S-9) in the truck parking lot/driveway area; one location (S-11) adjacent to the terminal building; and one location (S-18) south of the enclosed settling tank and drum storage area.

The potential sources of organic compounds detected in soil collected as part of the shallow soil sampling effort include the following: 1) localized spills, leaks, and inadequate housekeeping in the truck parking lot/driveway area; 2) shallow soil contamination remaining at the periphery of the former settling lagoons; and 3) the former leaks in the wastewater holding tank (Section 1.2).

Table 4-23 presents the results of analysis for inorganic constituents, classical and indicator parameters in soil collected as part of the shallow soil sampling effort.

Shallow soil samples that exceed background levels by the widest margin, including S-1, S-6 and S-19, also show concentrations of semivolatiles; S-19 exceeds the NJDEP soil cleanup objective for semivolatiles. Lead, detected at 254 ppm in S-6 and at 364 ppm in S-19 ppm, is the only metal detected at concentrations in excess of the NJDEP soil clean-up objective, which for lead ranges from 250 to 1000 ppm.

Table 4-24 presents the results of analysis for TICs in soil samples collected as part of the shallow soil sampling effort. These analytical results show that soil samples from the parking lot/driveway area which displayed the highest concentrations of organic compounds (S-1, S-3 and S-6) also recorded high estimated concentrations of TICs. Soil from S-19, which recorded the largest variety of organic compounds (14 compounds) also showed the largest variety of TICs (12 compounds).

The probable sources of the elevated levels of selected inorganic constituents and indicator parameters in S-1, S-6 and S-19 are the same as those identified above as contributing to higher levels of volatile and semivolatile organic compounds in

Table 4-23

Priority Pollutant Inorganic Constituents, Classical Parameters, and Indicator Parameters in Shallow Soil Samples Collected in the Remedial Investigation at the CLTL Site

PARAMETER	REFERENCE LEVEL*	S1	S2	S3	S4	S5	S6	S7	S8	S9
ANTIMONY										
ARSENIC	20	11.40	3.01	0.07	14.00	3.73	0.22	4.70	3.71	12.10
BERYLLIUM	1	0.42	0.22		0.33	0.32		0.22	0.21	0.33
CADMIUM	3						0.41			0.22
CHROMIUM	100	10.60	7.90	21.90	15.80	20.20	9.30	8.00	13.00	13.30
COPPER	170	4.20	3.20	3.10	7.00	2.13	5.20	6.50	5.30	6.70
LEAD	250-1000	75.90	3.20	4.20	15.50	3.30	254.00	10.00	9.40	23.40
MERCURY	1									
NICKEL	100	4.20	3.20		5.50	2.10	2.10	3.30	3.20	3.30
SELENIUM	4									
SILVER										
THALLIUM										
ZINC	350	18.00	11.00	12.30	31.00	12.00	60.20	35.10	15.00	25.00
PHENOLS		1.10					0.31			
CYANIDE										
TOC		8700	100	980	4200	910	17000	4300	600	860
TOX										
COD ∞		83400	900	4700	12000	3200	20000	11000	3000	11000

@ - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
NO CONCENTRATIONS ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
S1-S9 COLLECTED FEBRUARY 1988
S10-S15 COLLECTED APRIL 1988
S16-S19 COLLECTED MARCH 1988
ALL SAMPLES COLLECTED 0.5-1.5 FEET BELOW SURFACE
∞ - COD ANALYSIS HOLDING TIME EXCEEDED FOR S1 THROUGH S15; CONCENTRATION ESTIMATED

°NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP 8/88.

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Table 4–23 (cont.)

PARAMETER	REFERENCE LEVEL*	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19
ANTIMONY											
ARSENIC	20	14.10	6.47	6.10	5.05	4.03	3.30	4.00 J	3.50 J	8.30 J	7.70 J
BERYLLIUM	1		0.32	0.21	0.43	0.21	0.19				
CADMIUM	3										2.02
CHROMIUM	100	40.00	22.70	17.00	22.00	35.00	6.20	10.70	6.00	13.10	10.40
COPPER	170	8.00	9.70	5.20	6.40	4.20	2.10	3.80		4.00	13.10
LEAD	250-1000	7.00	9.70	4.20	5.40	5.20	1.00			9.50	304.00
MERCURY	1										
NICKEL	100	4.40	3.20	2.10	4.30	3.10					4.40
SELENIUM	1										
SILVER											
THALLIUM											
ZINC	350	20.30	23.70	14.50	17.10	14.20	5.87	20.2 J	15.00 J	16.70 J	71.00 J
PHENOLS			0.14		0.000						0.08
CYANIDE											
TOC		400	1000	1000	1400	940	300	3000	3200	5700	7000
TOX											770 B
COD **		1900	2700	3100	2500	1000	900	11200	8010	13000	24000

B - REPORTED RESULT IS QUALITATIVELY INVALID SINCE THIS COMPOUND WAS DETECTED IN A BLANK AT A SIMILAR CONCENTRATION
J - REPORTED RESULT IS A QUANTITATIVE ESTIMATE
NO CONCENTRATIONS ENTERED FOR PARAMETER NOT DETECTED ABOVE QUANTITATION LIMIT
CONCENTRATION REPORTED IN mg/kg (ppm) dry weight
S1-S9 COLLECTED FEBRUARY 1988
S10-S15 COLLECTED APRIL 1988
S16-S19 COLLECTED MARCH 1988
ALL SAMPLES COLLECTED 0.0-1.0 FEET BELOW SURFACE
** - COD ANALYSIS HOLDING TIME EXCEEDED FOR S1 THROUGH S10; CONCENTRATION ESTIMATED

*NJDEP SOIL CLEANUP OBJECTIVES PROVIDED BY NJDEP 1988

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Table 4-24

Tentatively Identified Organic Compounds Detected In Shallow Soil Samples Collected In the Remedial Investigation at the CLTL Site

COMPOUNDS	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	S-16	S-17	S-18	S-19
ALIPHATIC HYDROCARBON	1303.000		6.300			181.300				1.100	3.600	65.000	38.000	1.300					
UNKNOWN	80.300		10.000														0.428	0.381	1.002
UNKNOWN HYDROCARBON										0.300	6.000		2.100	10.400					7.000
UNKNOWN POLYAROMATIC HYDROCARBON			11.000																
METHYL CYCLOHEXANE	0.700																		
DIMETHYLCYCLOHEXANE	0.700																		
1-ETHYL-4-METHYL CYCLOHEXANE	0.370																		
1,1,3-TRIMETHYLCYCLOHEXANE	2.800																		
ETHYLCYCLOHEXANE	0.840																		
6-(1-METHYLETHYLIDENE)-BICYCLO																			
[3.1.0]OCTANE	0.400																		
DIMETHYLNAPHTHALENE	43.000																		
NITROBENZENAMINE	33.000																		
DIMETHYLPHENANTHRENE			8.000																
METHYL PHENANTHRENE			3.000																
TRIMETHYLPHENANTHRENE			7.000																
METHYL PYRENE			5.700																
METHYL BENZO(A)ANTHRACENE			2.000																
PERYLENE			3.100																
DIMETHYL BENZO(C)PHENANTHRENE			2.800																
SULFUR										0.100									
ACETIC ACID, PENTYL ESTER														0.700					
PHENOL, 2-FLUORO-																	0.130		
1-PROPENE, 3-ISOTHIOCYANATO-																	4.300		
1,1-BIPHENYL, FLUORO-																	2.520		
1H-BENZOTRIAZOLE																			1.067
BENZENE, 2,4-DICHLORO-1-(TRIFLUOROMETHYL																			2.301
CHLOROANILINE																			0.003
1H-INDENE, 1-ETHYLIDENE-																			0.726
NAPHTHALENE, METHYL																			0.424
BENZENAMINE, DICHLORO																			2.010
HEPTADECANE, 2,6,10,15-TETRAMETHYL																			1.739
HEXADECANE, 8-OCTYL																			1.730
HEXADECANE																			1.413
HEPTADECANE																			1.100
PHENOL, 2,4-DITERTBUTYL																			2.410
BENZENE,1-CHLORO-4-TRIFLUOROMETHYL																			0.999

ALL REPORTED RESULTS ARE QUANTITATIVE ESTIMATES.
CONCENTRATIONS ARE REPORTED IN mg/kg (ppm)
S1-S9 COLLECTED FEBRUARY 1988
S10-S15 COLLECTED APRIL 1988
S16-S19 COLLECTED MARCH 1988
ALL SAMPLES COLLECTED 0.5-1.5 FEET BELOW SURFACE
NO CONCENTRATIONS ENTERED FOR COMPOUNDS NOT DETECTED ABOVE THE QUANTITATION LIMIT

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shallow soil: 1) inadequate housekeeping in the truck parking lot/driveway area (S-1, S-6); and 2) residual contamination in the area surrounding the former settling lagoons (S-19).

SECTION 5

CHARACTERIZATION OF CONTAMINANT SOURCE AREAS

This section describes the history of CLTL's former wastewater lagoons and summarizes the main contaminants associated with each of the former wastewater disposal lagoons. This section also identifies secondary indicators of subsurface contamination that should be considered in evaluating subsurface soil remediation.

The three former settling lagoons located east of the CLTL terminal were excavated in 1982 and therefore will be addressed as one unit. None of the former lagoons southwest of the CLTL terminal have been excavated, therefore they will be discussed individually.

5.1 Former Primary Settling Lagoons

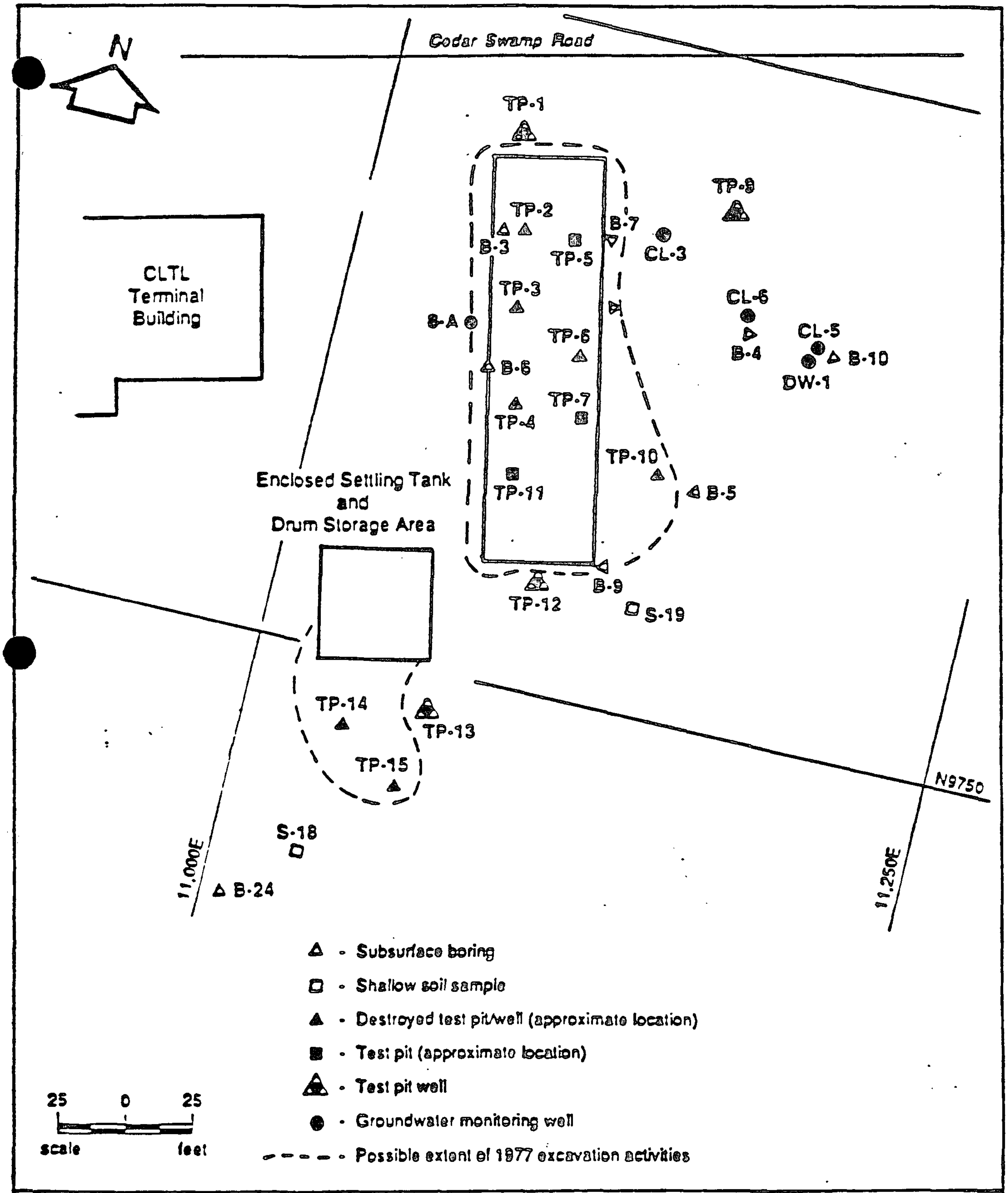
The former primary settling lagoons located east of the CLTL terminal (Figure 5.1) consisted of three lagoons in series (approximately 37 feet by 50 feet by 4 feet each) and were in service from October 1961 (NJDOH, 01/20/69) through 1975 at which time CLTL ceased discharging its effluent to the adjacent wetlands and began transporting its wastewater to the E.I. Dupont facility for treatment. The liquids remaining in these lagoons were drained into the adjacent wetlands in early 1977 (NJDEP 03/21/77). Sludge accumulations were reported to have been vacuumed prior to backfilling the lagoons with brickbat, sand and concrete (NJDEP, DWR, 1982). This vacuuming process may not have been completely effective in removing the sludges because test pits dug in this lagoon area in 1981 (TP-2 through TP-4) encountered white "plastic latex-type" sludge layers, over one foot thick, just two feet below the surface (Table 5-1). The wells installed in these test pits were later found to contain 18 to 24 inches of oil during a 12/04/81 NJDEP, Division of Water Resources, Bureau of Groundwater Management inspection.

The former settling lagoons were excavated under NJDEP supervision to a reported depth of approximately 12 feet in 1982. The exact depth of excavation is difficult to determine because the sides of the excavation frequently caved in due to the relatively high water table at this site. Approximately 145 truckloads of soil were excavated with a backhoe from the former settling lagoons and the settling tank/drum storage area. The exact extent of these excavations were not recorded, however Figure 5-1 indicates the possible extent of these excavations

Table 5-1

Description of Test Pits Dug in the Primary Settling Lagoon Area (Adapted from ERM, 1981) (Depths in Feet Below Surface)

TP-1	0 - 1.3	Very coarse-grained sand, poorly sorted with approximately 10% granules, 5% pebbles and cobbles, roots are abundant to a depth of 0.8 ft; color - dark yellowish-orange: 10 YR 5/6.
	1.3 - 2.8	Medium-grained sand with 5% fine sand and 5% pebbles interlayered with grayish silty clay stringers less than 5 mm thick: color - grayish-olive: 10 Y 4/2.
	2.8 - 3.2	Clay with 10 to 15% medium sand and abundant root; color - black: N 1.
	3.2 - 6.0	Fine- to medium-grained sand, moderately well sorted quartzite interbedded; color - grayish-green: 10 A 4/2 and moderate brown: 5 YR 3/4.
		Pit caved at approximately 5.0 feet, north side of pit showed natural soil development, south side of pit showed some soil discoloration at approximately 2.0 to 3.0 feet with a thin layer of latex-like material at about 3.0 feet. Water incoming into pit bottom has slight organic odor.
TP-2	0 - 2.0	Brick, wood, and fill material.
	2.0 - 3.2	Plastic, latex-type material, white to grayish in color.
		Pit caved at 3.2 feet. Large quantities of water flowing into pit from fill material above the latex layer. Quantity of flow diminishing with time. Soil below latex material appeared moist.
TP-4	0 - 1.8	Brick, wood, and fill material
	1.8 - 4.0	Plastic, latex-type material coating soil and following root holes interbedded with very coarse-grained sand, color - dark yellowish-brown: 10 YR 4/2.
	4.0 - 4.8	Medium- to fine-grained sand with 20% silt and clay and dark gray organic material, color - dark yellowish-brown: 10 YR 4/2.
	4.8 - 7.5	Medium- to very coarse-grained sand, poorly sorted with 5 to 10% granules and pebbles, mottled with black silty organic material; color - dark yellowish-brown: 10 YR 4/2.
		Pit caved at approximately 4.5 feet. Water incoming in the bottom of the pit has an organic odor.
TP-5	0 - 4.7	Fill material
	4.7 - 7.2	Black humic material and silt interbedded with gray plastic synthetic material.
		Water flowing into pit bottom has an organic odor, latex material appears in large masses and is more abundant in TP-4 than in other pits.



EPA **Figure 5-1**

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CDM

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Sample Location Map for the Primary Settling Lagoon Area

Chemical Leaman Tank Lines

based on the analytical results of subsequent subsurface soil samples and the locations of wells and test pits that were destroyed during the excavation process. The excavated soil was allowed to dewater on an adjacent concrete pad prior to being transported to a Browning-Ferris Industries, Inc., disposal facility. The excavated areas were backfilled with sand and gravel from Bridgeport Materials, Inc.

No soil samples were collected for analysis during this excavation process, and therefore the degree to which the contaminated soil had been removed cannot be determined. Correspondence between ERM and NJDEP indicated that excavation proceeded until the soil was free of dark discoloration. The test pit findings indicate that white discoloration was one of the main characteristics of contaminated soil in this area. It is not clear if white discoloration was used as an indicator of contaminated soils during this excavation.

Following the excavation of the settling lagoons, CLTL excavated a lagoon just east the southernmost former settling lagoon which it planned to use as an air stripping lagoon but was unable to obtain a NJDEP permit to do so.

Figure 5-1 shows the locations of the various types of environmental sampling conducted to date in the vicinity of the former primary settling lagoons. Many of the test pit/wells that were installed in the vicinity of the primary settling lagoons by CLTL in 1981 were destroyed during the 1982 excavation activities. Most of the RI subsurface borings in this area are located within the excavated area of the former primary settling lagoons and therefore encountered clean fill over the first 5 to 6 feet.

Sand which was saturated with a black oily substance and had a strong odor was encountered during the installation of Well 8-A at depths between 6 to 15 feet. Well 8-A is located along the western edge of the excavated former primary settling lagoons.

Volatile and semivolatile organic contamination in excess of NJDEP recommended soil cleanup objectives were detected in subsurface borings along the western edge of the former primary settling lagoons from 7 to a minimum of 17 feet below the ground surface with the highest contamination levels occurring in the deeper soil samples (Table 5-2). Subsurface boring samples obtained between 9 to 14 feet along the eastern edge of this area detected no volatile or semivolatile organic contaminants which would suggest that the excavation process succeeded in removing contaminated soil to a depth of 9 to 14 feet along the eastern edge of the primary settling lagoons. It should be noted that these uncontaminated soil samples were obtained several feet below the water table where ground water contaminant levels

Table 5-2

[illegible]ubsurface Boring Soil Sample Analyses Taken In the Immediate Vicinity of the Former Settling Lagoons

Parameter	Reference Level°	B3	B6		B7	[illegible]	B9	
		9.5-10	7-8	16-17	11-12	11-12	8-10	13-14
Volatiles								
Methylene Chloride								
trans-1,2-Dichloroethylene		1.0		10				
Trichloroethene				220				
Benzene				1.16				
Toluene		0.0		0.57				
Tetrachloroethene		0.6		16				
Chlorobenzene		2.0	0.47	63				
Ethylbenzene		3.8	0.24	17.4				
1,1,1-Trichloroethane								
Total Volatiles		9.0	0.71	323.19				
Semivolatiles								
1,2-Dichlorobenzene			2.57	11.0				
1,4-Dichlorobenzene								
Naphthalene		3.7	6.69	301				
Di-N-Butyl Phthalate		1.4	0.71	15.1				
Di-N-Octyl Phthalate			0.63	5				
N-Nitrosodiphenylamine		12.7	1.63	18.7				
1,2,4-Trichlorobenzene		0.6	4.74					
Butyl Benzyl Phthalate		23.1	2.73	539				
Bis(2-Ethylhexyl) Phthalate		44.3	20.5	371				
Phenol			0.71					
2,4-Dimethylphenol								
2,4-[illegible]lorophenol								
4-N[illegible]phenol								
Anthracene								
Fluoranthene		0.8	1.65	5.0				
Phenanthrene		0.6	1.0	2.2				
Pyrene		0.8	1.42					
Benzo (A) Anthracene		0.6						
Benzo (K) Fluoranthene		0.7	0.71					
Fluorene			0.83	11.6				
Benzo (A) Pyrene		0.7						
Acenaphthene				11.6				
Pentachlorophenol								
Total Semivolatiles		98.3	46.58	1133.4				
Pesticides								
Heptachlor								
DDT								
DDE		0.69	2.49	0.174				
DDD								
Antimony								
Arsenic	20	4.4	4.74	3.13	0.56	1.95	3.37	4.22
Beryllium	1							
Cadmium	3	2.0	1.70					
Chromium	100	9	29.6	11.6	6.9	6.9	5.0	7.6
Copper	170	5	10.7	3.5	2.3	1.1	1.2	1.1
Lead	250-1000	103	699	103			1.2	
Mercury	1							
Nickel	100	3	3.6	2.3	1.2	2.3	2.3	1.1
Selenium	1							
Silver								
Thallium								
Zinc	350	16.3	87.3	11	4.72	3.19	5.43	5
Ph[illegible]s		0.5		3.5	0.56			
C[illegible]								
TOC		370	640	5800	160	120	170	130
TOX							120	
COD**		11100*	10500*	23500*	<500*	500*	500*	<500*

No concentration entered for parameter not detected above quantitation limit concentration reported in mg/kg (ppm) dry weight

* Reported on wet weight basis sample depths given in feet below surface

** COD analysis holding time exceeded, concentration estimated

° NJDEP soil cleanup objectives (ppm) provided by NJDEP 5/89 exceeded 60,000 ppb.

5.2 Possible Former Secondary Settling Lagoon

This lagoon (approximately 20 feet by 75 feet each) is located southwest of the CLTL terminal and west of the two former aeration lagoons (Fig. 5-2). It was probably constructed in 1961 along with the primary settling lagoons and the two aeration lagoons. Although CLTL reports that it has no knowledge of this lagoon or how it was utilized, it is clearly visible on historical aerial photographs of the site (EPA, 1985). These photographs indicate that it was backfilled sometime between April 17, 1965 and July 26, 1972. It may have been used as a settling lagoon judging by its similar size and appearance to that of the primary settling lagoons as they appear on black and white aerial photographs. One subsurface boring sample was collected in this lagoon).

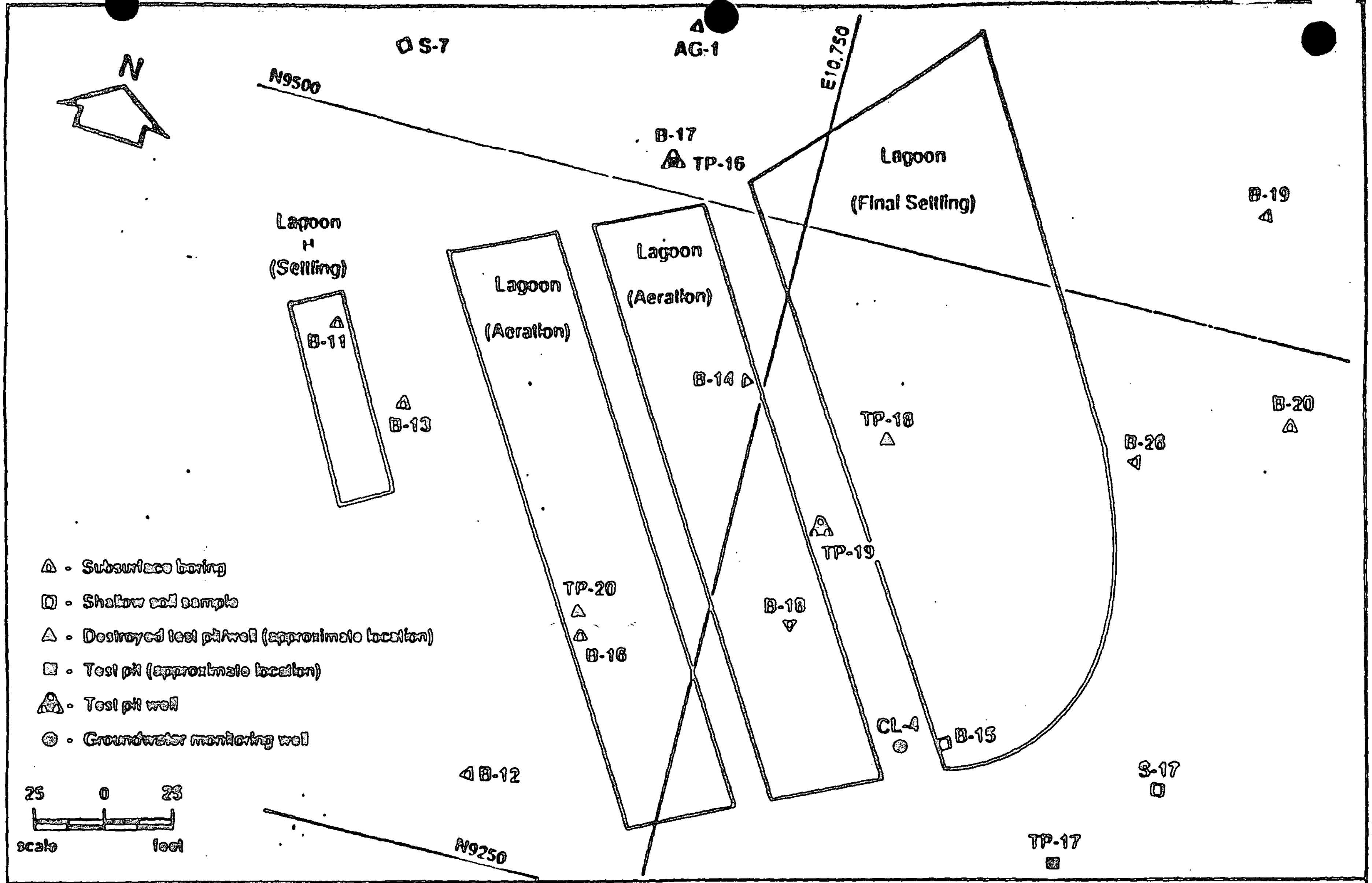
Subsurface boring B-11 (Figure 5-2) detected volatile (total 22 ppm) and semivolatile (total 1233 ppm) organic contaminants at levels exceeding NJDEP soil cleanup objectives at a depth of 8 feet below the surface (Table 5-3). Analyses of B-11 samples taken between 9 to 10 feet below the surface detected only 2.8 ppm total volatile organics. Subsurface boring B-11 is located in the northeastern corner of this lagoon and may not fully represent the degree of contamination throughout this lagoon.

5.3 Former Aeration Lagoons

These two aeration lagoons (approximately 45 feet by 225 feet each) southwest of the CLTL terminal building (Figure 5-2) were in use from September 1961 through 1975. They are reported to have been operated in series and may have been equipped with approximately 8 spray aerators in each lagoon (EPA, 1985).

Although they are referred to as aeration lagoons they may have been used for other purposes. An oil slick was present on all of the settling and aeration lagoons during a July 7, 1972 NJDEP inspection. During a May 22, 1974 inspection, NJDEP observed that one of the aeration basins was used as a settling lagoon (NJDEP, 05/23/74). Prior to June 1963, wastewater from these lagoons may have been discharged directly into the wetlands because the final settling lagoon had not yet been constructed (EPA, 1985). The final settling lagoon was constructed sometime between June 24, 1963 and April 17, 1965 (EPA, 1985).

The aeration lagoons were utilized until 1975. The lagoons were closed in early 1977 at which time openings were cut into the dikes of the lagoons allowing some discharge of their liquid contents into the adjacent wetlands (NJDEP, 03/23/77). The



EPA **Figure 5-2**

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Sampling Location Map for Lagoons

Chemical Leaman Tank Lines

Table 5-3

Subsurface Boring Soil Sample Results from Lagoons

Parameter	Reference Level°	Max Site BKGD°	D11 7-8	D11 9-10	D16 3-4	D16 7-8	D16 9-10	D10 2-3	D10 3-4	D10 7-8	D15 3-4	D15 7-8
Volatiles												
Methylene Chloride											0.53	
Trans-1,2-Dichloroethylene									0.50			
Trichloroethene			210									
Benzene												
Toluene			4.93						0.53			
Tetrachloroethene			1.1									
Chlorobenzene			0.43						0.45			
Ethylbenzene			3						0.33			
1,1,1-Trichloroethane			0.43									
Total Volatiles			21.69						1.44		.56	
Semivolatiles												
1,2-Dichlorobenzene			220									
1,4-Dichlorobenzene			0.85									
Naphthalene			46.1		63				10		3.13	0.93
Di-N-Butyl Phthalate			11.0		77				7.0		1.24	
Di-N-Octyl Phthalate			3.64									
N-Nitrosodiphenylamine			60.7		63				12.2		2.03	0.7
1,2,4-Trichlorobenzene												
Butyl Benzyl Phthalate			257	1.3	639	2.13			63.5		7.70	1.59
Bis(2-Ethylhexyl) Phthalate			600	1.54	1020	0.71	1.63	10.6	212		25.0	3.71
Phenol					12.1				4.70			
2,4-Dimethylphenol					0.6				1.56			
2,4-Dichlorophenol					4.4				0.45			
4-Nitrophenol					3.3							
Anthracene			2.57									
Fluoranthene			4.07									
Phenanthrene			4.61								0.68	
Pyrene			2.65									
Benzo (A) Anthracene												
Benzo (K) Fluoranthene												
Fluorene			4.5									
Benzo (A) Pyrene												
Acenaphthene			4.61									
Pentachlorophenol					0.6							
Total Semivolatiles			1232.04	2.04	1823	2.04	1.63	10.6	312.3		39.66	0.53
Pesticides												
Heptachlor												
DDT												
DDE					1.54			0.037				0.104
DDD					0.22			0.036				0.104
Antimony		0										
Arsenic	20	0.6	0		12.7	3.07	1.03	0.14	0.57	5.2	0.12	0.27
Beryllium	1	2			0.22				0.22	0.11	0.23	0.12
Cadmium	3	0			16.3	2.01		1.11	0.45		1.24	4.4
Chromium	100	15	3.2	1.2	76.00	0.3	0.1	13.4	17.0	15.0	23.7	22.00
Copper	170	6	1.1		30.6	2.4	1.1	0.8	7.0	4.5	7.8	12.7
Lead	250-1000	7			130	2.4	1.1	21.2	22.3	5.7	20.3	37.1
Mercury	1	0										
Nickel	100	5			12.1	3.5	2.3	5.0	6.7	4.5	6.0	7.00
Selenium	1	0										
Silver		.9										
Thallium		2										
Zinc	350	23	3.11	2.13	110	30.2	0.13	53.0	61.5	15.0	39.5	63.7
Phenols		0	5.4		17.0			0.23	13			0.93
Cyanide		0										
TOC		1400	1400	180	1100	149	149	5000	2700	540	2100	2000
TOX		0	540									
COD**		10600	38800	<600°	54700°	600°	1000°	10700°	32800°	1500°	25600°	22100°

Concentration reported in mg/kg (ppm) dry weight
No concentration entered for compound not detected above quantitation limit
Sample depths given in feet below surface
° Pesticides/PCB extraction holding time exceeded; concentrations estimated

NJDEP soil cleanup objective provided by NJDEP 5/88
Soil cleanup objectives are 1 ppm for total volatile organics and 10 ppm for total base neutrals

remaining liquids were pumped into a tanker truck and transported to a landfill. The lagoons were then backfilled with perimeter diking materials, brickbat and concrete rubble without being dredged (NJDEP, DWR,1982).

The large volume of concrete rubble used to backfill these lagoons made it difficult to drill subsurface borings in the central parts of these lagoons. This explains why the majority of the subsurface borings are located near the edges or outside of the lagoon areas where there was less concrete rubble to interfere with the collection of subsurface soil samples (Figure 5-2). The exact depth of soil/sludge contamination cannot be precisely determined based on subsurface boring sample analyses because 3 to 8 foot intervals exist between sample depths over which no samples were collected.

5.3.1 Western Aeration Lagoon

One subsurface boring and one test pit are located along the southwestern border of the western aeration lagoon (Figure 5-2).

Test pit TP-20, dug by CLTL prior to this RI, (ERM, 1981) encountered a 0.5 foot thick layer of "latex" approximately 2 feet below the surface. Between 4.5 to 6.0 feet below the surface, soil was heavily stained with what appeared to be oil (Table 5-4).

Analyses of subsurface boring samples from boring B-16 detected a total of 1923 ppm of semivolatile organics and 36 ppm cadmium at 3 to 4 feet below the surface (Table 5-4). These analyses exceed the NJDEP soil cleanup objectives. Samples collected between 7 to 8 and 9 to 10 feet below the surface detected less than 3 ppm semivolatile organics.

5.3.2 Eastern Aeration Lagoon

Two subsurface borings (B-14 and B-18) were installed along the eastern border of Lagoon D during the RI field sampling (Figure 5-2). A total of 1.4 ppm volatile and 312 ppm semivolatile organics were detected 3 to 4 feet below the surface in boring B-18 (Table 5-3). Samples from boring B-18 taken between 7 to 8 feet below the surface did not detect any volatile or semivolatile organics.

5.4 Final Settling Lagoon

The final settling lagoon (approximately 80 feet by x 225 feet) was constructed along the east side of the former aeration lagoons (Figure 5-2) sometime between June 24, 1963 and

Table 5-4
Description of Backhoe Test Pits in Lagoons (Adapted from ERM, 1981) (Depths in Feet Below Surface)

TP-18

0 - 2.0	Fill material, some parched water.
2.0 - 5.5	Black organic layer at 2.0 ft overlying very coarse-grained quartzitic sand with opaque minerals and muscovite; sand is poorly sorted with pebbles and granules; color - pale yellowish-brown: 10 YR 6/2.

Water in pit bottom has organic odor.

TP-19

0 - 0.8	Fill material
0.8 - 2.7	Medium- to coarse-grained, poorly sorted sand, approximately 25% clay, slightly mottled; color - dark yellowish-orange: 10 YR 6/6.
2.7 - 4.5	Sand as above but more highly mottled with iron oxide stringers and some dark gray sand; color - moderate yellowish-brown: 10 YR 5/4.
4.5 - 5.8	Medium- to coarse-grained quartz sand with micaceous minerals, fairly well sorted; color - medium gray: N 5.

Water incoming into pit bottom has some organic odor.

TP-20

0 - 2.0	Fill material
2.0 - 2.5	Latex layer, similar to material found in old lagoon area, thins toward the west side of the pit.
2.5 - 4.0	Very coarse-grained clean quartzitic sand, moderately sorted; color - moderate brown: 5 YR 4/4.
4.5 - 6.0	Medium- to coarse-grained sand, heavily stained with what appears to be oil; color - dusky brown: 5 YR 2/2.

Water looks oily and has oil odor.

April 17, 1965 (EPA, 1985). It is first recognized on 1965 aerial photographs as an new impoundment. By 1972 it had been developed into a well defined lagoon (EPA, 1985). Liquid wastes contained in the former final settling lagoon were discharged to the adjacent wetlands as the final step in CLTL's wastewater treatment process. Wastewater was discharged via a "T-pipe" which was probably located in the northeast corner of this lagoon adjacent to a drainage path leading to the wetlands.

This discharge of wastewater resulted in the death of surrounding vegetation. A seventy-five foot wide lane of dead trees marked the flow of effluent discharge into the wetlands (NJDEP, 05/29/72; NUS, 1984). Discharge of wastewater to the wetlands continued until 1975 when the lagoon was taken out of service. In July 1977, the liquids remaining in the lagoon were allowed to evaporate, sludge was reportedly excavated and the lagoon was backfilled with construction debris.

The subsurface boring soil samples for the final settling lagoon were also collected along the border of the lagoon and not within its center. This may be due to problems encountered in obtaining subsurface samples through the concrete rubble used to backfill the lagoon. Test pits TP-18 and TP-19 were installed within the central part of the lagoon. ERM (1981) states that fill material and contaminated soil were observed to a depth of two to three feet below the surface. The drillers log for well CL-4, located on the southern edge of the lagoon, states that at a depth of six feet below the surface the soil had a chemical odor and was stained and discolored.

5.5 Supplemental Soil Investigations Being Conducted By EPA

The soil investigations conducted by CLTL and described above were extensive, however they raise questions as to the nature and extent of soil contamination at the site.

Questions which were raised by the previous CLTL studies include:

- What are the exact boundaries of the former wastewater lagoons?
- What are the volumes of contaminated soil from the former wastewater lagoons which need to be remediated?
- What is the extent of soil contamination in the parking lot/active driveway area?

In order to answer the above questions, EPA is conducting a supplemental soil investigation. The results of this investigation will be included in a supplemental RI report.

SECTION 6

CONCLUSIONS

6.1 Contaminant Sources

- Seven unlined lagoons were utilized by CLTL as a treatment process for wastewater generated from the cleaning of chemical tank trucks. This practice resulted in the development of sludge layers and contaminated soil in the immediate vicinity of these lagoons. Infiltration of these wastewaters into the underlying aquifer caused the contamination of ground water up to several hundred feet from the lagoon boundaries.

- Wastewater was discharged from the final settling lagoon into the adjacent wetlands as the final step in CLTL's wastewater treatment process which resulted in the surface deposition and/or infiltration of contaminants into the underlying aquifer along the discharge path.

- CLTL-related volatile organics, semivolatiles and inorganics have been detected in soil at the site at levels that exceed New Jersey Soil Cleanup Objectives.

6.2 Hydrogeology

- The upper aquifer beneath the CLTL site consists of unconsolidated sands, silts, gravels and clays approximately 150 feet thick. It is underlain by a locally continuous clay layer approximately thirty feet thick.

- The upper aquifer beneath the CLTL site can be divided into three subzones: a shallow unconfined subzone which is approximately twenty feet thick; a semiconfined intermediate subzone which is approximately 80 feet thick (this subzone was divided by ERM into an upper and lower intermediate subzone); and a semiconfined deep subzone which is approximately 40 feet thick.

- The ground-water flow regime in the upper aquifer is very subtle and complex. The direction of ground-water flow in the upper aquifer is to the north-northeast. Ground-water flow directions are influenced by precipitation and tidal events due to the relatively flat piezometric surfaces. Any minor ground-water level measurement error could result in an incorrect interpretation of ground-water flow patterns. The radial distribution of ground-water contamination surrounding the former wastewater lagoons may be the result of ground-water mounding that may have been occurring while these lagoons were in use.

- A downward component of ground-water flow exists across the site indicating the potential for the downward migration of ground-water contaminants into the deeper aquifer system.

- The lower aquifer consists of an approximately fifty foot sand unit which is overlain by a thirty foot continuous clay layer and underlain by weathered bedrock. The ground-water flow regime in the lower aquifer has yet to be determined as there are not enough wells drilled into this aquifer at the CLTL site.

6.3 Nature and Extent of Ground-water Contamination

- Organic and inorganic contaminants were detected in the shallow, intermediate and deep subzones of the upper aquifer underlying the CLTL site.

- Ground-water contaminants have migrated radially away from the former wastewater lagoons as evidenced by the distribution of detected levels of these contaminants. This pattern of contaminant migration may be the result of ground-water mounding that occurred below the wastewater disposal lagoons, when they were active.

- Of the priority pollutant ground-water contaminants detected at the site, volatile organics were found most extensively and at the highest levels across the site. Volatile organics have been detected over 600 feet from the former wastewater lagoons.

- Volatile organic ground-water contamination is detected at higher levels and is more widespread than semivolatile organic and inorganic ground-water contaminants. The highest levels of volatile organic ground-water contamination have been detected in the intermediate subzone.

- Semivolatile ground-water contamination is considerably less widespread. The highest levels of semivolatile ground-water contaminants were detected in the shallow subzone in wells drilled near the former wastewater lagoons.

- The pattern of inorganic ground-water contamination is less well defined. Higher levels of inorganics are generally found in the intermediate and shallow subzones in wells drilled near the former wastewater lagoons.

6.4 Nature and Extent of Soil Contamination and Buried Sludges

- The former primary settling lagoons were excavated to a depth of approximately ten feet below the ground surface in 1982. However, volatile organic and semivolatile organic compounds have been detected at levels in excess of NJDEP recommended soil cleanup objectives in the immediate vicinity of the former primary settling lagoons. Subsurface boring sampling results indicate that significant levels of soil contamination exist below the depth to which the former primary settling lagoons were excavated.

- Levels of priority pollutant semivolatile organics were detected in the former aeration lagoons that exceed NJDEP soil cleanup objectives. Levels of chromium and beryllium were detected in the western former aeration lagoon at levels exceeding NJDEP soil cleanup objectives. Beryllium was detected at levels exceeding NJDEP soil cleanup objectives in the eastern former aeration lagoon.

- Levels of priority pollutant semivolatile organics, chromium and beryllium that exceed the NJDEP soil cleanup objectives were detected in the former final settling lagoon.

- Levels of priority pollutant volatile and semivolatile organics that exceed NJDEP soil clean up objectives were detected in the former possible secondary settling lagoon. However, only one subsurface boring is located in this lagoon. No information is available concerning the use of the former possible secondary settling lagoon or how it was closed.

- Levels of arsenic exceeding NJDEP soil cleanup objectives were detected in a shallow bucket auger samples taken from the unlined and unpermitted containment basin, adjacent to the existing CLTL wastewater holding tank.

- Volatile organics and semivolatile organics were detected at levels exceeding NJDEP soil cleanup objectives in one shallow soil sample taken along the western edge of the tank truck parking area. NJDEP soil cleanup objective levels for semivolatile organics were also exceeded at one location near the existing wastewater holding tank and one location near the southeast corner of the former primary settling lagoons. No shallow soil samples were taken from within the boundaries of the former aeration or final settling lagoons.

- A supplemental soils investigation is required to fully delineate the nature and extent of soil contamination within the former wastewater lagoons and around the CLTL parking lot/active driveway area.

6.5 Nature and Extent of Wetlands Contamination

- Preliminary sampling of wetland sediments and surface water detected inorganic contaminants including arsenic and chromium.

- A subsurface conductivity anomaly is located along the drainage path formerly used to discharge wastewater from the final settling lagoon into the adjacent wetlands. The relatively high levels of some CLTL-related inorganic contaminants detected in sediments, surface water and well point ground-water samples collected within this anomaly suggest that it is caused by an area of contaminated sediments and ground water related to past CLTL wastewater disposal practices.

- A separate operable unit RI is required to better define the nature and extent of CLTL-related wetlands contamination.

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